NET ZERO CITIES SGA-NZC

City-driven Monitoring, Evaluation and Learning (MEL)

Governance innovation and implementation in the Cities Mission: Second Case Anthology - Theme 2

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30/04/2026

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Funded by the European Union

Summary

This report examines how city-driven monitoring, evaluation and learning (MEL) is being developed and used as a governance mechanism in six Mission-labelled cities: **Stockholm**, **Zaragoza**, **Cork**, **Münster**, **Bergamo** and **Turin**. The cases show that MEL is no longer functioning only as a technical reporting requirement or an accountability tool for external institutions. Instead, it is increasingly being used by cities to steer climate-neutrality transitions, connect emissions trajectories to implementation portfolios, inform investment and budgeting decisions, and support learning across municipal departments, stakeholders and partners.

The report builds on the first NetZeroCities work on reflexive MEL in city climate governance and extends this analysis through a second set of cases. It draws on Climate City Contracts, associated action and investment plans, municipal strategies, interviews with city officials, partner inputs and a peer-to-peer learning workshop held in April 2026. The analysis focuses on how cities are embedding MEL in governance architectures, constructing measurement systems, developing indicators and co-benefit approaches, using MEL in decision-making, and creating learning and communication processes around climate-neutrality implementation.

Across the six cases, city-driven MEL is closely shaped by institutional histories, data environments and governance capacities. Stockholm and Münster illustrate how MEL can become powerful when it is embedded in established management and budgetary systems. In both cities, climate units coordinate indicator reporting, emissions monitoring and synthesis across departments, while annual reporting cycles connect climate progress to political and financial decision-making. Bergamo and Turin show the potential of mission-specific and platform-based MEL architectures, where Transition Teams, scientific partners and digital tools link action portfolios, investment needs, emissions impacts and co-benefits. Zaragoza demonstrates an advanced approach to data governance and co-benefit monitoring, combining open data, economic modelling and a strong emphasis on just transition concerns. Cork illustrates a pragmatic pathway for a capacity-constrained city, integrating Mission MEL into statutory climate action planning while progressively building analytical capacity through NetZeroPlanner and external support.

Effective MEL depends on a central coordinating entity with clear responsibility for synthesis, quality assurance and strategic use of data. In all six cities, this role is played by a climate unit, transition team, mission team or climate action office. However, data generation and implementation responsibilities remain distributed across departments, municipal companies, utilities, universities, private actors and national agencies. This creates both an opportunity and a challenge. MEL can support coordination across fragmented implementation systems, but it also depends on reliable data flows, shared methodologies and sustained institutional capacity.

Measurement architectures across the cases combine greenhouse gas inventories, sectoral implementation indicators and, increasingly, financial, co-benefit and distributional metrics. Stockholm and Münster rely on mature inventory systems aligned with recognised standards and embedded in regular reporting cycles. Bergamo and Turin have developed digital platforms that connect action-level data to portfolio monitoring and scenario analysis. Zaragoza uses a comprehensive indicator framework linked to economic modelling and open-data infrastructure, while Cork is moving from manual and national-data-dependent approaches towards a more dynamic tool-based system. These differences show that there is no single model for city-driven MEL, but they also confirm that measurement systems become more useful when they are connected to implementation, investment and governance routines.

The report also finds that indicator strategies are expanding beyond emissions monitoring. All six cities combine greenhouse gas indicators with implementation metrics, and several are developing indicators for co-benefits such as air quality, health, employment, social inclusion, energy poverty and economic development. However, the maturity of these approaches varies significantly. Air quality is among the most measurable co-benefits, while health, distributional impacts, behavioural change and

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socio-economic outcomes remain more difficult to quantify. Cities are cautious about over-claiming causal impacts where attribution is uncertain, and many therefore rely on a combination of quantitative indicators, proxy measures and narrative reporting.

The cases highlights how MEL can support adaptive management. In Stockholm and Münster, annual climate assessments and climate controlling reports feed into budget deliberations and help identify gaps, delays and resource needs. In Bergamo and Turin, MEL supports prioritisation across large portfolios of actions and helps assess whether investment and implementation trajectories remain credible. In Zaragoza and Cork, MEL is increasingly being connected to action plan revision, economic assessment and project pipeline development. These examples demonstrate that MEL becomes most valuable when it informs decisions on budgets, procurement, planning, investment and implementation sequencing, rather than remaining separate from core governance processes.

The cases also reveal several shared challenges.

- Data gaps remain significant, particularly for privately owned buildings, SMEs, mobility behaviour, scope 3 emissions, consumption-based impacts and socio-economic co-benefits.
- Capacity constraints affect all cities, including those with relatively mature systems, because advanced MEL requires dedicated staff, analytical skills, data infrastructure and regular engagement with implementation actors.
- Methodological uncertainty also remains a recurring issue, especially where cities must distinguish between changes caused by municipal action and those resulting from national policy, market shifts or wider structural trends.
- Multi-level governance further complicate MEL, since cities are required to monitor and report emissions trajectories even when key levers, such as building regulation, energy market design, taxation and vehicle standards, sit at national or EU level.

Despite these challenges, the report identifies important opportunities for Mission Cities.

- First, MEL can become a core governance capability when it is institutionally resourced and linked to existing management systems.
- Second, digital platforms and shared data infrastructures can support more integrated, portfolio-based monitoring, especially where they connect emissions, finance, implementation status and co-benefits.
- Third, mission-wide tools and peer learning can reduce duplication and help cities adapt common methods to local conditions.
- Fourth, reflexive approaches to MEL can help cities acknowledge uncertainty, revise assumptions and improve their systems over time without waiting for perfect data.

Together, the six cases show that city-driven MEL is emerging as an essential component of mission-oriented urban climate governance. Its value lies not only in measuring progress towards climate neutrality, but in helping cities organise learning, coordinate actors, prioritise actions, mobilise investment and adapt implementation pathways. For the wider Cities Mission, this points to the need for continued support to strengthen MEL capacities, improve access to high-quality and disaggregated data, develop proportionate methods for co-benefit and distributional indicators, and align local MEL systems with national and European governance frameworks. As cities move further into implementation, MEL will be increasingly important for understanding not only whether progress is being made, but how climate-neutrality transitions can be governed, adjusted and accelerated in practice.

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Disclaimer

Abbreviations and acronyms

Acronym	Description
CCC	Climate City Contract, the main governance instrument of the EU's 100 Climate Neutral and Smart Cities Mission including a city's action plans, investment plans and stakeholder commitments
ESG	Environment, social and governance; a framework used by investors and companies to measure a business's long-term sustainability
EU	European Union
MoU	Memorandum of Understanding
NECP	National Energy and Climate Plan
RES	Renewable Energy Source
SECAP	Sustainable Energy and Climate Action Plan
SMEs	Small and medium enterprises
WTE	Waste To Energy

Keywords

Mission Governance; Monitoring, Evaluation, and Learning (MEL), Multi-Actor Collaboration.

Introduction

This chapter focusses on how city-driven monitoring, evaluation and learning (MEL) functions as a governance mechanism in six Mission-labelled cities pursuing climate-neutrality commitments: **Stockholm**, **Zaragoza**, **Cork**, **Münster**, **Bergamo** and **Turin**. The cities are part of the EU Mission on 100 Climate-Neutral and Smart Cities and are also engaged in the NetZeroCities (NZC) support framework, which emphasises mission-oriented, systemic approaches to urban climate transitions (Edmondson et al., 2025; NetZeroCities, 2022).

City-driven MEL is understood here as monitoring, evaluation and learning processes that are initiated, coordinated and used by city governments and their partners to steer climate transitions, rather than as functioning for external reporting to national or European institutions. Building on earlier conceptual work on reflexive MEL in city climate governance (Edmondson et al., 2025), the report examines how MEL is embedded in governance architectures, how measurement systems are constructed, and how learning processes support adaptive management, accountability and just transition objectives under mission-oriented frameworks.

The chapter focuses on six cases that collectively provide a diverse sample of Mission Cities with advanced or particularly illustrative MEL practices. Stockholm and Münster represent cities with long-standing climate governance and mature integration of MEL into core management and budgetary systems (City of Stockholm, 2023a, 2024b; City of Münster, 2023). Zaragoza, Cork, Bergamo and Turin illustrate how MEL is being constructed or significantly upgraded through the Climate City Contract (CCC) process, often in combination with new digital platforms, economic modelling tools and co-creation processes (Ayuntamiento de Zaragoza, 2025; Cork City Council, 2024; Municipality of Bergamo, 2023; Città di Torino, 2024).

The aims of the report are threefold. First, to provide a structured comparative synthesis of city-driven MEL across the six cases, focusing on how MEL operates as an enabler of climate action and broader city governance. Second, to draw out shared challenges, breakthroughs and opportunities that can inform mission-wide support for MEL. Third, to contribute to a growing body of knowledge on net-zero delivery frameworks that treat MEL not only as a compliance instrument but as a reflexive governance capability (Vo & Bornemann, 2011; Frantzeskaki et al., 2018).

Methodology

This chapter includes case-studies prepared for each of the six cities following a common approach, combined with a peer-to-peer workshop and supporting conceptual work on reflexive MEL.

Each case study draws on document analysis of the Climate City Contract, associated climate action and investment plans, and other relevant strategies, complemented by semi-structured interviews with city officials and, where applicable, mission partners. For Stockholm, Zaragoza, Cork and Münster, two interviews of approximately 60 minutes were conducted with key officials involved in the MEL system between January and March 2026. Bergamo and Turin, which have more desk-based cases, the analysis combines CCC Action Plans, technical annexes and MEL notes prepared by research partners with follow-up clarifications (Città di Torino, 2024).

In addition to the six case reports, the work draws on material from an online city-to-city peer workshop on city-driven MEL held in April 2026 within the NetZeroCities peer learning programme. The workshop involved presentations and discussions with representatives from Cork, Münster, Zaragoza and Stockholm, focusing on MEL system development, current stages of implementation, challenges and strategies for future iterations (City P2P workshop - MEL, 2026). These reflections

provide additional triangulation of the written cases and help illuminate shared concerns and emerging practices.

Finally, the report builds on the previous NetZeroCities 2025 report on reflexive MEL in city climate governance (Edmondson et al., 2025), which provides a conceptual lens and comparative insights from four earlier Mission Cities. That report identifies five core dimensions of reflexive MEL - governance and partnerships; measurement and monitoring; MEL applications and storytelling; learning and adaptation; and outcomes and success stories - that inform the analytical framework used here.

Interview evidence is cited in the cases using an anonymised numbering system for each respective city (e.g., Stockholm Interview 1, 2026), without disclosing the identities or positions of individual interviewees. All claims drawn from interviews are triangulated where possible with documentary sources such as CCCs, action plans or workshop presentations. The empirical focus is on how MEL systems are designed and used in practice, rather than on formal institutional descriptions alone.

Overview of the six Mission Cities

Across the six cities, greenhouse gas emissions profiles are dominated by stationary energy and transport, with varying contributions from industry and waste (**Table 1**). In Bergamo and Turin, building-related emissions account for around 80% of baseline emissions, while in Cork and Zaragoza, the combination of inefficient building stocks and car-dependent transport systems drives the majority of emissions (Cork City Council, 2024; Ayuntamiento de Zaragoza, 2025; Municipality of Bergamo, 2023; Città di Torino, 2024). Stockholm and Münster have already substantially reduced emissions from district heating and electricity, but face persistent challenges in transport, construction-related scope 3 emissions and consumption-based impacts (City of Stockholm, 2023a; City of Münster, 2023).

All six cities have adopted ambitious 2030 targets under the EU Cities Mission, but they differ in the way boundaries are defined and residual emissions are treated. Some focus on territorial scope 1 and 2 emissions within municipal boundaries, while others also track city-organisation emissions and selected scope 3 categories. These boundary choices condition what is visible in the MEL systems and how progress towards climate-neutrality is interpreted (Edmondson et al., 2025).

Table 1 - City context of the six cases.

City	Approx. population (city)	Territorial profile	Economic profile (selected features)	Climate-neutrality framing
Stockholm	≈1.0 million (municipal); >2 million in functional urban region	Capital and core of a fast-growing metropolitan region with high service density	Service- and knowledge-based economy; relatively little heavy industry within city limits	Climate-positive by 2030 and fossil-free by 2040 within a cumulative emissions budget (City of Stockholm, 2023a, 2024b).
Zaragoza	≈693,000 (municipal, 2025); ≈745,000 in wider urban/commuter belt	Capital of Aragon in the Ebro Valley; major logistics and transport hub	Diversified economy with strong automotive manufacturing, logistics and services	Target of ~80-85% emissions reduction by 2030 relative to business-as-usual, with CCC organised around five pillars (Ayuntamiento de Zaragoza, 2025).
Cork	≈222,000 (2022); designated growth to ≈280,000 by 2030	Port city at head of large natural harbour; expanded boundary integrating urban core, suburbs and rural fringe	Global hub in life sciences, ICT and international financial services, alongside manufacturing	Mission-aligned target of at least 80% emissions reduction by 2030 vs 2018, with residual emissions treated as hard-to-abate (Cork City Council, 2024).
Münster	≈321,000 (2022) within 303 km²	Standalone urban district and regional centre in largely rural Münsterland	Service-dominated regional hub with strong education, administration and SME sectors	Climate neutrality by 2030 with >95% reduction vs 1990, using a carbon-budget approach (City of Münster, 2023).
Bergamo	≈120-130,000 (municipal); part of a wider urbanised area	Compact city framed as a "lighthouse" in a wider territorial transition	Mixed economy with services, industry and strong civic institutions	Climate neutrality by 2030 within municipal boundary, with a 2021 baseline and portfolio of 217 actions (Municipality of Bergamo, 2023).
Turin	≈861,000 inhabitants (end of 2023) across 130 km²	Capital of Regione Piemonte and core of a metropolitan area with complex socio-economic structure	Fourth-largest Italian economic and productive complex, with strong industrial and knowledge sectors	2030 climate-neutrality pathway anchored in 2019 baseline of 2.4 $MtCO_2$ and 30 macro-actions (Città di Torino, 2024).

1 Key themes for city-driven MEL processes

This section synthesises the main thematic dimensions of city-driven MEL across the six cases, using the common structure of Section 2 in the individual city reports. The themes are:

- (i) governance architecture and institutional set-up;
- (ii) measurement architecture and data governance;
- (iii) indicators, co-benefits and distribution;
- (iv) use of MEL in decision-making and adaptive management; and
- (v) learning, participation and communication.

For each theme, the subsection first clarifies the concept and then summarises how it has been operationalised across the cities.

1.1 Governance architecture and institutional set-up

Governance architecture refers to how responsibilities and capacities for MEL are organised within the city administration and in relation to external partners. Across the six cases, MEL is embedded in broader transition governance arrangements, rather than treated as an isolated technical function (Edmondson et al., 2025). Central features include mission teams or climate units, cross-departmental coordination structures, and partnerships with utilities, universities and other stakeholders.

In Stockholm, a climate and environment unit within the Environmental Department acts as the de facto MEL hub, coordinating indicator reporting and narrative accounts from all departments and city-owned companies (City of Stockholm, 2023a). Climate goals and MEL responsibilities are anchored in the Environment Programme and the City Council budget, which assign specific indicators and follow-up duties to committees and company boards. The city created 15-16 thematic focus groups during the climate action plan design phase, later consolidated into five transition teams (consumption, energy, transport, construction and city operations). Coordinators for these teams participate in a cross-sectoral MEL coordination group that meets roughly every two weeks to align reporting and review progress.

Zaragoza's MEL governance builds on a long-standing environmental planning tradition. City Council Environment Office co-leads the Climate Neutral Mission within the municipality alongside the Directorate-General for Funds, building on many years of work in environmental planning. Regarding the CCC development, technical aspects are led by the Environmental Office, in collaboration with the Circe Foundation, jointly coordinating CCC design, implementation and indicator development (Ayuntamiento de Zaragoza, 2025). The city governance is built on a quadruple-helix approach, that reflects the evolving governance model, bringing together the participation of public administration, academia, private sector and civil society, combining traditional participatory bodies such as the Environmental Sector Council with newer innovation labs and data governance initiatives. The Spanish Mission Platform - CitiES2030 - support the city in this process, while provide methodological support for indicator frameworks and economic modelling.

In Cork, the operational responsibility for MEL is centralised in a small Climate Action Office that collates data from across municipal departments and external agencies, including the Environmental Protection Agency and Sustainable Energy Authority of Ireland (Cork City Council, 2024; Medway, 2026). The Climate City Contract is anchored in the statutory Local Authority Climate Action Plan, ensuring that mission MEL is not a parallel structure but integrated into the city's legal obligations. A Climate Neutral Cork leadership group has been established, bringing together universities, major institutions and municipal actors to guide strategic priorities and, in the longer term, to help unlock data sources and analytical capacity for MEL (Medway, 2026).

Münster's governance architecture reflects decades of climate policy continuity. A central climate unit in the Strategic Development Department coordinates MEL and reports directly to political leadership (City of Münster, 2023). Responsibility for emissions and implementation data is distributed across municipal offices, utilities and research partners, notably the Institute for Energy and Environmental Research (ifeu), which developed the inventory tool. The City Council has mandated an annual climate controlling report, explicitly linking MEL to budget processes and ensuring that climate monitoring is integrated into core governance routines (City of Münster, 2023).

In Bergamo, the Transition Team anchored in the Ecology and Environment Department coordinates the Mission and MEL across municipal departments, with the Head of Department acting as Climate Transition Manager (Municipality of Bergamo, 2023). Designated contact persons in departments responsible for mobility, public works, green space, buildings, housing, heritage and European planning ensure cross-administrative engagement. External support from NetZeroCities advisors, TerrAria and AESS bolsters technical and methodological capacity. The wider Urban Ecosystem

encompasses around 40 stakeholders whose actions and data feed into the MEL system, reflecting a multi-actor governance model.

Turin has established an integrated Mission Team that brings together a municipal Transition Team and a scientific working group at the Politecnico di Torino's Energy Center (Città di Torino, 2024). The municipal side includes departments responsible for environment, ecological transition and European funds, supported by an interdepartmental working group on climate change. The scientific side, coordinated by the ESTenergycenter lab, provides modelling, indicator design, data architecture and methodological validation. This arrangement embeds analytical capacity inside the governance architecture rather than treating it as external consultancy, which is particularly important for a large metropolitan system with complex socio-economic structures.

1.2 Measurement architecture and data governance

Measurement architecture covers how cities construct greenhouse gas inventories, indicator sets and data infrastructures to support MEL. Data governance concerns the rules, responsibilities and infrastructures through which data are collected, validated, stored, shared and used. Across the six cases, measurement systems link baseline emissions, sectoral trajectories, action portfolios and, to varying degrees, financial and co-benefit metrics (Ayuntamiento de Zaragoza, 2025; City of Stockholm, 2023a; City of Münster, 2023; Municipality of Bergamo, 2023; Città di Torino, 2024; Cork City Council, 2024).

In Stockholm, the measurement architecture combines a city-wide greenhouse gas inventory aligned with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC) with a set of formal indicators embedded in the integrated management system (City of Stockholm, 2023a). Road transport emissions are calculated using the HBEFA traffic model, calibrated with local data on vehicle counts, fuel types and speed profiles. Building-sector emissions rely on local energy consumption data and national emission factors. A written methodological guideline documents data sources and calculation methods, while the integrated management system provides a digital interface for departments to report energy, transport and procurement indicators annually. Nonetheless, full standardisation across sectors remains a work in progress .

Zaragoza uses a comprehensive indicator framework derived largely from prior municipal strategic plans, which were compiled and adapted to fit the **Climate City Contract (CCC) framework**, with the European Conservation Agriculture Federation (ECAF) serving as a primary methodological reference. The Economic Model for Cities Decarbonisation (EMCD), applied to evaluate the life-cycle costs and economic viability of decarbonization strategies, ensuring that monitoring is linked not only to environmental outcomes but also to financial feasibility, was applied through the Spanish Mission platform CitiES2030 (Ayuntamiento de Zaragoza, 2025).

The city's baseline inventory identifies buildings, transport, industry and services as the main emission sectors - totalising 94.7% of the city total emissions, 2023 GHG Inventory, and the Action Plan targets 99% of scope 1 and 2 emissions through measures in four high-impact sectors. Data governance is supported by an Open Government platform where structured, interoperable and geo-referenced data are publicly accessible, and currently being further developed by the IPPCP (Intelligent Private-Public

Carbon Platform[1]) project, which systematises industrial emissions reporting through a public-private data partnership .

Cork's measurement architecture is shaped by Ireland's highly centralised data landscape. The 2018 and 2023 baseline emissions inventories rely heavily on national Environmental Protection Agency and Sustainable Energy Authority datasets, statistically downscaled to city level (Cork City Council, 2024; Medway, 2026). Recognising the limitations of infrequent, retrospective inventories, the city is customising the NetZeroPlanner tool, with consultancy support, to develop a robust data source library and treatments that enable more regular updating of emissions models and scenario analyses. The aim is a rolling data approach, where new national datasets are incorporated as they become available, and where project-level impacts can be estimated more systematically (Medway, 2026; City P2P workshop - MEL, 2026).

Münster's measurement backbone is an annual greenhouse gas inventory constructed using the BISKO standard and an ifeu-developed tool, providing consistent coverage of all major sectors since 1990 (City of Münster, 2023). Data are supplied by the municipal utility, private energy providers, infrastructure operators and other external partners. In parallel, implementation monitoring is organised through the climate controlling process, which tracks key strategic projects and their status. Data governance relies on established relationships and professional norms rather than highly formalised data-sharing contracts, although interoperability is facilitated by the use of national standards (City of Münster, 2023).

Bergamo's measurement architecture is closely tied to its digital platform ForImpact.ai. The 2021 baseline inventory adapts the Sustainable Energy and Climate Action Plan (SECAP) methodology to NetZeroCities guidance, using IPCC emission factors and local energy and waste data (Municipality of Bergamo, 2023). During the co-planning phase, stakeholders provided action-level information on expected emissions reductions, investment volumes and co-benefits for 217 actions. These data feed into ForImpact.ai, which aggregates implementation status and impacts by sector and lever of change, enabling the Transition Team to monitor progress and prioritise key actions . Data gaps - particularly for privately owned buildings, industrial processes, socio-economic co-benefits and behavioural change - are addressed through proxy indicators, scenario assumptions and iterative refinement.

Turin's measurement system centres on the CLICC platform and the Energy Transition Data Room, which together link a 2019 baseline inventory (2.4 $MtCO_2$) to 30 macro-actions and 227 micro-actions across stationary energy, transport, waste and AFOLU (Città di Torino, 2024). CLICC uses ad hoc models and algorithms to assess ex ante and in silico the impacts of policy options in terms of avoided emissions and costs, and to compare observed trajectories with those expected under the Climate City Contract. The Data Room is designed as a hyperconverged data infrastructure hosting copies of relevant city datasets, enabling high-performance queries and scenario analysis. Data governance involves structured pipelines from municipal departments, utilities, regional agencies and national statistics offices, with scientific validation by ESTenergycenter (Città di Torino, 2024).

1.3 Indicators, co-benefits and distribution

Indicators are the operational core of MEL systems, translating climate objectives and impact pathways into measurable variables. All six cities combine greenhouse gas indicators with sectoral implementation metrics, and several incorporate financial and co-benefit indicators. However, the

[1] https://www.zaragoza.es/sede/portal/ippcp/en/

balance between quantitative and qualitative indicators, and the maturity of co-benefit and distributional measurement, vary considerably (Edmondson et al., 2025; Ayuntamiento de Zaragoza, 2025; City of Stockholm, 2023a; City of Münster, 2023; Municipality of Bergamo, 2023; Città di Torino, 2024; Cork City Council, 2024).

In Stockholm, formal indicators embedded in the budget and integrated management system include total and sectoral greenhouse gas emissions, energy use in city operations, numbers and types of vehicles, public EV chargers, food-related emissions in municipal procurement, and selected circularity metrics such as material logging in construction (City of Stockholm, 2023a, 2025b). Departments and companies report these annually, and underperformance generates 'red marks' that require explanation and corrective measures . Alongside these, Stockholm is experimenting with transformative indicators in selected urban development projects, designed to capture early changes in organisational routines, collaboration patterns or stakeholder engagement that are not yet visible in emissions statistics . Co-benefits such as health and cost savings from reducing plastics in care services, or financial and climate benefits from building material reuse, are recognised but not yet systematically integrated into the core indicator set.

Zaragoza has developed a particularly comprehensive indicator framework. The CCC and its First Iteration specify targets for 2025, 2027 and 2030 for indicators such as per capita emissions, modal shares, public transport electrification, annual building renovation rates and renewable electricity shares (Ayuntamiento de Zaragoza, 2025). Co-benefit indicators were introduced in the iteration process, covering air quality (PM10, NO_2, PM2.5), temperature-related variables, health outcomes, social inclusion, innovation and job creation. The city also distinguishes co-risks - potential negative impacts such as job losses or rising living costs - and seeks to monitor them to support a fair transition. However, availability of disaggregated social data, such as income distribution or energy poverty, remains a major constraint, and some intended indicators had to be dropped or substituted .

Cork's indicator set, distilled from the extensive NetZeroCities framework, includes approximately 23 core metrics, with a deliberate emphasis on feasibility and decision relevance (Cork City Council, 2024; Medway, 2026). Direct indicators focus on emissions from stationary energy, transport, waste and AFOLU, while indirect indicators cover air quality, green jobs, modal share, citizen engagement and social innovation funding. The city recognises that many co-benefit indicators rely on proxy measures and that thresholds (e.g., World Health Organization air quality guidelines) can create communication challenges if local 'improvements' still fall short of stricter external standards. Quantifying co-benefits in monetary terms, particularly in health and well-being, is a priority for future capacity-building but is not yet achieved (Medway, 2026).

Münster's indicator framework remains relatively conservative. Core indicators track absolute and sectoral emissions, shares of renewable energy in electricity and heat consumption, and residual emissions required to reach climate neutrality (City of Münster, 2023). Implementation monitoring focuses on project status (implemented, delayed, under preparation) and estimated impact levels, without attempting precise attribution of emissions reductions to individual measures . Co-benefits such as air quality, health or energy poverty reduction are acknowledged qualitatively in project proposals or contextual reporting, but the city is cautious about making strong causal claims in the absence of robust data.

Bergamo combines quantitative greenhouse gas indicators - primarily tonnes of CO_2 equivalent reduced per year - with investment-related indicators and qualitative descriptors of co-benefits (Municipality of Bergamo, 2023). Indicators emerged directly from stakeholder-provided action data on emissions reductions, investment volumes, timelines and co-benefits, reinforcing the link between the portfolio and MEL. Co-benefits such as improved air quality, social inclusion, health gains and economic development are aggregated narratively by sector, with early examples in green infrastructure and social cohesion projects like Clic.Bergamo. However, systematic measurement of distributional effects, such as energy poverty or job quality, remains under development.

Turin assigns a central role to indicators through Module B-3 of their Climate City Contract, which specifies metadata for indicators linked to macro-actions and micro-actions (Città di Torino, 2024). The indicator set covers emissions reductions, implementation variables (e.g., square metres of buildings retrofitted, kilometres of district heating expansion), financial indicators (capital expenditure, leverage ratios) and co-benefit metrics where feasible. Distributional aspects, such as impacts on energy poverty, employment and social inclusion, are recognised as important but face data access challenges, especially where information depends on utilities, private firms or national statistical agencies.

1.4 Use of MEL in decision-making and adaptive management

Beyond data collection, city-driven MEL is intended to inform strategic and operational decisions. The six cases illustrate different degrees of integration between MEL outputs and budgeting, investment planning, policy design and stakeholder engagement. In all cases, cities emphasise that MEL should support adaptive management - revisiting assumptions, adjusting portfolios and reallocating resources in response to evidence - rather than acting solely as a retrospective compliance mechanism (Edmondson et al., 2025).

In Stockholm, MEL is deeply embedded in the annual budget cycle. Each year, departments and city-owned companies report indicator values and qualitative narratives via the integrated management system; the environmental department synthesises these into a climate assessment that informs both evaluation of the Environment Programme and the drafting of the next budget's strategic priorities (City of Stockholm, 2023a, 2025b). Underperforming indicators can trigger follow-up meetings with sector departments and influence the assignment of new tasks or funding in subsequent budgets. Sectorally, MEL supports the transport transition by tracking gaps to targets (e.g., 80% emissions reduction vs 2010 and 30% reduction in car traffic vs 2017) and assessing whether policy packages around congestion charging, public transport and cycling are sufficient or require strengthening (City of Stockholm, 2023a).

Münster offers a clear example of MEL integration with financial governance. The annual climate controlling report brings together the updated greenhouse gas balance, a status report on strategic climate projects and an entry point into a climate-oriented budget (Klimahaushalt). The report is timed to coincide with City Council budget deliberations, ensuring that climate progress and resource allocation are considered together (City of Münster, 2023). This process allows political and administrative leaders to identify implementation delays, resource gaps and priority investments, even though precise impact attribution remains limited.

In Bergamo, MEL is used to prioritise actions and assess portfolio credibility. The Transition Team uses ForImpact.ai outputs to identify high-impact and investment-critical actions and to distinguish enabling actions that unlock multiple downstream measures (Municipality of Bergamo, 2023). The integration of emissions, investment and implementation data allows the city to assess whether the action portfolio remains aligned with the 2030 neutrality pathway and whether financing commitments from public and private actors are keeping pace. MEL thus informs both strategic discussions with political leadership and operational coordination with stakeholders.

Turin's MEL system supports decision-making at multiple levels. CLICC enables scenario comparison and cost-effectiveness assessment of alternative decarbonisation strategies, helping planners to prioritise combinations of macro-actions and micro-actions based on emissions impact, feasibility and co-benefits (Città di Torino, 2024). The linkage between environmental and financial indicators allows the city to monitor whether the estimated EUR 27.1 billion investment package is being mobilised and where financing gaps or implementation bottlenecks are emerging. MEL outputs are used to justify

corrective actions, such as revising sequencing of electrification measures if infrastructure deployment lags, or adjusting social policies if co-benefit indicators reveal unequal distribution of gains.

Zaragoza and Cork are integrating MEL into decision-making, with clear visible trajectories. In Zaragoza, the **Economic Model City's Decarbonization (EMCD)** was employed, to support economic decision-making by evaluating the life-cycle costs and economic viability of decarbonization strategies, ensuring that monitoring is linked not only to environmental outcomes but also to financial feasibility. The city use MEL findings to influence municipal budget priorities and adjustments to the Action Plan, particularly within the five strategic pillars where emissions reduction potential, co-benefits and economic viability intersect (Ayuntamiento de Zaragoza, 2025). In Cork, MEL currently focuses on ensuring alignment between the Climate City Contract and existing statutory obligations but is evolving towards more concrete use in investment planning as the NetZeroPlanner tool is implemented. The city aims to use MEL evidence to assess the adequacy of project pipelines relative to the 2030 neutrality goal and to support access to funding mechanisms that require robust climate and co-benefit assessments (Cork City Council, 2024; Medway, 2026).

1.5 Learning, participation and communication

Reflexive MEL emphasises learning and adaptation across governance levels and stakeholder groups. Learning processes include revising indicators and methods, co-interpreting data with stakeholders, and translating technical results into accessible narratives. Participation and communication are both inputs to, and outputs from, these learning processes (Edmondson et al., 2025).

In Stockholm, learning is institutionalised through the transition teams and the MEL coordination group, which function as recurring arenas where data and narratives from different departments are compared, inconsistencies are discussed and shared interpretations are developed . Methodological revisions, such as the shift to a GPC-compatible inventory, are timed to coincide with major target updates to preserve coherence of trajectories (City of Stockholm, 2023a). Externally, the city communicates MEL findings through local media, dashboards such as the environmental barometer and presentations in stakeholder pacts, although citizen co-interpretation of data remains limited.

Zaragoza's learning approach is anchored in the conception of its Action Plan as a living document subject to regular revision, incorporated in the first iteration of CCC published by October 2025. Indicator revision processes involve both technical staff and stakeholders through structures like the Environmental Sector Council, a consultative body connecting associative and community perspectives with decision-making processes, formally channelling citizen and civil society feedback. Through iteration and further developments embedding multiple-sector's needs, the city achieved notable progress in estimating challenging metrics such as energy poverty, satellite technology and multispectral imagery to monitor carbon sequestration and urban heat islands. Alongside, the city if progressing in its communication and dissemination strategy, through the Open Government platform and IPPCP, in addition to the NetZeroCities CESF to translate technical monitoring outputs into accessible narratives for diverse audiences, this facilitate communication and transparency by making emissions and co-benefit data accessible to citizens, companies and researchers.

Bergamo integrates learning into MEL through explicit acceptance that data, indicators and assumptions will improve over time. During the co-planning phase, workshops and bilateral meetings enabled stakeholders to co-create the action portfolio and to discuss expected impacts, barriers and co-benefits, effectively turning MEL into a formative design practice (Municipality of Bergamo, 2023). As implementation progresses, ForImpact.ai provides a shared digital environment where partners can update data and observe aggregated results, creating opportunities for joint reflection and adjustment, provided that governance routines sustain regular review cycles.

Münster's learning processes are incremental and linked to annual reporting cycles rather than to large redesign moments. New evidence is incorporated into inventories, climate controlling templates

and project classifications, with a digital Kanban board used to track follow-up responsibilities (City of Münster, 2023). The city distinguishes between participatory processes for long-term visioning - such as the 2017 conference with more than 1,000 participants - and expert-led design of indicators and impact pathways, recognising both the value and limits of co-creation for technically complex MEL tasks.

Cork and Zaragoza both use mission peer learning and external support to enhance learning. Cork's engagement with NetZeroCities tools and the CESF-funded NetZeroPlanner customisation is explicitly framed as a learning exercise to understand the adequacy of actions and to build internal analytical capacity (Medway, 2026; City P2P workshop - MEL, 2026). Zaragoza experiments with advanced digital tools such as satellite imagery for urban heat island mapping and carbon sequestration, and with narrative strategies to translate complex MEL outputs into accessible stories for different audiences (Ayuntamiento de Zaragoza, 2025).

Communication tools such as public dashboards, open data portals and progress reports play important roles across the cases. Münster's climate dashboard provides real-time data on selected indicators, such as bicycle counts, supporting transparency and public engagement (City of Münster, 2023). Zaragoza's Open Government platform allows users to explore emissions and co-benefit datasets; Stockholm's environment barometer consolidates key environmental indicators in an accessible format. However, all cities identify further work needed to link these tools to participatory interpretation processes and to tailor narratives to different audiences, including vulnerable groups and sceptical stakeholders.

2 Discussion of main comparative themes

Building on the thematic synthesis (for a summary see **Table 2**), this section compares how the six cities operationalise city-driven MEL across the main dimensions, while also highlighting the main differences, key strengths, shared challenges and emerging opportunities.

2.1 Governance practices

The six cases reveal a spectrum of governance models for city-driven MEL.

- Stockholm and Münster embed MEL deeply in existing management and budgetary systems, with climate and environment units acting as hubs that coordinate indicator reporting and synthesis across departments (City of Stockholm, 2023a; City of Münster, 2023).
- Bergamo and Turin have developed mission-specific Transition Teams and integrated Mission Teams that bring together municipal staff, scientific partners and external stakeholders in purpose-built structures (Municipality of Bergamo, 2023; Città di Torino, 2024).
- Zaragoza and Cork have both integrated MEL into existing environmental and climate action offices while experimenting with new governance devices such as leadership groups and quadruple-helix platforms (Ayuntamiento de Zaragoza, 2025; Cork City Council, 2024).

A commonality across all six cities is the presence of a central coordinating entity with explicit MEL responsibilities, whether a climate unit, mission team or transition team. Another is the distribution of

data generation and implementation responsibilities across departments, companies and utilities, reflecting the multi-sectoral nature of emissions and interventions.

Distinctions arise in the positioning of scientific partners and intermediaries. Turin and Bergamo integrate universities and technical agencies directly into governance through formal Mission Teams and platform management roles; Münster and Stockholm rely on research partners for methodological support but maintain stronger internal control over inventories and indicators. Cork and Zaragoza lean on national platforms and external consultants for tool development and economic modelling, constrained by centralised data systems and resource limitations.

2.2 Measurement backbones and digital infrastructures

Measurement architectures across the six cities share a multi-layered character - combining greenhouse gas inventories, sectoral implementation indicators and, in some cases, financial and co-benefit metrics - but differ in their digital infrastructures and degrees of integration.

- Münster and Stockholm exemplify cities where long-standing inventory practices have been incrementally aligned with mission requirements, using national standards (BISKO, GPC) and domestic data sources (City of Stockholm, 2023a; City of Münster, 2023).
- Bergamo and Turin have built more integrated digital backbones (ForImpact.ai and CLICC plus the Data Room) directly around the Climate City Contract, emphasising portfolio monitoring and scenario analysis (Municipality of Bergamo, 2023; Città di Torino, 2024).
- Zaragoza and Cork illustrate configurations shaped by national platforms and tools. Zaragoza leverages the CitiES2030 economic model and NetZeroCities indicator framework, embedding MEL within an open data and data governance agenda (Ayuntamiento de Zaragoza, 2025). Cork's reliance on national EPA and SEAI data, combined with limited internal econometric capacity, has motivated the customisation of NetZeroPlanner as a central analytical tool for future MEL. This has been temporarily supported by consultants, but will be integrated into routine functions over time (Cork City Council, 2024; Medway, 2026).

Table 2 - Overview of city cases across six core themes of city-driven MEL.

City	**Governance & set-up**	**Measurement & data governance**	**Indicators & co-benefits**	**Use of MEL in decision-making**	**Learning, participation & communication**
Stockholm	Climate and environment unit; transition teams; MEL coordination group; responsibilities anchored in budget and Environment Programme.	GPC-compatible inventory; integrated management system for departmental indicators; methodological guideline; partial cross-sector standardisation.	Formal budget indicators for emissions, energy, transport, procurement; experimental transformative indicators; ad hoc co-benefit examples.	Annual climate assessment feeds budget priorities and assignments; sectoral MEL (e.g. transport) used to assess adequacy of policy packages.	Biweekly coordination group; internal learning across departments; external communication via environment barometer and media; limited citizen co-interpretation.
Zaragoza	Environment Office and European Funds Office co-lead Mission; quadruple-helix governance; sector councils; innovation labs.	CCC indicator framework and EMCD-based modelling; annual inventory; Open Government platform; IPPCP manages industrial emissions data.	Comprehensive indicators with 2025/2027/2030 targets; co-benefits (air quality, health, inclusion, jobs); co-risks; emerging energy poverty metrics.	MEL informs prioritisation within five pillars and municipal budget choices; indicators used to recalibrate Action Plan and investments.	Iterative indicator revision; citizen input via Environmental Sector Council; open data and advanced digital tools; exploration of new narratives.
Cork	Climate Action Office as central MEL node; Climate Neutral Cork leadership group; integration with statutory climate action plan.	Baseline inventories relying on national EPA and SEAI data; NetZeroPlanner customisation underway; manual, Excel-based tracking.	Lean set of ~23 indicators balancing emissions and co-benefits; emphasis on feasibility; current lack of monetised co-benefit metrics.	MEL used to align CCC with legal obligations; evolving towards assessing adequacy of project portfolios and supporting investment cases.	Learning through NetZeroCities tools and consultant support; limited resources for participatory MEL; focus on building internal analytical capacity.
Münster	Climate unit in Strategic Development; strong political anchoring; distributed data responsibilities; annual climate controlling mandated.	Annual BISKO-standard inventory; data from utilities and providers; interoperable through national standards.	Core indicators on emissions, renewable shares and project status; cautious, mainly qualitative treatment of co-benefits.	Climate controlling report informs City Council budget deliberations; MEL used to identify delays, resource needs and strategic gaps.	Incremental learning linked to annual reporting; major participatory processes for visioning separated from expert-led MEL design; public climate dashboard for transparency.
Bergamo	Transition Team with cross-departmental contacts; Urban Ecosystem of stakeholders; external technical partners (TerrAria, AESS, NZC advisors).	SECAP-derived baseline adjusted to NZC guidance; ForImpact.ai aggregates action-level data; adaptive treatment of data gaps.	Indicators derived from stakeholder action data (emissions, investment, status); qualitative co-benefit descriptors; early focus on distributional themes.	MEL used to prioritise high-impact and enabling actions; integration with Investment and Commitment Plans; supports discussions with political and external partners.	Co-creation in portfolio design; ForImpact.ai as shared learning environment; recognition that assumptions and indicators will evolve over time.
Turin	Integrated Mission Team combining municipal Transition Team and ESTenergycenter scientific group; interdepartmental working group.	2019 baseline inventory; CLICC platform models macro- and micro-actions; Energy Transition Data Room hosts city data; structured pipelines from partners.	Indicators linking emissions, implementation variables, finance and co-benefits; explicit handling of uncertainty and data gaps.	MEL informs prioritisation of macro-actions, investment oversight and corrective measures when trajectories deviate from targets.	Co-design of pathways and indicators with stakeholders; scenario-based learning; communication of co-benefits to diverse audiences; reliance on scientific partnership for continuous improvement.

2.3 Indicator strategies and co-benefit practices

Indicator strategies differ in scope and complexity.

- Zaragoza and Turin have arguably the most extensive indicator sets, with clear targets across multiple time horizons and explicit inclusion of co-benefits and co-risks (Ayuntamiento de Zaragoza, 2025; Città di Torino, 2024).
- Bergamo's indicator framework emerged bottom-up from stakeholder-provided action data, ensuring close correspondence between the portfolio and MEL but leaving co-benefit metrics largely qualitative (Municipality of Bergamo, 2023).
- Stockholm and Münster prioritise indicators that fit into existing management systems and legal accountability frameworks, limiting the number of co-benefit indicators and experimenting cautiously with transformative metrics (City of Stockholm, 2023a; City of Münster, 2023).
- Cork, constrained by data and capacity, has selected a lean set of indicators that balance emissions, key co-benefits and feasibility (Cork City Council, 2024; Medway, 2026).

Across all cases, systematic measurement of co-benefits and distributional effects remains a major challenge. Air quality is the most consistently quantified co-benefit, particularly where monitoring stations already exist (Ayuntamiento de Zaragoza, 2025; City of Stockholm, 2023a). Health outcomes, energy poverty and employment impacts are more difficult to operationalise, often depending on external datasets and complex attribution assumptions. Cities express concern about over-claiming causal impacts and about the administrative burden of repeated surveys or bespoke data collections.

This suggests a need for increased mission-level support in developing proportionate methodologies to populate co-benefit indicators, potentially further leveraging national and European data sources.

2.4 Main differences and key strengths

Table 3 summarises the main strengths and distinctive features of each city's MEL system across the core Section 2 themes. It highlights that rather than converging on a single model, cities are developing complementary approaches that reflect their institutional histories, data environments and strategic choices.

The table highlights that each city's MEL system has distinctive strengths that can inform mission-wide learning:

- Stockholm and Münster demonstrate how integration into existing management systems can give MEL significant steering power.
- Bergamo and Turin show the potential of platform-based, multi-actor MEL architectures.
- Zaragoza exemplifies advanced data governance and co-benefit integration, while Cork illustrates a pragmatic pathway for capacity-constrained cities to progressively deepen MEL practices.

Table 3 - Main comparative dimensions and key strenghts across the city cases.

City	Governance architecture	Measurement backbone	Digital / platform tools	Indicator and co-benefit strategy	Notable strengths
Stockholm	Climate and environment unit as MEL hub; transition teams and MEL coordination group embedded in municipal budget system.	GPC-aligned inventory plus integrated management indicators.	Integrated digital reporting system; environment barometer.	Strong focus on indicators that fit budget and management logic; early experimentation with transformative indicators; selective co-benefit tracking.	Deep integration of MEL into core governance and budget cycles; strong internal synthesis capacity.
Zaragoza	Environment Office and European Funds Office co-lead Mission; quadruple-helix governance with sector councils and innovation labs.	CCC indicator framework plus EMCD-based modelling and annual inventory.	Open Government platform; IPPCP public-private climate data platform.	Comprehensive indicator set with explicit co-benefits and co-risks; emerging energy poverty metrics.	Advanced data governance and open-data practices; strong alignment between MEL, economic modelling and just transition agenda.
Cork	Lean Climate Action Office coordinating across departments; Climate Neutral Cork leadership group.	Baseline inventories using national EPA and SEAI data; NetZeroPlanner adoption underway.	Planned NetZeroPlanner customisation; Excel-based tracking for climate action plan.	Lean indicator set balancing emissions and key co-benefits, chosen for feasibility in a capacity-constrained context.	Pragmatic approach that integrates Mission MEL into statutory climate action planning and seeks to build analytical capacity over time.
Münster	Climate unit in Strategic Development Department; annual climate controlling mandated by City Council.	Annual BISKO-standard inventory since 1990.	Public climate dashboard; digital Kanban for follow-up.	Focused indicator set on emissions and implementation status; cautious qualitative treatment of co-benefits.	High degree of institutionalisation and political anchoring; strong link between MEL and budget decisions.
Bergamo	Transition Team with cross-departmental contact persons; Urban Ecosystem of ~40 stakeholders.	SECAP-adapted baseline plus action-level monitoring based on stakeholder inputs.	ForImpact.ai platform for portfolio and MEL.	Indicators derived from action data; qualitative co-benefit descriptors; emerging focus on distributional aspects.	Strong integration of MEL with action and investment plans; platform-based governance of a multi-actor portfolio.
Turin	Integrated Mission Team combining municipal departments and ESTenergycenter scientific group.	2019 baseline inventory linked to 30 macro-actions and 227 micro-actions.	CLICC modelling platform and Energy Transition Data Room.	Rich indicator set linking emissions, implementation, finance and co-benefits; recognition of data uncertainties.	Sophisticated science-based MEL architecture that connects climate data, investment oversight and adaptive management.

2.5 Shared challenges and opportunities

Across the six cases, several shared challenges and opportunities emerge for city-driven MEL under mission-oriented climate governance. These resonate with findings from the first NetZeroCities report on city-driven MEL (Edmondson et al., 2025).

- **Data gaps and uneven measurement are a pervasive challenge**. Cities face structural difficulties in obtaining reliable, disaggregated data on privately owned buildings, small and medium-sized enterprises, mobility behaviour, socio-economic co-benefits and certain scope 3 emissions (Ayuntamiento de Zaragoza, 2025; Cork City Council, 2024; Municipality of Bergamo, 2023; Città di Torino, 2024; City of Stockholm, 2023a; City of Münster, 2023). Reliance on national models and statistical downscaling introduces uncertainties that can undermine confidence in local estimates, particularly for sub-sectors where municipal influence is limited.
- **Capacity and resource constraints affect all cities, albeit to different degrees**. Even relatively well-resourced administrations such as Stockholm and Münster report pressure on core MEL teams and the need to prioritise basic monitoring over more advanced co-benefit analysis or participatory interpretation. In Cork and Zaragoza, the combination of limited human resources, complex data environments and ambitious reporting expectations makes it difficult to sustain sophisticated MEL functions without external support (Medway, 2026).
- **Methodological uncertainty and attribution challenges remain**. Cities are reluctant to attribute emissions changes or co-benefits to specific measures where multiple factors interact, national policies play a decisive role, or data are insufficient to support strong causal claims (City of Münster, 2023; Medway, 2026). As a result, several cases prioritise MEL functions that track implementation status and overall trajectories rather than detailed impact attribution, accepting a trade-off between precision and governance usability.
- **Multi-level governance (mis)alignments complicate MEL design and interpretation**. Many key levers for decarbonisation - such as building codes, grid regulation, vehicle standards or taxation - are controlled at national or EU level, while cities are held accountable for ambitious neutrality targets (Edmondson et al., 2025; City of Münster, 2023). This creates difficulties in distinguishing which parts of emissions trajectories can reasonably be ascribed to municipal actions versus broader structural changes, and challenges in designing indicators that reflect municipal agency and influence.

Despite these challenges, the cases also highlight significant opportunities and breakthroughs.

- Integration of MEL with budgetary and investment processes in Stockholm, Münster, Bergamo and Turin strengthens the strategic relevance of MEL and embeds climate considerations in core governance routines (City of Stockholm, 2025a; City of Münster, 2023; Municipality of Bergamo, 2023; Città di Torino, 2024).
- Platform-based MEL architectures, such as ForImpact.ai, CLICC and Zaragoza's data platforms, demonstrate the potential for multi-actor, portfolio-oriented monitoring that goes beyond traditional inventories (Municipality of Bergamo, 2023; Città di Torino, 2024; Ayuntamiento de Zaragoza, 2025).
- Mission-wide tools and peer learning provide shared reference points that enable cities to adapt methodologies rather than starting from scratch. These tools include the NetZeroCities indicator framework, NetZeroPlanner, EMCD, scope 3 guidance, MEL guidance and outcome harvesting etc.

Reflexive framing of MEL as a living, adaptive system is increasingly visible, with cities revising indicators and methods iteratively and openly acknowledging uncertainties and data limitations. These developments offer promising foundations for future support.

3 Conclusions and outlook

The six cases of Stockholm, Zaragoza, Cork, Münster, Bergamo and Turin show that city-driven MEL is emerging as a central component of mission-oriented urban climate governance, rather than a peripheral reporting obligation. While starting points and trajectories differ, common features include: (i) anchoring MEL in Climate City Contracts and related plans, (ii) linking emissions trajectories with action portfolios and investments, (iii) using MEL as a mechanism for effective partnership building with the utilities, data provider or the private sector, and (iv) gradually expanding indicator frameworks to encompass co-benefits and distributional dimensions.

The comparative overview suggests that MEL systems are most effective when they are:

- (i) integrated into core management and budgetary processes, as in Stockholm and Münster;
- (ii) designed from the outset alongside action portfolios and investment plans, as in Bergamo and Turin;
- (iii) supported by appropriate digital and data governance infrastructures, as in Bergamo, Turin and Zaragoza; and
- (iv) treated as reflexive, adaptive systems that explicitly recognise uncertainty and support learning-by-doing, as all six cases increasingly do.

These features make MEL not only a tool for accountability but also a practical governance mechanism for steering complex transitions.

For the broader Mission Cities community, the experiences documented here underline the importance of investing in MEL as a governance capability. This includes resourcing dedicated teams and intermediaries, strengthening data infrastructures and interoperability, and institutionalising learning processes that connect MEL findings to decisions on budgets, planning and procurement. At mission and national levels, support is needed to develop proportionate methods for co-benefits and distributional metrics, to improve access to high-quality data for key indicators, and to align multi-level governance frameworks so that city MEL can more accurately reflect and influence the conditions for climate-neutral urban futures (Edmondson et al., 2025).

Looking ahead, further work could deepen comparative analysis across a wider set of Mission Cities, with particular attention to scope 3 emissions, just transition metrics and the role of private-sector data in city-driven MEL. Similarly, further work could help support cities bridge their MEL efforts on their pilots/demonstrators' implementation and the achievements of their CCC impacts with varying scales of interventions (city-wide vs. domain-specific).The six cases discussed here provide a rich foundation for such efforts, illustrating both the potential and the limitations of current MEL systems and offering concrete examples of how cities are transforming monitoring and evaluation into engines of learning and governance for climate neutrality.

4 City Cases: City-driven Monitoring, Evaluation and Learning (MEL)

4.1 Stockholm

4.1.1 City context

Stockholm is Sweden's capital and largest city, a political and administrative centre and the core of a fast-growing metropolitan region with more than one million inhabitants within the municipal boundary and over two million in the wider functional urban area (City of Stockholm, 2025a). As a service- and knowledge-based economy with relatively little heavy industry inside the city limits, Stockholm's greenhouse gas (GHG) profile is dominated by emissions from buildings, transport, waste and consumption rather than from large point sources in energy-intensive manufacturing (City of Stockholm, 2023a; Interview 1, 2026).

The city has articulated increasingly ambitious climate goals over several decades. The Environment Programme 2020-2023 set an overarching goal of a fossil-free and climate-positive Stockholm by 2040, underpinned by a emission budget capping cumulative emissions at 19 million tonnes of CO2-equivalent between 2020 and 2040 (City of Stockholm, 2020). Building on this trajectory, the 2030 Climate Neutrality Action Plan (2023), prepared within the EU Cities Mission and NetZeroCities framework, raised the ambition further by targeting a climate-positive city already by 2030 and a fossil-free city by 2040 (City of Stockholm, 2023a). This target was integrated into the Stockholm's new Environmental Programme (2024), which also includes four other climate goals, including consumption based emissions (City of Stockholm, 2024a). The budget complements the climate goal by describing the total volume of emissions in carbon dioxide equivalents (CO2e) that may be emitted on the way to achieving the goal. Stockholm's emissions budget 2024-2040 states that a maximum of 9 million tonnes CO2e may be emitted for the period 2024-2040. This is a raising of ambitions compared with the City's previous Climate Action Plan (City of Stockholm, 2024b).

Emissions within the city's territorial system boundary decreased from approximately 3.4 million tonnes CO2e in 1990 to an estimated 1.2 million tonnes CO2e in 2024, corresponding to a reduction in per capita emissions from 5.4 to about 1.2 tonnes (City of Stockholm, 2024). Achieving climate positivity by 2030 requires annual emissions to fall further to around 700,000 tonnes CO2e, combined with negative emissions of roughly 800,000 tonnes CO2e from a planned full-scale Bioenergy with Carbon Capture and Storage (BECCS) facility, yielding net negative emissions of about 100,000 tonnes CO2e by 2030 (City of Stockholm, 2023a).

The city's 2026 Budget embeds these long-term goals in a broader vision of "a green and fossil-free Stockholm leading a just climate transition" and explicitly links climate targets to welfare, equality and social cohesion (City of Stockholm, 2025a). The budget asserts that Stockholm must both meet and often exceed Paris Agreement commitments, positioning climate action as a core dimension of a fair city that "holds together" socially and economically (City of Stockholm, 2025a).

Stockholm's commitments are codified in both a national Climate City Contract 2030, negotiated through the Viable Cities programme with several Swedish government agencies, and a European Climate City Contract submitted through NetZeroCities and awarded the Mission Label in 2023 (City of Stockholm, 2023b; NetZeroCities, 2023). The national contract emphasises coordination between local and national levels, while the European contract stresses the link between municipal

governance, European support instruments and the mission target of 100 climate-neutral and smart cities by 2030 (City of Stockholm, 2023b; European Commission, 2021).

4.1.2 MEL as a governance mechanism in Stockholm

Monitoring, evaluation and learning (MEL) have gradually evolved from relatively narrow reporting tools into a central governance device connecting Stockholm's climate goals, budgets and organisational structures. In the 2030 Climate Neutrality Action Plan, indicators for MEL are presented as integral to the city's management system, being embedded in the financial budget and reported annually through an integrated management system to the City Council (City of Stockholm, 2023a). This aligns with reflexive MEL concepts developed in NetZeroCities research, which highlight MEL as a means of adaptive, participatory and mission-oriented governance rather than merely a compliance function (Edmondson et al., 2025).

Governance architecture and institutional set-up

Stockholm's MEL system combines several layers: (i) a city-wide GHG inventory aligned with the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories (GPC); (ii) a set of formal indicators embedded in the municipal budget and management control system; (iii) sectoral and project-level metrics used by departments and city-owned companies; and (iv) emerging "transformative indicators" aimed at capturing early changes in practices and relationships (City of Stockholm, 2023a; Interview 1, 2026; Interview 2, 2026). These elements are coordinated by a climate and environment unit that acts as a de facto MEL hub, while responsibility for data generation and implementation is distributed across the administration (Interview 1, 2026; Interview 2, 2026).

Transition arenas and organisational structure

The institutional context for MEL is shaped by Stockholm's transition governance architecture. In preparing the climate action plan and related impact pathways, the city convened approximately 15-16 thematic focus groups, each addressing key domains such as buildings, different aspects of transport, energy, food and city operations (Interview 1, 2026). Over the course of roughly one year, these groups followed a structured workshop process that began with open brainstorming about "what needs to happen" to reach climate goals, without initial constraints of budget or municipal mandate, and then gradually narrowed down to lists of actions considered feasible for the city or its companies to implement (Interview 1, 2026).

Participation in these focus groups was broad but primarily internal to city departments and city owned companies. Almost all municipal departments and city-owned companies participated in at least one group, meaning that operational staff, rather than only senior managers, contributed to defining impact pathways and candidate actions (Interview 1, 2026). Selected groups invited researchers or university partners to workshops on specific themes, but external stakeholders were not systematically embedded in the governance structure at this stage (Interview 1, 2026).

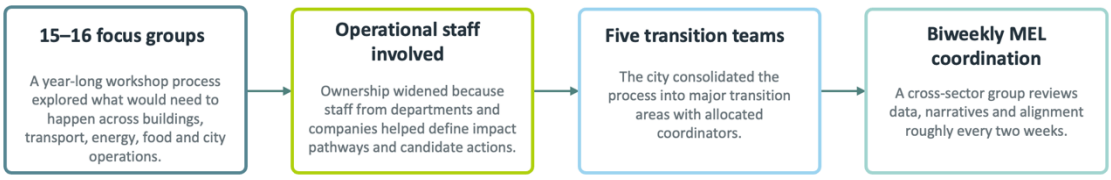

Figure 1 - MEL operationalisation process in Stockholm.

Following this design phase, the city consolidated the 15-16 focus groups into five transition teams corresponding to major emission and leverage domains: citizens' consumption, energy, transport, construction, and city operations (including procurement and internal activities) (Interview 1, 2026). Each transition team has designated coordinating personnel with allocated time, and these coordinators participate in a cross-sectoral MEL coordination group that meets roughly every two weeks to exchange information, review data and align reporting (Interview 2, 2026).

Leadership and strategic steering

MEL is anchored in the City Council's budget and in the Environment Programme, which together set climate targets and allocate responsibilities. The 2026 Budget assigns the City Executive Board responsibility for coordinating the implementation of the environmental programme and the climate action plan, including the transition areas "Acting for a fair and inclusive climate transition" and "Steering towards low-climate-impact consumption" (City of Stockholm, 2025a). It also tasks the Board with leading work on the Swedish and European Climate City Contracts, developing city-wide climate adaptation, and strengthening partnerships and pacts with businesses and civil society (City of Stockholm, 2025a).

The budget makes explicit the intention for Stockholm to be a "world leader" in reducing emissions and that environmental and climate goals must be integrated into welfare and equality policies (City of Stockholm, 2025a). It positions MEL not only as a technical instrument but as a means of ensuring "order and good governance" through strong economic control, transparent performance tracking and alignment of investments with climate and welfare priorities (City of Stockholm, 2025a).

Measurement architecture and data governance

Stockholm’s measurement architecture distinguishes between (i) formal indicators embedded in the municipal budget and integrated management system, (ii) GHG inventory indicators for the city as a geography and for the city organisation, and (iii) emerging “transformative indicators” intended to capture early signs of systemic change. Formal indicators typically concern quantitative variables such as electricity use, district heating consumption, emissions from food procurement, plastic use, and selected transport metrics, which departments and city companies report annually through a digital integrated management system (Interview 1, 2026).

For the city-wide GHG inventory, different subcategories (e.g. road transport, harbour, working machinery, water transport) are modelled using combinations of national statistics, the HBEFA road traffic model, and locally collected data on traffic volumes, fuel composition, and renewable shares.

The city emphasises methodological consistency over time to read trends accurately, while acknowledging significant uncertainties in some subcategories, especially working machines where data are generated by national models with long time lags and coarse municipal resolution.

Data governance is partly formalised through a written methodological guideline for climate calculations and the integrated management system that defines roles for reporting indicators at departmental level. Even so, there isn’t fully standardised cross-sector data governance frameworks for all MEL-related data flows. Consequently sectoral practices coexist, and the climate team must cross-check whether external partners have changed their methods since previous years (Interview 1, 2026).

Indicator architecture and data systems

Stockholm's MEL architecture makes a distinction between formal indicators, which are written into the budget and integrated management system, and a wider set of technical and experimental indicators used for analysis and project monitoring (Interview 1, 2026; City of Stockholm, 2023a). Formal

indicators are typically quantitative and include, among others, total and sectoral GHG emissions, district heating and electricity use, numbers and types of vehicles, numbers of public EV chargers, food-related emissions in municipal procurement, volumes of specific materials such as plastic, and selected climate adaptation or air quality metrics (Interview 1, 2026; Interview 2, 2026; City of Stockholm, 2025b).

Departments and city-owned companies are required to report annually on relevant indicators through a digital integrated management system, which is also used for broader Agenda 2030 and welfare indicators (Interview 1, 2026). For example, city operations report their electricity and heat consumption, waste volumes, food procurement emissions and plastic usage; these data are then aggregated at city level and used both for internal management and for external reporting to mechanisms such as CDP (Interview 1, 2026; Interview 2, 2026).

In parallel, the climate unit compiles a city-wide GHG inventory disaggregated by sub-sectors such as heating, electricity, road transport, working machinery, shipping and aviation (City of Stockholm, 2023a; Interview 2, 2026). Emissions from road transport, for instance, are estimated using the European HBEFA model, which combines road network characteristics, speed profiles and vehicle fleet composition with emission factors; Stockholm then calibrates the model using local data from the traffic department on vehicle counts and fuel types (Interview 2, 2026).

Heating-sector emissions have decreased by roughly 75% since 1990 due to reduced energy demand and a shift to renewable fuels, while emissions from electricity and gas use have halved as the Nordic electricity mix has decarbonised (City of Stockholm, 2023a). By contrast transport emissions have only fallen by around 15% over the same period, and represents a major remaining mitigation challenge (City of Stockholm, 2023a). These trends are reflected in the city's MEL focus: scopes 1 and 2 emissions from transport and energy are well tracked, whereas scope 3 emissions and consumption-based impacts remain less well quantified (Interview 2, 2026).

Scope 1-3 coverage and data gaps

Stockholm's MEL framework now covers scopes 1 and 2 comprehensively at the territorial scale and reasonably well for the municipal organisation, but scope 3 remains partial. Where indicators and robust data exist, attention and activity levels tend to be higher, whereas areas without verified numerical data rely more on qualitative descriptions that are more difficult to translate into strategic steering (Interview 2, 2026). This is evident for construction-related emissions, working machinery and household consumption, which together constitute a large part of the city's wider carbon footprint (City of Stockholm, 2023a; Interview 2, 2026).

For construction and civil engineering, the city increasingly demands climate-related requirements in procurement, including life-cycle climate criteria and environmental logging of materials through a Building Materials Assessment system (City of Stockholm, 2025b). The 2026 Budget sets city-wide indicators such as "Proportion of completed construction and civil engineering contracts where goods have been environmentally assessed and logged in the Building Materials Assessment" and "Proportion of procurements that contribute to circularity" (City of Stockholm, 2025b). Even so, the interviews highlighted that the city still lacks systematic data on quantities of high-impact materials like concrete and asphalt procured annually, limiting its ability to fully leverage procurement as a decarbonisation tool (Interview 1, 2026; Interview 2, 2026).

For working machinery, the city currently relies on national statistical models, which produce delayed and uncertain municipality-level estimates that are sufficient for covering all categories in the inventory but not reliable enough to discern local trends or the effects of specific interventions (Interview 2, 2026). In contrast, data for road transport and building energy use are considered relatively robust, albeit still dependent on consistent emission factors and model assumptions provided by national agencies such as the Swedish Energy Agency (Interview 2, 2026).

Consumption-based emissions, especially from household consumption, remain largely outside the current MEL system, beyond high-level references in the Climate City Contract and Climate Action Plan (City of Stockholm, 2023a; City of Stockholm, 2023b). Climate officials explicitly identify this as an area where new indicators and learning from other cities would be particularly valuable, alongside improved monitoring of climate-related aspects of city planning processes (Interview 2, 2026).

Indicators, co-benefits and distribution

Within the formal MEL system, quantitative indicators predominate because they fit well into the budget and management control logic and are perceived as more legitimate for political decision-making (Interview 1, 2026; Interview 2, 2026). Examples include targets for energy purchased by the city organisation (1,675 GWh in 2026, declining to 1,625 GWh by 2028), electricity production from solar energy (10.7-11.6 GWh), and the proportion of procurements that contribute to circularity (City of Stockholm, 2025b). These climate-related indicators sit alongside a broader set of welfare and governance indicators, such as co-creation indices for employees, procurement follow-up rates and job placements, illustrating how MEL is embedded in a holistic governance framework (City of Stockholm, 2025b).

Qualitative and narrative indicators nonetheless play an important role in Stockholm's MEL practice. Each year, all departments and city-owned companies submit qualitative reports describing what they have done in relation to various targets, perceived effects of their actions and emerging challenges (Interview 1, 2026). The environmental department synthesises this material into a strategic assessment of climate progress, identifying areas where activity is increasing, gaps remain or additional coordination is needed, even when precise quantitative effects cannot be attributed (Interview 1, 2026).

Recent work on "transformative indicators" in at least one urban development process seeks to better capture early signs of change (including shifts in organisational routines, cross-departmental collaboration or stakeholder engagement) that are not yet visible in emission statistics (Interview 1, 2026). This aligns conceptually with the reflexive MEL literature, which stresses the importance of tracking institutional and behavioural changes alongside material impacts (Edmondson et al., 2025). At the time of writing, however, these transformative indicators remain experimental and have not yet been systematised across the transition teams (Interview 1, 2026; Interview 2, 2026).

Co-benefits (i.e. health improvements, cost savings, enhanced comfort, or social inclusion) are acknowledged in Stockholm's climate discourse but are not consistently integrated into the core indicator set. Interviews noted that initiatives to reduce plastic use in preschools and elder care bring significant co-benefits: reduced exposure to harmful chemicals, increased comfort for elderly residents when plastic covers are replaced with textiles, and substantial cost savings when single-use products are reduced without compromising hygiene (Interview 2, 2026). Similarly, the establishment of a reuse centre for building materials, prioritised in the 2026 Budget, is expected to generate both climate and financial benefits (City of Stockholm, 2025b). Yet these co-benefits are often captured in separate indicators or narrative accounts rather than being systematically linked to climate MEL (Interview 2, 2026).

Use of MEL in decision-making and adaptive management

Integration with the budget and management system

The City of Stockholm has integrated environmental and climate objectives into its management system for more than two decades, and MEL is now firmly embedded in the annual budget cycle (City

of Stockholm, 2023a; City of Stockholm, 2025a). Each year, the City Council adopts a budget that includes a set of indicators for environmental, climate and governance goals. Committees and company boards are obliged to plan activities, monitor progress and report results against these indicators (City of Stockholm, 2025a, 2025b). Underperformance is visible through the integrated management system and may result in "red marks" that require explanation and corrective measures (Interview 1, 2026).

Figure 2 - Integration of MEL in Stockholm's budgeting process.

Climate staff describe how indicator data and narrative reports from all departments and companies are collected early in the year, synthesised into a climate assessment, and then used to inform both the evaluation of the Environment Programme and the drafting of the next budget's strategic priorities (Interview 1, 2026; Interview 2, 2026). This process creates an annual learning and accountability cycle, even if it is not formally labelled as such: evidence on trends and activities feeds into political deliberation, which then shapes new assignments, funding allocations and indicator choices (City of Stockholm, 2025a; Interview 2, 2026).

Policy assessment in key sectors

In the transport sector, MEL informs policy primarily at sectoral rather than individual-action level. The GHG inventory tracks emissions from road traffic, harbours and other modes, while additional indicators record trends in vehicle types, EV chargers, parking policies and modal shares (City of Stockholm, 2023a; City of Stockholm, 2025b; Interview 2, 2026). These data underpin efforts to tighten procurement requirements for transport services, for example by mandating fossil-free or fully electric vehicles in contracts and then attempting to monitor whether suppliers comply (Interview 1, 2026). Yet interviewees acknowledge that robust, systematic follow-up on contracted transport remains challenging, and that better data on vehicles and fuel use in procured services would substantially strengthen MEL's steering power in this area (Interview 1, 2026; Interview 2, 2026).

In construction and urban development, the climate action plan and budget identify decarbonising construction machinery, materials and processes as a major priority, given the significant share of scope 3 emissions associated with building and infrastructure projects (City of Stockholm, 2023a; City of Stockholm, 2025a). MEL supports this by tracking environmental logging of building materials, piloting reuse centres for construction materials, and gradually tightening procurement criteria for low-carbon concrete and asphalt (City of Stockholm, 2025b; Interview 1, 2026). However, the city is still in the early stages of linking these interventions to quantified emission outcomes, and climate staff highlight the need for more granular data on material flows to strengthen feedback loops (Interview 1, 2026; Interview 2, 2026).

The Climate Action Plan also emphasises the importance of monitoring progress towards intermediate targets such as an 80% reduction in transport-sector emissions by 2030 relative to 2010 and a 30% reduction in car traffic volumes relative to 2017 (City of Stockholm, 2023a). MEL plays a central role in tracking whether planned measures (including congestion charges, public transport enhancements, cycling infrastructure and eventual zero-emission zones) are sufficient to close the emission gap, but the action plan also underscores the dependence on national and EU policy changes for achieving these targets (City of Stockholm, 2023a; Interview 1, 2026).

Reflexive revision of indicators and methods

Stockholm's MEL practice exhibits elements of reflexive governance, especially in its approach to revising methods and indicator sets over time. The city recently replaced a long-standing local "Stockholm model" for emission calculations with an internationally recognised GPC-compatible method, simplifying communication and alignment with European mission requirements (Interview 2, 2026; City of Stockholm, 2023a). They also maintain a methodological guideline describing data sources, emission factors and calculation steps, while acknowledging that changes in upstream models and emission factors (including those provided by national agencies) can significantly affect reported emissions (Interview 2, 2026).

At the same time, officials are acutely aware that methodological changes can disrupt time series and complicate interpretation of trends and targets (Interview 2, 2026). As a result, substantial revisions to methods or emission factors are preferentially timed to coincide with the adoption of new targets, including the shift to climate positivity by 2030, so that trajectories can be recalibrated in a coherent way (Interview 2, 2026; City of Stockholm, 2023a). This illustrates a balancing act between improving accuracy and maintaining continuity for political accountability and public communication.

Learning, participation and communication

From a reflexive MEL perspective, learning is not only about technical improvements in data and methods but also about how the city uses MEL to question assumptions, coordinate actors and engage stakeholders (Edmondson et al., 2025). Stockholm's experience shows partial but not yet fully institutionalised progress on this front. Internally, the transition teams and MEL coordination group function as recurring spaces where data and narratives from different departments are compared, inconsistencies are discussed, and shared interpretations are developed; particularly when climate staff seek follow-up meetings with sector departments whose reports are unclear or incomplete (Interview 2, 2026).

Externally, the city communicates climate progress and challenges through several channels, including local newspapers, online dashboards like the environment barometer, and presentations in stakeholder pacts and networks (City of Stockholm, 2023a; City of Stockholm, 2025a). The 2030 Action Plan underscores the importance of making data transparent and accessible to citizens, so that progress towards climate neutrality is visible and can be scrutinised (City of Stockholm, 2023a). Even so, the available evidence suggests that citizens and civil society organisations are more engaged as recipients of information and participants in specific projects than as more active contributors, such as through co-creation or collective sensemaking and data interpretation processes (Interview 1, 2026).

Participation and multi-actor collaboration are more fully institutionalised in adjacent parts of Stockholm's climate governance, for instance through Environment and Climate Pacts with businesses, Electrification Pacts with transport actors, and strategic partnerships with universities including KTH Stockholm University and Karolinska Institutet (City of Stockholm, 2023a; City of Stockholm, 2023b). These arrangements provide opportunities for more reflexive MEL practices (i.e. co-interpretation of data, citizen science or joint definition of co-benefit indicators) but the current MEL system governance has only begun to tap this potential (Interview 2, 2026).

Outcomes and Impact

The outcomes of Stockholm's MEL system can be observed by looking beyond immediate emission trends to the ways in which MEL has reshaped governance processes. Integrating climate indicators into the city's budget and management system has helped increase transparency and created stronger incentives for departments and companies to align their activities with climate targets (City of Stockholm, 2025a, 2025b; Interview 1, 2026). The requirement to report both quantitative indicators and narrative accounts each year fosters a culture in which climate-relevant work must be documented and justified, rather than remaining invisible or discretionary (Interview 1, 2026).

MEL has also helped reveal systemic gaps and dependencies that were previously less visible. For example, the analysis of emission trends against the city's climate budget and 2030 neutrality target makes clear that current trajectories in transport and construction are insufficient without major policy and technological shifts, including electrification, behaviour change and the deployment of BECCS (City of Stockholm, 2023a).

At the same time, several potential avenues could further strengthen the MEL operationalisation to support city climate governance. First, sector-level quantitative indicators remain predominant. While these date points are necessary for high-level tracking and comparability, this level of granularity does not enable the city's to fully evaluate the effectiveness of individual measures, and could be complimented by further experimentation with more qualitative, process-based indicators at scale (Interview 1, 2026; Interview 2, 2026). Second, the integration of co-benefits, distributional impacts and justice considerations into MEL could be strengthened to avoid narrowing political debates about climate action to emission figures alone. While budget documents repeatedly stress the need for a "just climate transition" and for reducing socio-economic inequalities, additional indicators and data points could be developed and integrated to support planning and delivery of these objectives (City of Stockholm, 2025a; Interview 2, 2026).

Third, while Stockholm's MEL practice displays elements of reflexivity (such as workshops to identify desired indicators, methodological documentation and experimental transformative indicators) the learning function is still less formalised than monitoring and evaluation. Interviewees explicitly argue that more structured approaches are needed to translate MEL findings into revised strategies, to question whether existing pathways are sufficient, and to learn systematically from pilots and cross-city exchanges (Interview 2, 2026; Edmondson et al., 2025).

4.1.3 Conclusion and lessons learned

Stockholm's experience offers several lessons for other mission cities seeking to use MEL as a governance mechanism rather than only a reporting tool.

- Embedding climate indicators and narratives within the core budget and management system can significantly strengthen institutional commitment and accountability, provided that climate objectives are made visible alongside other political priorities. This reduces the risk that MEL remains a peripheral technical exercise detached from resource allocation and strategic steering.
- Broad internal co-creation processes (for example, the 15-16 focus groups that fed into the climate action plan and the subsequent transition teams) can generate more realistic and widely owned impact pathways, but they require strong central facilitation to reconcile overlapping proposals and to manage cross-sectoral dependencies and translate bottom-up

suggestions into politically acceptable commitments. MEL systems should therefore allocate explicit capacity for such facilitation and synthesis work, not only for data handling.

- Methodological transparency and consistency are crucial for maintaining trust in MEL outputs, and must be balanced against the need for improvement and alignment with international standards. Stockholm's shift to GPC-compatible inventories and its documentation of emission factors and data sources illustrate good practice, while its caution about changing methods only at key target-revision moments reflects a pragmatic compromise between rigour and continuity.
- Reflexive MEL requires more than trends in aggregate emission indicators. Cities need to invest in indicators and methods that can capture co-benefits, social and distributional effects, and early signals of systemic change, particularly in areas such as plastics reduction, circular economy and consumption-based emissions where climate and social objectives intersect. Stockholm's emerging work on transformative indicators and co-benefit-rich initiatives demonstrates the potential of such approaches but also their current underutilisation.
- MEL in mission-oriented governance must be understood as a multi-level instrument. In Stockholm, MEL not only informs municipal decisions but also documents where national policies and infrastructure constraints (for example, electricity grid reinforcement or standards for CCS and negative emissions accounting) limit local action. By making these dependencies visible, city-driven MEL can contribute evidence to national and European debates, thereby helping to realign higher-level frameworks with local climate neutrality trajectories.

Stockholm has developed a city-driven MEL system that is tightly integrated with its budget and management structures and aligned with both national and European Climate City Contracts. This system has supported substantial emission reductions, clarified remaining gaps to climate neutrality, and strengthened internal accountability for climate-related actions. At the same time, it faces ongoing challenges around scope 3 coverage, co-benefit integration, action-level evaluation and the institutionalisation of learning. For other mission cities, Stockholm's experience underscores that MEL can be a powerful governance mechanism for climate transitions when it is treated not merely as a reporting requirement but as a reflexive, multi-level and justice-oriented process of monitoring, evaluation and learning.

4.2 Zaragoza

4.2.1 Background Information

Zaragoza is the capital of the autonomous community of Aragon and one of Spain's largest cities, with a population of around 700,000 inhabitants in the metropolitan area.

The city is also known for its rich cultural heritage, exemplified by landmarks such as the Basilica of Our Lady of the Pillar.

In April 2022, was selected by the European Commission as one of the '100 Climate Neutral and Smart Cities', a recognition that opens the door to new European collaborations and support to reach the goal climate neutrality by 2030.

This case study presents the pathway towards advancing their Climate Neutral Mission journey and highlights their learnings, as well as their continued commitment to learning and reviewing their progress, reflected in the First Iteration of the Zaragoza Climate City Contract (CCC).

Geographic and Demographic Context

The broader **metropolitan area of Zaragoza** (urban and commuter belt) is estimated at approximately **745,000 people in 2026** (ongoing small annual growth). This metropolitan figure includes nearby towns and suburbs closely linked economically and socially to Zaragoza's urban core.

Age distribution within the municipality, according to the latest age structure figures for Zaragoza city (INE 2025 base):

- Ages 0-17 (youth): ~111,297 residents
- Ages 18-64 (working-age): ~429,426 residents
- Ages 65+ (elderly): ~158,284 residents

The city serves as an important economic and logistical hub in northeastern Spain, thanks to its strategic position between major cities. The local economy is diverse, with key industries including manufacturing (notably automotive, with the Opel plant in Figueruelas), logistics, agriculture, and a growing services sector.

It lies within the Ebro Valley, along the banks of the Ebro River, the longest river entirely within Spain. This central position has historically made Zaragoza a key crossroads for trade, transport, and communication.

The geographical boundary for its climate neutrality target covers the entire municipal area, encompassing 974 km².

Zaragoza institutional declaration of commitment to advance the objective of reducing emissions by 50-55 % by 2030 compared to baseline levels, is reflected in the city council's central climate strategy

is the *Estrategia de Cambio Climático, Calidad del Aire y Salud de Zaragoza (ECAZ 3.0) 2030*[2], approved on 26 April 2019. This strategy integrates climate mitigation (reducing greenhouse gas emissions), air quality improvement, and public health protection with the United Nations Sustainable Development Goal 13 (Climate Action) and was developed through broad technical and social participation. It also reflects

Zaragoza's city council is formally committed to several climate and sustainability initiatives, including:

- *Pacto de las Alcaldías por el Clima y la Energía* - joining this European initiative to align local policies with EU climate goals.
- Community *#PorElClima* membership - a national initiative uniting local authorities and organizations in climate action aligned with the Paris Agreement.
- A sequence of municipal declarations and agreements recognizing climate change urgency (e.g., *Declaración Institucional frente al Cambio Climático in 2019*), as well as joining urban sustainability pacts and urban food system commitments.

In April 2022, Zaragoza was selected by the European Commission as one of the '100 Climate Neutral and Smart Cities', a recognition that opens the door to new European collaborations and support to reach the goal climate neutrality by 2030. The municipal government also has a dedicated Office for Environment, Climate Action and Public Health to coordinate policy implementation and interdepartmental governance. The city submitted its Climate City Contract in 2023, *Original CCC hereafter*, and in 2025 developed the First Iteration to its Climate City Contract (CCC), *CCC- First Iteration hereafter*, which incorporate learnings and new approaches to speed up the climate neutral journey.

Economic Activity and Key Indicators

Regional GDP per capita: The autonomous community of Aragon, which includes Zaragoza, had an estimated GDP per capita of €36,7K in 2024, placing it above the Spanish national average (Approx. € 32,6K) and among the higher-income regions of Spain.

Number of Businesses & Business Density: according to the latest municipal economic indicators from the Ayuntamiento de Zaragoza, there were approximately 42,897 registered businesses in Zaragoza's municipality in 2025. To approximate businesses per 1,000 residents: with a ~693,000 population in 2025, this is about 62 businesses per 1,000 people. (This excludes non-market public bodies not covered in the business register and focuses on active enterprises per INE data.)

Types of Businesses / Key Industries: Zaragoza's economic landscape is diversified, with several strong industrial and service sectors reflecting both historical specialization and modern development:

- **Manufacturing and industry:** Particularly automotive (e.g., Opel plant and component supply chains) and related manufacturing sectors (machinery, appliances, textiles, paper & packaging).
- **Logistics and transport:** The city's hub position in northeast Spain makes it a major logistics node, anchored by the Plataforma Logística de Zaragoza (PLAZA) and extensive road/rail connectivity.

[2] https://www.zaragoza.es/contenidos/medioambiente/ecaz/ECAZ30_WEB03102019.pdf

- **Services:** Includes professional/business services, retail, tourism and hospitality, education, finance, and ICT (information and communications).
- **Agriculture and agro-industry:** While agricultural businesses are a small share within the city, the surrounding province has a significant agro-industrial economy (e.g., cereal, viticulture, food processing).

Employment Distribution by Sector:

The employment structure in Zaragoza municipality, according with from municipal statistics, indicates the following approximate distribution among its major sectors:

- **Services:** concentrates 82.2 % of employment, the dominant employer in the city.
- **Industry:** gathers 12.2 %, significantly higher relative to many other major Spanish cities, reflecting strong manufacturing presence.
- **Construction:** represents 4.8 %, roughly similar to other large Spanish cities.
- **Agriculture:** Very small share within the city core, with **0.54 % of establishments** dedicated to it, consistent with urban economies where agriculture is primarily rural/provincial rather than metropolitan.

Climate Neutrality Mission and Climate City Contracts Objectives

Zaragoza has recently submitted the first iteration of their CCC, which review and further develop the city commitments towards climate neutrality. The main defined objective is to achieve an **80% reduction in emissions by 2030** (compared to the maintenance of the current circumstances or business-as-usual case), reinforcing the goal set in the Original CCC, leveraged on the decarbonisation potential of key sectors of activity. This will lead to a systemic transformation of the city.

According to the Zaragoza GHG inventory by sector, the main contributors are the following sectors: buildings (26.1%), transport (28.5%), industry (36.7%), and institutional and services (3.4%).

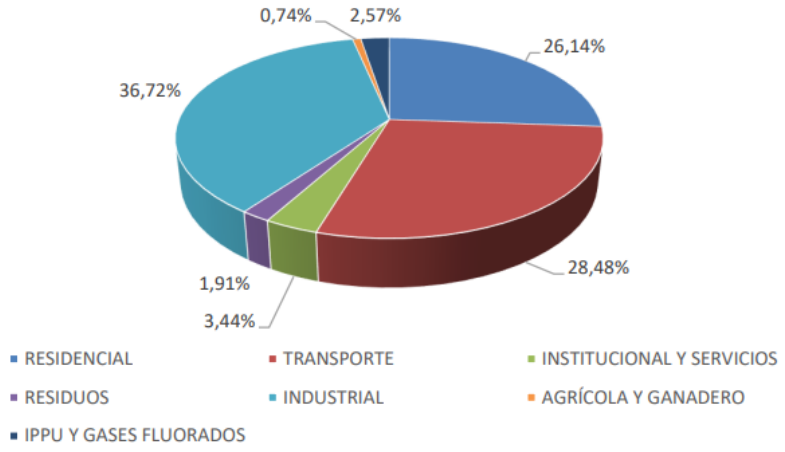

Figure 3 - Distribution of gross greenhouse gas (GHG) emissions by sector in 2023.

Source: Zaragoza Emissions' Inventory, year 2023.[3]

Accordingly, in the city original CCC the four sectors having the greatest decarbonisation potential are identified as follows:

1. Transport
2. Buildings and heating
3. Electricity generation
4. Waste

As per the *CCC - First Iteration*, it is estimated that these four sectors can jointly achieve the **80% reduction of total emissions.** According to the economic case developed for the city in the framework of this Agreement, the actions planned in the city, aimed mainly at these four sectors, would **mean a reduction of 1,474,000 tons of carbon dioxide emissions until 2030**[4].

The analysis of strategic priorities led to the definition of three main pillars - as per the Zaragoza Original CCC - which represented the city's strategic priorities for emissions reduction: (1) sustainable and smart mobility; (2) re-naturalisation and the circular economy; and (3) energy efficiency and renewable energy. Building on this, the CCC -First Iteration, October 2025, refine these priorities and expand them into five key pillars, as follows:

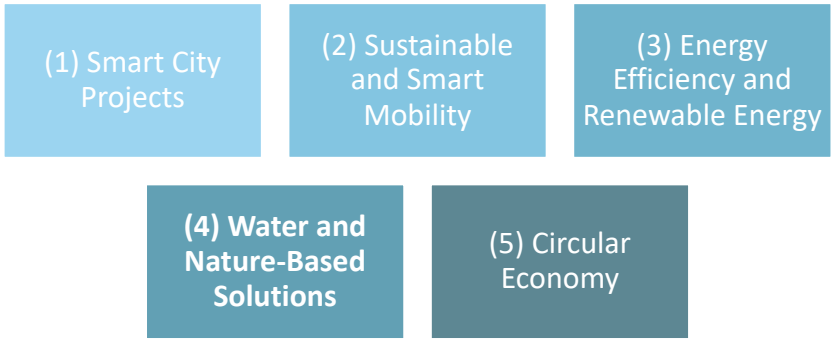

Figure 4 - Zaragoza five key pillars to emission reductions. CCC-First Iteration. Oct 2025.

The Zaragoza Action Plan reflects these priorities, and specific measures are indicated, such as transport electrification, energy efficiency in buildings and heating decarbonisation, shift to renewable electricity generation. Mitigation measures are combined with other re-naturalisation and circular economy strategies to achieve the city emissions targets.

[3] Zaragoza Emissions Inventory, 2026.
[4] "These total emissions are calculated based on the aggregation of expected reductions through a series of levers for action." Zaragoza CCC First Iteration. October, 2025.

Some of the initiatives summarised in the **CCC First Iteration** that address the five defined pillars are as follows:

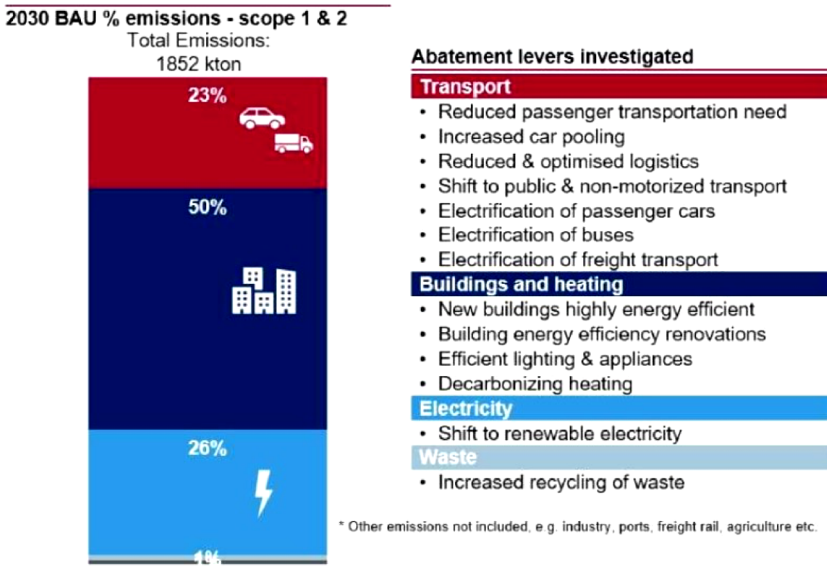

Figure 5 - The Action Plan subsectors target 99 per cent of total Scope 1 and 2 emissions.(Source Zaragoza CCC - First Iteration)

Pillar	**Key Actions & Measures**	**Impacts / Outcomes**
1. Smart City Projects	• EU-funded innovation projects (NEUTRALPATH, INCUBE, CHRONICLE) • Development of energy-positive districts and smart neighbourhoods • Multi-stakeholder governance (public, private, citizens)	• Improved efficiency and data-driven urban management • Enhanced sustainability and innovation capacity • Stronger collaboration for climate neutrality
2. Sustainable & Smart Mobility	• Electrification of public transport (buses, taxis) • Charging infrastructure (depots + public points) • Financial incentives for zero-emission taxis • Optimisation of urban logistics	• ~274,000 tCO_2/year reduction • Better air quality and lower noise • Increased walking and cycling • Reduced travel demand (proximity, teleworking)
3. Energy Efficiency & Renewable Energy	• Retrofitting 25,000 homes • Replacement of fossil-fuel heating systems • Renewable energy communities and solar installations • Industrial energy communities (MercaEnergy) • “Balsas Positivo” project • Energy-positive districts	• ~780,000 tCO_2/year reduction (largest impact) • Reduced energy consumption • Lower energy poverty • Improved housing quality
4. Water & Nature-Based Solutions	• El Bosque de los Zaragozanos (1,000 ha, 700,000 trees) • Huerva River restoration • Green infrastructure strategy	• Carbon sequestration • Increased biodiversity • Improved public health • Reduced flood risks • Enhanced climate resilience
5. Circular Economy	• Circular Biochar project (industrial-scale biorefinery) • Treatment of ~1/3 of organic waste • Reuse of organic waste (e.g., compost/biomass)	• ~700 jobs created • Waste-to-resource systems • Increased circularity • Synergies with nature-based solutions

With an **initial investment estimated at 3,925 million euros between 2020 and 2030** (corresponding to 6,887 euros per capita), benefits of 6,223 million euros are projected between 2020 and 2050. Specifically, the economic case analysed shows a return on investment (ROI) of 59%.

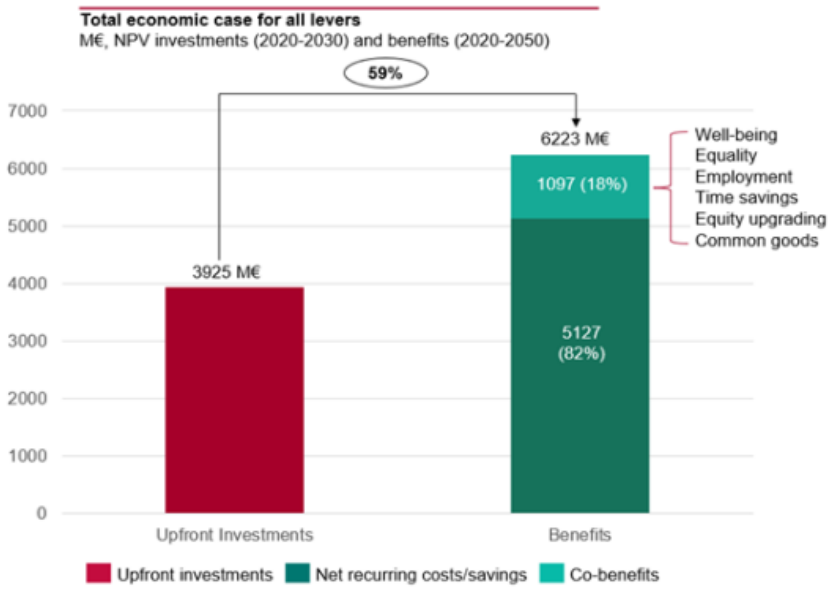

Figure 6 - Conclusions of the economic case for the city of Zaragoza (Source: Zaragoza CCC: First Iteration).

According to the Investment Plan, presented as part of the Original CCC, the following actions are presented to attract companies to create jobs and attract investments towards the climate initiatives and aligned with the city climate commitments of systemic transformation towards net zero:

- **Economic Output and Investment:** The city has a "Fiscal Plan for Investment Attraction," which has facilitated nearly **€1 billion in private investment** in the medium term.
- **Employment:** New investments from groups like Saltoki, Becton Dickinson, and Quirón are expected to create more than **2,500 direct jobs**.

Major business and industrial sectors of the city, including **automotive** (e.g., Stellantis, Dana Automoción), **logistics** (e.g., Zaragoza Logistics Center, Carreras), and **agri-food** are larger contributors to these figures.

MEL framework and indicators (from CCC Action Plan and Investment Plan)

The MEL framework defined in the Zaragoza's Climate City Contracts is established as a dynamic and iterative process designed to review and adjust commitments, actions, and investments needed to reach climate neutrality. It will be mainly based on measurable and verifiable climate action planning based on Zaragoza's baseline inventory of greenhouse gas emissions. Data is treated as something public and open to all citizens, focusing on being structured and shared across.

In the CAP, the Comprehensive Indicator Sets developed by NetZeroCities[5] is used to develop the MEL framework for the Original CCC. These are categorized by outcomes and impacts across the pre-defined city's *three* priority pillars, as per the Original CCC definition: Sustainable Mobility, Energy/Efficiency, and Re-naturalization/Circular Economy. In the MEL framework specific target values are set for 2025, 2027, and 2030 for diverse metrics, such as the percentage of bus fleet electrification (100% by 2030) and the annual building renovation rate (4% target). Beyond direct GHG reductions, the MEL process tracks indirect positive impacts resulting from the climate action, called co-benefits).

The CCC First Iteration includes additional indicators on co-benefits in the MEL framework, accounting for the improved air quality, public health, social inclusion, innovation, and job creation in the city. Identifying and evaluating them properly is key to gaining political and social support for climate neutrality, as they demonstrate that this transition not only protects the environment but also improves quality of life.

Additionally, in the CCC-First Iteration, co-risks are also included, monitoring possible negative effects on the initiatives, such as job losses or increased cost of living, to ensure a fair and sustainable transition.**Fourteen impact pathways of the city come from the Economic Model**, which has been elaborated with the support of the Spanish National Platform, CitiES2030.

In the CCC - First Iteration, indicators metadata were included, accounting for the evolution on indicators that inform the impact pathways defined. Data on daily temperature (Average daily maximum temperature (TXX), air quality indicators - such as PM10 concentration levels, NO2 concentration levels, PM2.5 concentration levels; data on noise pollution such as *Percentage of population exposed to day-afternoon-night noise levels (Lden)* 55 dB; on city infrastructure such as *Green Spaces*; on transport and energy consumption. This enrich the city robust and comprehensive MEL framework.

The Investment Plan attached to the Original CCC, relies on the framework of Economic Model for Cities' Decarbonisation (EMCD), used by cities joined to the Spanish Mission Platform, citiES2030. The model uses a life-cycle approach to assess the economic viability of different decarbonization strategies, taking into account upfront cost and also recurring costs and benefits of each option over its lifetime. Decarbonisation costs, such as cost of renewable energy deployment, the cost of energy efficiency measures and the cost of changes in transport systems, are also integrated.

Aligned with the actions defined in the CCCs, Zaragoza defined financial indicators to account for the costs (CAPEX, OPEX) , co-benefits NPV, Return on Investment (ROI), to estimate total investment per kton CO2e reduction NPV.

Complementary to the financial estimates, the city defined a framework for policies to enable capital deployment. This is a comprehensive approach to address financial markets decisions, and create favourable conditions to develop funding mechanisms to implement the initiatives defined in the CCCs.

[5] The Indicator Framework, methodology defined by NetZeroCities, describes a set of indicators for monitoring the impact of Climate City Contracts (CCC) in terms of: 1) Required Indicators: Direct Benefits - Impact on GHG emissions. and 2) Recommended Indicators: Co Benefits/ Co Risks - Indirect impact. NetZeroCities Comprehensive Indicator Framework.

4.2.2 City MEL processes and application

The following sections are based on information from the original and first-iteration versions of the Zaragoza Climate City Contract, as well as an interview conducted with key representatives of the City of Zaragoza who have played an important role in defining, implementing, and monitoring the city's climate commitments and projects. The interview included representatives from the following institutions:

- City Council Environment Office, which co-leads the Climate Neutral Mission within the municipality alongside the Directorate-General for Funds, building on many years of work in environmental planning. It oversees key initiatives linked to the Covenant of Mayors, including emissions inventories, mitigation and adaptation plans, and energy poverty strategies, as well as the development and monitoring of indicators for municipal environmental strategies.
- The European Funds Office of the Zaragoza Municipality, with a role of coordinating the Climate Neutral Mission from an organizational perspective, ensuring that projects across all municipal departments contribute to the city's climate commitments. The technical aspects of the Climate City Contract are led by the Environmental Office, in collaboration with the Circe Foundation.
- Circular Economy Group at Circe, a technology centre, that has been collaborating with the city council for many years on various initiatives and supported the city with technical assistance on the Climate City Contract development.

Processes/Collaboration in design and operationalisation of MEL

The participatory process used to define the indicators for Zaragoza's Climate Contract is rooted in a long-standing tradition of inclusive planning and stakeholder engagement within the city. Rather than being developed from scratch, the indicators build on a solid foundation of previous strategies and plans-such as the Green Infrastructure Plan, the Air Quality, Climate Change and Health Strategy, and the Climate Adaptation Plan (approved in 2023)-all of which were developed through comprehensive participatory processes. These earlier initiatives had already established clear objectives, impacts, and associated indicator systems, which provided the basis for the current framework.

The defined structural participatory processes, aims to involve citizens in decision-making and in the implementation of public policies, in order to achieve a fairer and more sustainable city. In the field of citizen participation, Zaragoza has promoted the creation of various mechanisms for consultation and dialogue with citizens, through the creation of sectoral councils and the holding of popular consultations.

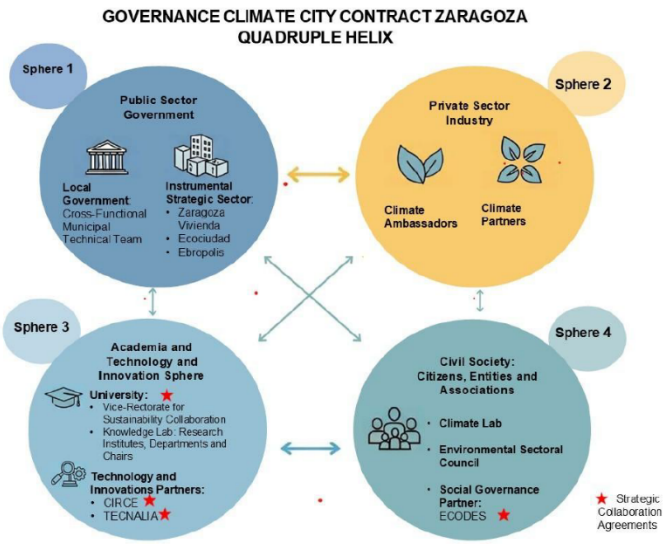

Figure 7 - Governance Climate City Contract Zaragoza. Quadruple Helix Approach. (Source: Zaragoza CCC - First Iteration - Annex. Part C).

With Zaragoza's participation in the Cities Mission, this existing foundation was further developed and systematized through an evolving governance model based on the quadruple helix approach. This model brings together public administration, academia, the private sector, and civil society, aiming to structure participation in a more integrated and consistent way. While stakeholder engagement had already been present in earlier processes, the current approach seeks to formalize and strengthen these interactions. Traditional participatory bodies, such as the City Environmental Sectoral Council, continue to play a role, but are now complemented by more systemic approaches, including the introduction of innovation labs and new communication strategies tailored to different audiences.

A key element in the definition of indicators has been the active involvement of all municipal departments. Indicators were co-developed through internal collaboration across the different areas of the city council, ensuring alignment with existing projects, policy priorities, and operational realities. This process was closely linked to the city's strategic priorities within the Climate Mission, which are structured around ***five main pillars***[6]. For each of these pillars, specific indicators were identified to measure progress. For example, in the area of mobility, indicators include reductions in motorized transport and the electrification of public buses. This collaborative approach ensures that indicators are both relevant and feasible, reflecting the practical implementation of ongoing initiatives.

"…within each of these pillars, the areas were defined-that is, by involving all departments of the city government and, of course, taking into account all the projects that were already underway…"

The participatory process also extends beyond the initial definition of indicators into their ongoing monitoring and evaluation. Regular coordination meetings - held annually or biennially - bring together

[6] See in Section 1:
Climate Neutrality Mission and Climate **City Contracts Objectives** .

the relevant municipal departments to review progress, assess the implementation of projects, and address any delays or budgetary constraints. This iterative process allows the indicator framework to be continuously refined and adapted to changing circumstances.

Finally, many of the indicators included in the Climate Contract are derived from pre-existing systems, particularly those developed under earlier strategies such as the Air Quality, Climate Change and Health framework. These indicators have been incorporated into the Climate Mission and adjusted to reflect current needs and conditions. As a result, the participatory process can be understood as both direct and indirect: while new forms of collaboration and governance have been introduced, a significant portion of the indicator framework is the outcome of previous participatory efforts.

Measurement and Monitoring

Zaragoza's monitoring approach is built around **a yearly or biennial review process**, through which the city periodically assesses progress across its climate commitments. To support economic decision-making, the city has employed the **Economic Model City's Decarbonization (EMCD)** to evaluate the life-cycle costs and economic viability of decarbonization strategies, ensuring that monitoring is linked not only to environmental outcomes but also to financial feasibility.

The indicator set originated largely from prior municipal strategic plans, which already incorporated monitoring frameworks. These were compiled and adapted to fit the **Climate City Contract (CCC) framework**, with the European Conservation Agriculture Federation (ECAF) serving as a primary methodological reference. The city has currently finished its first iteration phase, updating indicators to better reflect its current state and policy priorities.

Beyond sectoral indicators, Zaragoza has also started to track **co-benefit indicators**, which capture broader impacts such as energy poverty and urban greening. However, city officials noted that social indicators pose particular challenges: they require robust definitions, sound methodologies, and reliable data sources before they can be systematically monitored. By contrast, more technical indicators - such as per capita emissions or public transport usage - are comparatively straightforward to obtain, as they rely on well-established data collection processes.

Data Governance Practices

Zaragoza operates under an **Open Government Platform** guided by "Data Government" principles, treating data as a **public good**. Data is structured, interoperable, and geo-referenced, enabling integration across different municipal systems and indicators. All compiled data is publicly accessible through the municipal platform, allowing citizens, researchers, and civil society organizations to consult it freely. One recognized limitation in current governance practices concerns **social indicators**, where data protection regulations and methodological gaps restrict availability and comparability - a challenge the city is actively working to address in its ongoing indicator revision process.

Additionally, **universities and research institutions** make active use of the city's open data, contributing to its broader analytical value. This has resulted in collaborative outputs such as emissions inventory maps published on the municipal website, which link emissions data to other urban indicators like the percentage of green areas.

Recently, data governance is being primarily worked out through the **IPPCP (Intelligent Private-Public neutral Carbon Platform)**[7] project, a European initiative running until August 2026. Its core objective is to establish a **public-private partnership for climate data governance**, with a focus on systematizing industrial emissions recording, projecting to expand it to other sectors soon. The platform is designed to allow companies to input their emissions data directly, streamlining reporting processes while simultaneously satisfying the requirements of multiple frameworks such as the Cities Mission, the Covenant of Mayors, and the CDP (Carbon Disclosure Project)[8].

Ownership and privacy rights are explicitly considered within this framework, particularly as industrial actors are invited to contribute proprietary emissions data. The city is therefore navigating a tension inherent to open data principles: maximizing transparency and interoperability while respecting the data privacy and property rights of participating companies. Data dissemination is built into the platform's design, balanced against the protection of data privacy and intellectual property rights.

"…to improve this entire process-both from a technical standpoint and in terms of transparency, visibility, and awareness-and, above all, to foster participation and co-creation from the outset with the industrial sector and all the various stakeholders and actors involved…"

Indicators and Metrics

Zaragoza has established a comprehensive indicator framework with defined targets at three-time horizons: **2025, 2027, and 2030**. These indicators span multiple sectors and are embedded within the Climate City Contract (CCC) framework, which was developed iteratively with the support of the **Spanish National Platform citiES2030**. The emissions inventory, a core component of the monitoring system, is revised and updated annually, while other indicators - such as air quality data collected through local monitoring stations - are updated on a more frequent but non-continuous basis.

Concrete quantitative targets illustrate the commitment to decarbonization: the city aims to **electrify 100% of its public bus fleet by 2030**, achieve a **4% annual building renovation rate**, and source **85% of its electricity from renewable energy**. These targets translate high-level climate commitments into measurable, sector-specific milestones.

The CCC iteration process has allowed Zaragoza to refine and update these indicators to better reflect its current priorities and operational capacity. Notably, the incorporation of **energy poverty** as a tracked indicator represents a recent advancement, enabled by the development of a dedicated strategic plan on the issue - though officials acknowledged it is still too early to assess the full monitoring challenges it will present.

Co-benefit indicators were also formally incorporated during the CCC iteration process and cover a range of **environmental, economic, and social dimensions**, including air quality, health outcomes, job creation, and financial returns.

The availability of co-benefit data, however, has been uneven. Some indicators were relatively straightforward to obtain because they aligned with existing workstreams - air quality indicators, particularly ozone measurements, are a clear example, supported by local monitoring stations. Others, such as **temperature-related indicators**, proved more elusive and required methodological

[7] https://www.zaragoza.es/sede/portal/ippcp/en/
[8] Carbon Disclosure Project.

adaptation to use available proxies in a representative way; these also demand constant surveillance given their variability.

A third category of co-benefit indicators could not be sourced at all in their intended form and had to be substituted or dropped. The **average income indicator** is a notable case: the Spanish National Institute of Statistics (INE) does not disaggregate income data at the level of granularity needed for medium-sized cities, leaving a gap that has yet to be resolved.

"…Data is key to decision-making. That is why we must prioritize obtaining high-quality data and providing it to the administration…"

Looking ahead, city officials pointed to promising developments at the national and European level that could strengthen co-benefit monitoring capacity. Initiatives such as the **Copernicus** European satellite project and the Spanish Ministry's **Respire** project - which measures greenhouse gas and methane emissions - may eventually offer access to more granular local data, though officials remained cautious about the timeline for their applicability at the city level.

Balance of Quantitative and Qualitative Indicators

City officials openly acknowledged that the indicator of the **CAP** framework is **skewed toward quantitative data and in the IP framework, there are not qualitative indicators considered**. This is described this as a difficult but deliberate trade-off. Quantitative indicators are generally easier to obtain, more standardized, and frequently mandatory under regulatory frameworks. The building retrofit sector illustrates this dynamic well: energy efficiency certificates are legally required in all renovation projects, making energy performance straightforward to track, whereas quality-of-life certifications are not mandated and would impose disproportionate administrative burdens with no regulatory obligation.

Qualitative indicators, by contrast, typically rely on **surveys**, which must be repeated periodically and carry significant economic costs. This makes systematic inclusion difficult, particularly within resource-constrained municipal contexts.

The challenge is also sector dependent. Measuring the impact of **decarbonization activities** - which produce direct, traceable emissions reductions - lends itself naturally to quantitative assessment. However, activities such as **urban re-naturalization** generate impacts that are more experiential and wellness-oriented, making them inherently harder to quantify. Officials noted that such impacts are subjective and not easily traceable through conventional metrics.

One pathway being explored to partially bridge this gap is the use of **health indicators** - for instance, data on physical and mental health outcomes - which can serve as indirect proxies for quality of life and help capture dimensions that purely technical indicators miss.

Use/Application of MEL Processes

Zaragoza's MEL system serves a dual temporal purpose: in the **short term**, it enables the city to monitor the implementation of projects and course-correct when actions deviate from intended outcomes; in the **long term**, it helps determine which initiatives merit continued investment and institutional support. Officials emphasized that indicators are not merely reporting instruments - they actively **encourage public policies to stay on track** with their overall climate objectives.

Monitoring findings directly feed into the revision and adjustment of actions and investments. This creates a **feedback loop between evidence and planning**: if pre-defined indicators tied to the city's five strategic pillars were not demonstrating progress on emissions reduction, the city would be compelled to recalibrate its approach and redirect resources accordingly. As officials noted, the

current focus on energy efficiency, self-consumption, building retrofitting, sustainable mobility, electrification of public transport, and digital transformation reflects precisely the kind of data-informed prioritization that the MEL system is designed to support.

Decision-making authority over priorities rests with the **mayor's office,** alongside continuing projects led primarily by the urbanism department. These priorities are further shaped by the **annual budget cycle**, which officials highlighted as a concrete expression of political commitment to climate neutrality - a signal that MEL outputs have genuine institutional weight rather than being treated as a compliance exercise.

"…Of course, Zaragoza's commitment-as reflected in the city council's budget-is focused on supporting all these pillars that were already outlined in both the climate contract and the iteration. These are the areas that have the greatest impact on decarbonization. And then, of course, there's the added focus on a just transition…"

The hierarchy of indicators used for decision-making follows a clear logic: **emissions reduction indicators** are considered the most fundamental, as they directly reveal whether the city is achieving its core climate objective, across which sectors, and at what pace. These are then complemented by **economic indicators**, which help operationalize decisions about where and how to act. Finally, **cross-sectoral indicators** - such as those related to energy poverty or air quality - add a layer of contextual intelligence, capturing indirect and spillover effects of climate actions across multiple domains.

Accessibility and Use of Data Sources (Including Addressing Gaps)

A key conceptual distinction raised by city officials concerns the difference between **emissions** and **immissions** - the former referring to pollutants released at source, and the latter to the concentration of pollutants present in the ambient environment. Officials stressed the importance of monitoring both separately, as conflating them can lead to misleading interpretations of progress and misguided policy responses.

Data accessibility varies considerably across indicator types. Technical and sectoral indicators - such as per capita emissions or public transport usage - are generally well-established and obtainable, even if they require analytical processing. More socially oriented indicators, including those related to energy poverty or quality of life, present greater challenges due to data availability constraints, methodological complexity, and, in some cases, data protection restrictions.

Particularly in the context of **building retrofitting**, MEL data has been identified as especially valuable. Given the intersection between building energy performance and energy poverty, monitoring indicators in this sector can simultaneously track decarbonization progress and flag social vulnerability - enabling more targeted and equitable resource allocation. Prior to the CCC framework, all relevant actions were financed through external sources; the institutionalization of MEL has supported the transition toward internally budgeted, strategically prioritized investment.

Use of Real-Time Monitoring and Digital Tools

Zaragoza has invested in advanced digital tools to enhance the precision and scope of its monitoring capabilities. The city uses **high-precision satellite technology and multispectral imagery** to monitor carbon sequestration in urban forests and identify **urban heat island** phenomena - applications that go beyond conventional emissions tracking and extend MEL into the domain of nature-based solutions and climate adaptation.

For more conventional indicators, local air quality monitoring stations provide regular data updates, offering a degree of near-continuous surveillance for atmospheric indicators such as ozone levels.

However, officials noted that this does not constitute fully **continuous monitoring** across the board, and many indicators remain dependent on periodic data collection rather than real-time feeds.

Learning and Adaptation

Processes for Revising Indicators and MEL Frameworks Based on Feedback

Zaragoza's approach to learning and adaptation is anchored in the conception of its Action Plan as a **"living document"** - one that is subject to regular revision in response to socio-economic evolution, new evidence, and shifting policy contexts. This framing institutionalizes adaptability as a core feature of the MEL system rather than treating it as an exceptional response to failure.

The revision of indicators is an ongoing process. The city has currently finished the first iteration **of the CCC**, through which indicators are being updated to better reflect the city's current operational state and emerging priorities. This iterative cycle ensures that the monitoring framework does not become static or misaligned with the realities it is meant to track. Officials confirmed that if indicators tied to the city's strategic pillars were not demonstrating meaningful progress on emissions reduction, the city would be compelled to recalibrate its direction - underscoring the direct link between monitoring outputs and planning adjustments.

Citizen and civil society feedback is formally channeled into municipal planning through the **Environment Sector Council**, which acts as a consultative body connecting associative and community perspectives with decision-making processes. This mechanism provides an institutionalized pathway for qualitative, bottom-up input to complement the quantitative data streams that dominate the MEL framework.

Incorporation of New Evidence into Existing Systems

A recurring theme in Zaragoza's learning process is the challenge of **data granularity and source diversity**, which shapes how new evidence can be meaningfully incorporated into the MEL system. Data sources vary significantly by indicator type: some are locally generated - such as water consumption figures or public transport usage - while others, such as air quality measurements, are produced by the city's own monitoring stations. However, a third and more problematic category encompasses indicators that require data from **regional or national sources**, such as energy poverty-related metrics, where the city has limited direct control over data collection and faces challenges of extrapolation and comparability.

A particularly illustrative case is **building retrofitting in privately owned properties**. While data on public buildings is managed by *Zaragoza Vivienda* - which systematically compiles emissions reductions, energy efficiency measures, and renovation records - data on private buildings remains difficult to access. A similar gap exists for **heating system decarbonization**, where the city must often rely on regional or national aggregates rather than local measurements, reducing the precision and policy relevance of the resulting indicators.

Data protection constraints add a further layer of complexity. In some cases, such as electricity consumption, the city cannot disaggregate data to identify what share stems from energy efficiency improvements. As a result, officials must **estimate and self-adjust certain data measures** - a practice that, while pragmatic, introduces uncertainty. Officials were clear that the fundamental challenge is not access per se, but rather **granularity and detail**: certain data, such as energy data, is simply not calculated at the local level through official channels, creating structural gaps that require methodological workarounds.

In response to these limitations, the city's stated direction is toward **higher quality and more granular data infrastructure**. Officials explicitly positioned better data as the foundation for adaptive governance, arguing that data quality is key to both adaptation and sound decision-making.

Outcomes and Impact

Examples of How MEL Data Has Influenced Policy or Resource Allocation

As outlined in previous sections, Zaragoza's MEL framework has played a meaningful role in shaping the city's climate governance, even in the absence of a formally established impact evaluation system. The clearest evidence of MEL data influencing decision-making lies in the **institutionalization of climate priorities within the annual municipal budget** - a shift that officials themselves identified as a strong signal of political commitment. The city's current focus areas, including energy efficiency, self-consumption, building retrofitting, sustainable mobility, electrification of public transport, and digital transformation, reflect a data-informed consolidation of priorities around the pillars demonstrating the greatest potential for emissions reduction.

The MEL framework has also enabled **course correction in the short term**, allowing the city to identify when projects are not advancing as expected and redirect efforts accordingly. In the longer term, it supports decisions about which initiatives warrant sustained institutional and financial support.

Success Stories and Challenges

One notable area of progress is the incorporation of previously difficult indicators into the monitoring framework. The inclusion of **energy poverty** as a tracked indicator, enabled by the development of a dedicated municipal strategic plan, represents a meaningful step toward more socially comprehensive MEL. Similarly, the use of **satellite technology and multispectral imagery** to monitor carbon sequestration and urban heat islands reflects an expanding technical ambition in how the city measures its environmental impact.

However, Zaragoza's officials were candid about the limitations of the current system. Most significantly, there is **no formally established process for systematically evaluating the impact of MEL outputs** on policy or climate outcomes. While data informs decisions in practice, this connection remains largely implicit rather than institutionalized through a dedicated evaluation mechanism. Officials acknowledged this gap and left open the possibility of developing such a system in the future - suggesting awareness that closing this loop is a necessary step toward a more mature MEL architecture.

A further challenge lies in **communicating MEL findings effectively** to diverse audiences. The city is currently working through the **CESF (City Expert Support Facility) of NetZeroCities** to improve the dissemination of compiled data and render it meaningful through new narratives tailored to different age and social groups. This effort is being developed in collaboration with the municipal area of transparency and open data, reflecting a broader ambition to transform technical monitoring outputs into publicly accessible, civically relevant information. While this work is ongoing, it underscores a recognized gap between data production and public engagement that the city is actively seeking to address.

4.2.3 Conclusion and Lessons Learned

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

Zaragoza's MEL experience offers a revealing portrait of a mid-sized city navigating the practical complexities of building a robust monitoring, evaluation, and learning system within a real-world institutional and resource context. Several cross-cutting insights emerge from the analysis of its practices.

Zaragoza's most fundamental characteristic of its MEL approach is its **commitment to iteration**. The CCC is treated as a living document, and the city has invested significantly in a structured iteration

process - supported by the Spanish National Platform citiES2030- to revise indicators, update frameworks, and align monitoring with its evolving policy priorities. One of the most valuable steps in this process has been conducting a **series of internal interviews across different municipal departments and areas**, which surfaced data gaps, clarified ownership of indicators, and strengthened cross-departmental coherence. This internal consultation model stands out as a replicable good practice for cities seeking to ground their MEL frameworks in institutional reality rather than external templates.

Zaragoza's participation in the broader network of EU Mission Cities has proven to be more than a technical exercise. Officials highlighted how **working jointly with peer cities on the iteration process** helped build institutional confidence - both in the validity of their approach and in their capacity to navigate uncertainty. The support of partners such as CIRCE has been similarly instrumental, reinforcing the value of combining local political ownership with external technical expertise. This points to a broader lesson: **MEL capacity is not built in isolation**, and peer learning networks play a meaningful role in sustaining momentum through complex, multi-year processes.

A recurring insight across all dimensions of Zaragoza's MEL system is the difficulty of balancing technically measurable indicators with socially meaningful ones. The framework is currently weighted toward quantitative data, not by design preference but by practical necessity - social indicators are costly to collect, methodologically demanding, and often constrained by data protection rules. While the city has made progress in areas such as energy poverty, significant gaps remain. Health indicators have been identified as a potential indirect proxy for quality-of-life outcomes, but this approach is still nascent.

Across sectors, the **core challenge** is not data access in principle, but **granularity and local specificity**. Nationally and regionally aggregated data frequently falls short of the resolution needed for meaningful local policy decisions, particularly in areas such as private building retrofitting, heating system decarbonization, and energy consumption disaggregation. The city's response - estimating and self-adjusting where necessary, while investing in new governance structures such as the IPPCP platform - reflects pragmatic adaptability, but also underscores the structural limitations that mid-sized cities face in building truly locally grounded MEL systems.

Zaragoza has recognized that producing data is not sufficient - making it meaningful to diverse audiences is an equally important challenge. The ongoing work with the NetZeroCities CESF to develop narratives adapted to different social and age groups, in collaboration with the municipal transparency and open data office, signals a maturing understanding of MEL as a **communication and civic engagement tool**, not only a technical monitoring instrument. Critically, this dissemination effort extends inward as well: ensuring that MEL findings reach and inform other municipal departments - not just climate-focused teams - is identified as a key priority for deepening the institutional impact of the system.

Finally, a straightforward acknowledgment from city officials points to an important structural gap: there is currently **no formally established process for evaluating the impact of MEL outputs** on policy decisions or climate outcomes. While data clearly influences priorities and budget allocations in practice, this influence remains implicit. The development of a more systematic impact evaluation mechanism has been identified as a future aspiration - and its absence serves as a reminder that even well-developed MEL systems require a dedicated feedback loop connecting monitoring outputs to assessable real-world change.

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

Zaragoza's immediate priorities reflect a consolidation and deepening of the work already underway, rather than a wholesale reorientation of its climate strategy. A central commitment is the

strengthening of existing partnerships, particularly with their core technological partner CIRCE and their broader network of social partners. These relationships have proven foundational to the city's MEL and iteration processes, and officials emphasized the importance of maintaining their continuity and depth.

A key strategic direction is the **expansion of multi-stakeholder governance with a new governance method**, with a particular focus on meaningfully involving the private sector alongside academia and civil society. This vision goes beyond consultation - officials described it as working "hand-on-hand" with all relevant actors across both societal and technological dimensions, pointing toward a more co-productive model of climate governance in which MEL data and planning processes are shared responsibilities rather than purely municipal functions. The ongoing IPPCP project, which aims to build a public-private climate data platform, is an early expression of this direction, but officials signaled ambitions that extend well beyond a single project.

Alongside governance innovation, the city is actively progressing its **communication and dissemination strategy**, working through the NetZeroCities CESF to translate technical monitoring outputs into accessible narratives for diverse audiences. This work is seen as essential not only for civic engagement but also for ensuring that MEL findings penetrate across municipal departments and contribute to a shared institutional understanding of climate progress.

Areas Where External Support Is Required

Officials were unequivocal about the centrality of **finance** as both an enabling condition and a political signal. Without dedicated budget, climate commitments risk remaining on paper - the iteration process and strategic plans cannot be operationalized in the absence of real resource allocation. This is not merely a technical constraint; it is also a governance one, as budgetary commitment reflects and sustains political will. Securing stable and sufficient financing is therefore identified as a prerequisite for translating MEL insights into durable action.

The Role of the National Platform and NetZeroCities

Zaragoza expressed a clear view on where external support could be most impactful: the **Spanish National Platform citiES2030**, and by extension NetZeroCities, could provide significantly greater value by taking a more active role in the **financial dimension** of cities' climate transitions. Specifically, officials envisioned the National Platform acting as a **nexus between cities, the national administration, and the European Commission** - helping cities identify, access, and navigate funding opportunities that are often complex, fragmented, or difficult to reach from the local level alone.

"…Without citiES2030, the seven cities that initially earned the label would have faced a much longer process, and we wouldn't have known which direction to take…"

In this framing, the Platform's most valuable contribution would not be purely technical or methodological, but rather **institutional and relational** - leveraging its position within the broader governance architecture to open financial pathways that individual mid-sized cities struggle to access independently. This perspective points to a broader insight: for cities like Zaragoza, which have developed meaningful internal MEL capacity and political commitment, the binding constraint is increasingly not knowledge or frameworks, but resources and the institutional connections needed to secure them.

Recommendations for other cities aiming for climate neutrality.

Zaragoza's experience navigating the practical complexities of climate monitoring and data governance yields a set of grounded recommendations for cities embarking on or advancing their own climate neutrality journeys.

A foundational lesson from Zaragoza is that effective MEL begins within the municipality itself. Involving all departments - not only those with an explicit climate mandate - is essential for building a coherent and institutionally owned monitoring system. Calculating emissions across an entire city is an inherently cross-sectoral endeavor, and without internal alignment, data gaps, duplications, and misaligned priorities will undermine the process. Cities should invest early in structured internal consultation mechanisms, as Zaragoza did through its departmental interview process during the CCC iteration, to surface existing data assets, clarify ownership, and build shared understanding of the monitoring framework.

External collaboration - with the private sector, academia, and civil society - is equally critical, but officials were candid that achieving meaningful engagement is neither quick nor straightforward. Cities should approach this as an ongoing process of relationship-building rather than a one-off consultation exercise. The goal is for all actors to genuinely understand and internalize the **collective benefit of collaboration**, which requires sustained dialogue, transparency about how data will be used, and tangible returns for those who contribute.

A particularly valuable insight from Zaragoza concerns the **asymmetry between large and small companies** in their capacity to engage with climate monitoring and decarbonization. Larger firms generally already have decarbonization plans in place, making alignment and data sharing comparatively manageable. Small and medium-sized enterprises (SMEs), however, frequently lack the human and technical resources to participate meaningfully, making their adherence to city-level climate missions a disproportionate burden. Cities should design **tailored engagement pathways for SMEs**, recognizing that a uniform approach will systematically exclude a large and emissions-relevant segment of the local economy.

Zaragoza's own response to this challenge offers a practical model: the city has established **collaboration pacts with the Confederation of Entrepreneurs and with CEPYME** (the Spanish Confederation of Small and Medium Enterprises) to create a structured channel for reaching this group. The underlying logic is instructive - the municipality needs SME data to build a complete emissions picture, so the responsibility is on the city to **simplify the data provision process** as much as possible, and to return that data to companies in a processed, digestible, and useful form. This reciprocal value exchange transforms data collection from an administrative burden into a genuinely collaborative relationship.

Before companies will share their data - particularly smaller ones with limited resources and potentially greater reticence - cities **must demonstrate that their intentions are collaborative** rather than regulatory, and that participation will yield tangible benefits. **Building this trust** takes time and consistency, and cities should plan accordingly, setting realistic expectations about the pace at which broad stakeholder engagement can be achieved.

Finally, Zaragoza's experience suggests that cities should resist the temptation to wait for a perfect data environment before acting. Gaps in granularity, methodological limitations, and uneven stakeholder participation are not exceptional problems to be solved before monitoring can begin - they are permanent features of the landscape that must be managed iteratively. The city's willingness to estimate, adapt, and continuously revise its framework is not a sign of weakness but of institutional maturity. Other cities would do well to adopt a similarly pragmatic orientation, treating their MEL systems as works in progress that improve through use rather than blueprints that must be perfected before deployment.

4.3 Cork

4.3.1 City Profile

Geographic and regional context

Cork City, Ireland's second-largest urban center, is a city defined by its relationship with water and its strategic location. Situated at the head of one of the world's largest natural harbors, its geography is historically shaped by the River Lee, which bifurcates to create a historic island center. This "island" identity, while central to its heritage, presents modern challenges for climate resilience, particularly regarding flood risk management and the constraints of medieval street patterns on modern transit.

In 2019, Cork underwent a transformative boundary expansion. This administrative shift quadrupled the city's land area to approximately 187 km2. This was not merely an expansion of borders; it was an integration of highly diverse land-use types. The city now manages a "rural-urban" mosaic: a dense urban core, sprawling post-war residential suburbs, and a newly integrated rural-urban fringe that includes critical greenbelts and agricultural land.

Population / demographics

The demographic profile of Cork is a crucial driver of its climate strategy. As of the 2022 Census, the city's population is approximately 222,000, but under the National Planning Framework, it is designated for aggressive growth, targeting 280,000 by 2030. Unlike many European cities facing stagnant growth or aging populations, Cork possesses a notable "youth bulge." This is largely sustained by its status as a premier educational hub, hosting over 35,000 students at University College Cork (UCC) and Munster Technological University (MTU).

With 62% of the population within the working-age bracket (20-64) and 23% in the youth bracket, the city benefits from a significant "innovation dividend." This young, educated workforce provides the talent pool necessary for a burgeoning green tech sector. However, this growth also exerts immense pressure on the city's infrastructure. To achieve neutrality, Cork must bypass the "lock-in" effects of traditional suburban development, ensuring that new housing for this growing population is decoupled from private car dependency and high-carbon heating systems.

Socio-economic conditions

Economically, Cork is a global powerhouse, particularly in life sciences, Information and Communication Technology (ICT), and international financial services. It is the European headquarters for Apple and a major manufacturing node for pharmaceutical giants like Pfizer and Janssen. This concentration of multinational corporations drives a high Gross Value Added (GVA) per capita, but it also creates a substantial carbon liability.

The 2018 Baseline Emissions Inventory identified total territorial emissions of 987 kt CO2 eq. A sectoral analysis reveals a stark reality:

- Stationary Energy**:** The heating, cooling, and powering of residential, commercial, and institutional buildings account for 49% of total emissions.

- Road Transport: Private vehicle use and freight account for 34%.
- Industry and Waste: While significant, these are secondary to the systemic challenges of heat and mobility.

Because Cork's economy is heavily anchored in energy-intensive manufacturing and high-end services, the climate mission is fundamentally a challenge of systemic infrastructure transformation rather than marginal behavioral change.

Sector	$CO_{2,eq}$ (ktonnes)	Sector Includes:
Road Transport	289.5	Emissions from vehicles driving on road links
Household	331.6	Emissions from heating and electricity energy demand in the home
Commercial & Industrial	216.0	Emissions from commercial and industrial buildings
Public Services	64.7	Emissions from known public energy use including public gas and electricity meter points; street lighting; schools and universities; hospitals and clinics; military barracks; prison
Agriculture, LULUCF & Fisheries	62.1	Emissions from farming (based on farmland) and fisheries (based on registered ships to Port of Cork)
Waste Handling & Treatment	21.8	Emissions from treatment of waste and wastewater
Total	985.7	

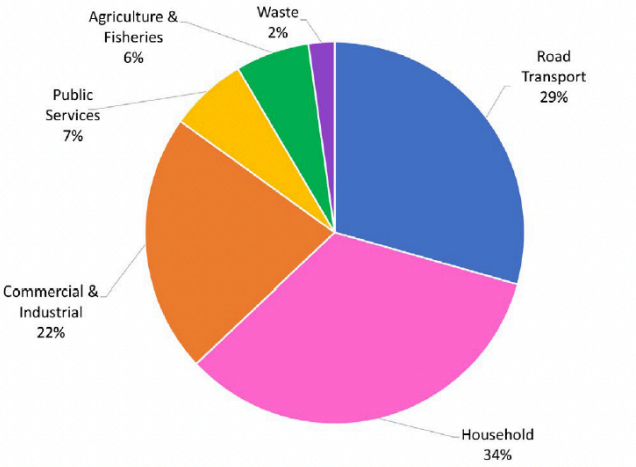

Figure 8 - Cork's main emission sources. Source: Cork Climate Action Plan, Climate City Contract (CCC), 2024.

Overview of the city's climate neutrality mission and objectives

Cork's climate neutrality mission is anchored in its commitment to the EU Mission for 100 Climate-Neutral and Smart Cities, aiming for a systemic urban transformation by 2030 through the strategic framework of its Climate City Contract (CCC). According to the Baseline Emissions Inventory (2024), the city's emissions profile is dominated by Stationary Energy (49%), primarily from residential and commercial heating, and Road Transport (34%), which together represent the most critical domains for decarbonization. To address these, the Action Plan prioritizes 130 high-impact measures, including a massive residential retrofit program to upgrade 10,000+ homes and the full implementation of the Cork Metropolitan Area Transport Strategy (CMATS) to achieve a radical modal shift.

These actions are supported by a robust Investment Plan that identifies a multi-billion euro capital requirement, necessitating a sophisticated Monitoring, Evaluation, and Learning (MEL) framework to track progress. This framework utilizes a "rolling" data approach through the Net Zero Planner to bridge the interagency data gap, employing a hierarchical set of indicators that balance absolute GHG reductions with qualitative co-benefits such as public health, air quality, and social equity. Central to this mission is a partnership ecosystem involving University College Cork (UCC), Munster Technological University (MTU), and national agencies like the SEAI and NTA, ensuring that monitoring data directly informs the mobilization of both public and private finance for a just and inclusive transition.

The city's climate strategy is organized into a portfolio of **130 high-impact measures**. Key sector-specific priorities include:

- **Stationary Energy (Residential & Commercial):** A massive residential retrofit program targeting over **10,000 homes** to upgrade their Building Energy Rating (BER) to B2 or higher.
- **Transport:** Full implementation of the **Cork Metropolitan Area Transport Strategy (CMATS)**, which includes significant investment in the "BusConnects" program (estimated at 71% of transport action impact) and a 9% shift toward pedestrian and cycling infrastructure.
- **Energy Systems:** Transitioning to **District Heating** and increasing renewable energy penetration, largely through private sector-led solar and wind integration.
- **Governance and Community:** Establishing the "Climate Neutral Cork" leadership group and public platform to coordinate interagency data sharing and citizen co-creation.

Estimated GHG Reductions

In 2022, Cork City underscored its commitment to rapid decarbonization and peer learning by joining the EU Mission for Climate-Neutral and Smart Cities, alongside concurrent commitments to the EU Missions on Climate Adaptation and Ocean Restoration. The Cork Climate City Contract (CCC) serves as an ambitious extension of the existing Climate Action Plan (CAP), specifically targeting net-zero greenhouse gas emissions by 2030.

Cork has established a tiered reduction target relative to its **2018 baseline of 942.5 ktCO_2-eq**:

- **Core Target:** A minimum of an **80% emissions reduction** over 2018 levels by 2030 for the EU Mission.
- **National Alignment:** Achieving a **51% reduction** in line with the Irish National Climate Ambition by 2030.
- **Residual Emissions:** The remaining 20% of emissions are classified as "hard-to-decarbonize" (e.g., heritage buildings and national grid base-load) and will require carbon sequestration or natural sinks.

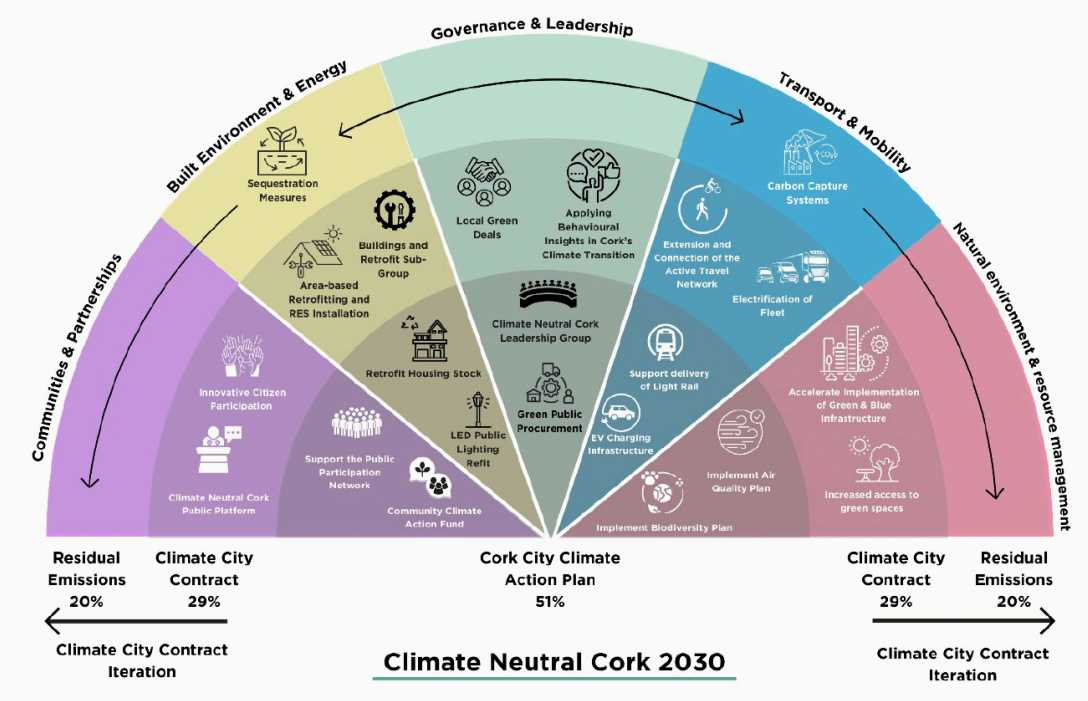

Figure 9 - Climate Neutral Cork 2030. Source: Cork Climate Action Plan, Climate City Contract (CCC), 2024.

MEL Framework & Indicators

Main indicators using NZC MEL framework:

Direct Indicators - GHG emission	Indirect Indicators
GHG from stationery energy (Domestic)	Residential emission currently sequestered.
GHG from stationery energy (commercial/Industrial/IPPU)	
GHG from transport	Negative emission through natural sinks.
GHG from waste	Improved air quality
GHG from AFLOU	Urban heat island effect
GHG from public sector	Wellbeing of citizens
GHG from supplied energy	Green spaces
	Citizen involvement in co-design/co-creation of climate action.
	Funding for social innovation initiatives for climate neutrality.
	Energy consumption per household
	Modal share of active and public transport

Green jobs

Public capital invested in climate action projects recycling rate of municipal waste.

Brownfield use.

%of tree canopy within the city

Citizen awareness regarding sustainability and the environment.

4.3.2 City MEL processes and application

Processes/Collaboration in design and operationalisation of MEL

In defining Cork's impact pathways, the city leveraged existing statutory processes to ensure alignment between local and European commitments. The foundational work was conducted during the development of the 2023 Local Authority Climate Action Plan (LACAP). This statutory instrument served as the "anchor" for the Climate City Contract (CCC), ensuring that the Mission's goals were not developed in a vacuum but were integrated into the city's legal obligations.

The participatory process involved a broad spectrum of stakeholders, including the public, civil society, the business community, and internal municipal staff and elected representatives. Rather than producing granular technical metrics, this phase served as a strategic "steer," identifying the high-level priorities and measures of progress that resonated with the city's ecosystem. This collaborative approach ensured that the impact pathways reflected both the community's aspirations and the council's operational realities.

Cork has established a diverse Climate Neutral Cork Leadership Group-including universities and major institutions. Although their role in MEL is currently strategic rather than operational due to lack of budget for such activities. it is identified as a priority for future development. Despite the presence of high-level academic partners, the city has not yet formally tasked or resourced these partners to conduct specific data collection or longitudinal studies. Moving forward, the role of Leadership Group is expected to help identify and "unlock" the right sources of information for datasets that currently lack clear ownership or established methodologies.

The operational responsibility for MEL in Cork City is centralized at the coordination level while being distributed at the source level. The climate Action office acts as the primary "owner" of the reporting process-responsible for gathering, collating, and interpreting data from across the municipal departments. The process relies on "leaning into" different municipal departments, but there is no large, dedicated "Transition Team" for data; rather, it is a lean operation that coordinates across existing administrative silos.

Measurement and Monitoring

Cork has adopted a "reflexive learning process" whereby the city has structured its monitoring around "Impact Pathways," which have been adapted from the NetZeroCities Theory of Change.

Measuring the impact of actions within the private sector remains one of the most significant hurdles for the MEL process. Cork has adopted a "Representative Group" strategy rather than engaging with individual firms; to manage administrative bandwidth, the city engages with the Cork Chamber of Commerce, the Construction Industry Federation, and the Business Association rather than individual businesses. The city relies on these groups' periodic research and advocacy data.

Ownership and Interoperability: The city's data governance is currently an exercise in "active coordination" rather than a fully automated system. The Climate Action Officer acts as the central node for collation and interpretation, but the "ownership" of the primary data flows remains with national bodies or external agencies. The intent is to move toward a system where reporting is less of a "single point in time" event and more of a continuous flow. However, the lack of mandate or standardized "playbooks" for external stakeholders to provide data systematically remains a barrier to full interoperability.

Internal Governance: Data management in Cork City is characterized by manual, labour-intensive processes rather than a centralized digital platform. While the city has various corporate and development plans with established KPIs, there is no "single source of truth" or dedicated software (like a CRM) to aggregate these data points. Reporting typically involves staff from specific departments manually tracking down information through informal internal networks. For the Local Authority Climate Action Plan (LACAP), the city uses a shared Excel-based tracking system with a RAG (Red-Amber-Green) status indicator to provide a snapshot of implementation progress.

Indicators and Metrics

While the qualitative "steer" came from local consultation, the technical selection of indicators for the CCC was driven by a pragmatic need for standardisation and feasibility. Cork City opted to utilize the NetZeroCities (NZC) monitoring framework and its indicators for three primary reasons:

- Comparability: To ensure measurements are mainstreamed and comparable with other European Mission cities.
- Guidance-Led Efficiency: To leverage established metadata and methodologies, reducing the administrative burden of creating bespoke metrics from scratch.
- Recognizing that the NZC framework contains a vast number of potential metrics, the city intentionally discriminated between indicators to avoid "measurement overwhelm."

Consequently, the city distilled the framework down to approximately 23 core indicators. This lean approach was designed to prevent the creation of unrealistic expectations regarding data collection while still covering the essential domains of the climate transition.

The current indicator set is intentionally weighted toward quantitative metrics, particularly within the major emissions domains such as domestic stationary energy and transport. This reflects the city's reliance on Baseline Emissions Inventories (BEI), which remain the primary tool for tracking progress toward the 2030 neutrality goal.

However, the city acknowledges a transition in its data maturity. Many primary indicators currently rely on statistical estimations. Efforts are underway to update the baseline year to 2023 to provide a more contemporary snapshot of the city's emissions profile.

More than half of the selected indicators focus on indirect emissions and co-benefits. For example, Air Quality is utilized as a key proxy for the success of transport and energy interventions, bridging the gap between technical climate targets and public health outcomes.

The indicators were selected with an awareness of their intended use-not just for reporting to the EU, but to provide a feedback loop for the Investment Plan. By focusing on measurable sectors, the MEL

process aims to provide the evidence base needed to justify the significant private and public capital mobilization outlined in the CCC.

While Cork City has detailed health benefit and job creation impacts in its investment planning, it currently lacks a robust mechanism for quantifying these co-benefit impacts in monetary terms. The city intends to address this in future iterations of the CCC by developing the capacity to reliably quantify co-benefit impacts in health and related sectors. The current challenges for measuring and quantifying co-benefits are:

- Threshold Conflicts: Using air quality as an example, a "cognitive issue" exists between national reporting standards and international ideals (WHO thresholds). Reporting against stricter WHO guidelines would redefine "good" air quality as "poor," creating political and communication challenges.
- Proxy Limitations: Many co-benefit indicators, such as "citizen well-being" are viewed as "shaky" or "blunt tools." The city struggles to draw actionable conclusions from these snapshots; for instance, it is unclear if a low well-being score necessitates more climate action or simply reflects a temporary mood unrelated to policy.
- The Scale of Impact: Certain indicators like "urban heat island" effects are deemed more relevant for larger, more densely concreted metropolises like Dublin. For Cork, these metrics may not show meaningful change within the 2030 Mission window, raising questions about their utility for short-term adaptive management.

Use/Application of MEL Processes

Given Cork's huge emissions originated from just two sectors: the Built Environment and Transport, the MEL process is being recalibrated to focus markedly on these areas:

The Built Environment: Priorities are divided between the private/commercial sector and the public estate. As the second-largest social landlord in Ireland (managing ~11,000 properties), the city views social housing retrofitting as a primary, measurable lever for both emissions reduction and social impact.

Transport and Modal Share: Despite high car dependency and a public transport network currently deemed "not fit for purpose," monitoring modal shift remains a top priority. However, this is hampered by a lack of direct observation sensors, forcing a reliance on "downscaled" national data.

The City Council acts as the central node for collation, but ownership of primary data flows remains with national bodies such as the Environmental Protection Agency (EPA) and the Sustainable Energy Authority of Ireland (SEAI). The city uses EPA emissions projections (compiled annually) as a key source for energy systems, industry, waste, and agriculture projections.

"you can't manage what you can't measure." Says Cork's Climate Action Coordinator, Peter Medway. He identifies the lack of mandatory, empirical impact reporting as a "massive gap" that currently leaves Local Authorities without the funded capacity to gather and assess the true consequences of their actions.

Outcomes and Impact

While the city has established a rigorous structure, it has noted that at the current stage of implementation, it is "too early to measure material impact on the city's emissions". However, the data gathered-such as the Baseline Emissions Inventory (BEI) has already served as the "anchor" for the Climate City Contract, ensuring that the Mission's goals are integrated into the city's legal obligations

rather than being developed in a vacuum. Furthermore, the climate crisis has already begun to influence changes in the public spending code, with the city awaiting national Green Public Procurement policy to further shape resource allocation.

Challenges and opportunities

Cork City's MEL process faces significant hurdles in tracking climate progress. A fundamental challenge is the "2% vs. 98% gap": the City Council directly controls only 2% of local emissions, leaving them heavily dependent on external stakeholders-from national agencies to private firms-to track the remaining 98%.

Data management is further complicated by three primary issues:

- Funding Mismatches: While cities can often secure capital for sensor hardware, they struggle to fund the recurrent operational costs (data cleaning and maintenance) required to keep information reliable. Without this "high-quality flow," evidence-based decisions, such as reallocating road space for bus lanes, remain difficult to justify.
- Methodological Friction: The city relies on "downscaling" national estimates to local levels, creating a disconnect between the city's "bottom-up" analysis and the government's "top-down" inventory. This variance makes it hard to reconcile local progress with national targets.
- Fragmented Engagement: To manage limited capacity, the city relies on business representative groups as proxies for the private sector. However, these groups collect data for advocacy, not for climate monitoring, resulting in inconsistencies that complicate tracking metrics like "green jobs."

Cork's evolving MEL framework presents several strategic opportunities to strengthen its climate-neutrality transition:

- Mainstreaming Climate Action: Through cross-directorate workshops, the city is aiming to shift climate considerations from a "secondary check-box" to a primary planning lens. By mapping planned infrastructure investments against emissions data, departments can actively integrate decarbonization into their 3-5 year programs.
- Evidence-Based Investment: The MEL system serves as a technical bridge to unlock capital. By providing empirical analysis of low-carbon outcomes, the city can better satisfy rigorous funding requirements like the EU Taxonomy.
- Strategic CCC Evolution: The upcoming Climate City Contract iteration offers the chance to transition from high-level goals to a concrete, investable pipeline of projects. Formalizing disclosure through the CDP-ICLEI Track further enhances international accountability, positioning Cork to attract the private and institutional investment necessary to close the remaining emissions gap.
- The bespoke NetZeroPlanner Tool (NZP) for Cork can be "a tool for adequacy". Its value lies in assessing the adequacy of actions. By mapping projects (e.g., active travel routes) against the city's emissions profile, the tool can help in determining if the combined impact of these measures is sufficient to meet 2030 neutrality goals. While it doesn't answer the question "Is the project on time?", It answers "Are we doing enough?"

4.3.3 Conclusion and lessons learned

The MEL process in Cork was intentionally designed to provide a strategic "steer" rather than focusing solely on producing granular technical metrics. This approach ensured that the identified priorities and measures of progress resonated with the city's broader ecosystem, bridging the gap between community aspirations and the council's operational realities.

The city has moved away from static reporting, instead adopting a "reflexive learning process" This structure accommodates both formal, documented reviews of actions and informal individual and group learning, allowing the city to adapt as it progresses.

The MEL system's strength lies in its integration with the 2023 Local Authority Climate Action Plan (LACAP), which served as an "anchor". By aligning the Climate City Contract (CCC) with these pre-existing legal obligations, the city ensured climate goals were not developed in a vacuum.

Moving forward, Cork is making major efforts in Detailed Project Specification. While current impact pathways remain at a high level, the city plans to specify delivery projects in much greater detail for the 2026 iteration of the CCC. This transition involves developing "bankable projects" that include specific budgets, timelines, and expected impacts.

The city has identified a "massive gap" in the funded capacity for Local Authorities to gather and assess the true consequences of their climate actions. Future needs include:

- Standardization: Developing reliable methodologies to quantify co-benefit impacts (e.g., health and related sectors) in monetary terms.
- Monitoring Private Investment: Building the capacity to monitor private sector investment in climate goals and identifying routes to mobilize private finance.
- Policy Support: Advocating for long-term funding models from central government, as current annual budget cycles hinder the medium-to-long-term certainty required for climate investment.

Last, several key learnings from Cork's MEL case can be inferred:

- Cities should integrate climate action into established structures rather than creating redundant networks. Using existing statutory instruments as an anchor helps ensure climate neutrality is viewed as a core local obligation.
- Local governments should leverage "soft power" by engaging in dialogue with central government departments-an opportunity often rarely afforded to local units-to create new partnerships and resolve legislative blockages.
- Cities should not wait for the perfect data set to start; instead, they should adopt a phased approach, starting with high-level pathways and evolving toward detailed, bankable projects as internal capacity and evidence bases grow over time.

4.4 Münster

4.4.1 City Profile

Background information

Münster is a city in the federal state of North Rhine-Westphalia in western Germany. It had an official population of about 320,946 in 2022, spread across an area of 303.3 square kilometres. The city lies in the northern part of the state and serves as the economic and administrative centre of the surrounding Münsterland region, a larger area of about 1.66 million residents that includes both the city and rural districts. Münster's economy features a strong services sector, supported by public administration, education and research institutions (including one of Germany's largest universities), as well as small and medium enterprises in logistics, insurance, mechanical engineering and healthcare. The service sector alone accounts for nearly 87% of employment among jobs subject to social insurance, with manufacturing at around 12-13 % and agriculture less than 1 %.[9]

Münster's city population of roughly 321,000 in 2022 shows a balanced gender mix and a notable share of foreign residents (about 12 %), with a relatively young and dynamic demographic profile overall. Age breakdowns for the city show that around 13.4 % of residents are under 16, 30.1 % are aged 18-34, 31.2 % are 35-59, and about 23.9 % are older than 60 (15 % aged 60-74 and 9 % 75+).[10] Münster itself is a standalone urban district rather than part of a larger metropolitan region, but the wider Münsterland has a mix of urban and rural populations tied economically and socially to the city.

Münster's economic output on a per-person basis is above regional averages; the city's GDP per capita is around €59,300 (2021 figures) and generally exceeds that of North Rhine-Westphalia as a whole. The labour market is relatively strong with unemployment rates generally below national averages and a significant commuter inflow from surrounding rural areas. Businesses are moderately dense: there were about 40.6 registered companies per 1,000 inhabitants in 2021, reflecting a vibrant small and medium enterprise ecosystem. Employment is heavily weighted toward services such as education, public administration, finance and health, while manufacturing and construction provide secondary employment opportunities. This mix supports a high quality of life and contributes to Münster's role as a regional hub for commerce, culture and innovation within its largely rural hinterland.

Climate Neutrality Objectives

Muenster's greenhouse gas inventory identifies 2021 as the baseline year, with total emissions primarily driven by the built environment and transport sectors. The city's main sources of emissions are buildings (56%), transport (30%) industrial processes and product use (10%), and agriculture, forestry, and land use (3%).

Münster has set a highly ambitious climate neutrality target for 2030, aiming to reduce CO_2 emissions by more than 95% compared to 1990 levels. In absolute terms, this means cutting annual emissions from 2.62 million tonnes in 1990 by approximately 2.49 million tonnes by 2030. This target is consistent with an 82% reduction relative to the 2021 baseline, as calculated by the city's economic

[9] https://www.muensterland.com/en/economy/living/places/munster/working
[10] https://www.bundeswahlleiterin.de/en/europawahlen/2024/strukturdaten/bund-99/land-5/kreis-5515.html

model. Building on more than three decades of climate action, Münster already recorded a comparatively low carbon intensity of 5.8 tonnes per capita in 2020, well below the German national average, reflecting the city's strong starting position and decentralized energy system.

Table 4 - Münster emissions inventory by sector.

Sector	Scope 1 (tCO_2e/yr)	Scope 2 (tCO_2e/yr)	Scope 3 (tCO_2e/yr)	Total Emissions (tCO_2e/yr)	% of Total
Transport	549,780	16,082	-	565,862	30%
Buildings	136,893	922,466	-	1,059,359	57%
IPPU	1,631	189,350	-	190,981	10%
Waste	2,595	190	-	2,785	0.2%
AFOLU	53,739	-	-	53,739	3%
Total	744,638	1,128,088	-	1,874,841	100%

Münster's Climate Neutrality Action Plan is structured around a combination of high-impact technical measures and non-technical actions aimed at societal transformation. Key technical fields of action include low-carbon energy production, sustainable mobility, and building-related carbon reduction measures, focusing on efficiency improvements and emissions reductions across the existing building stock. In parallel, the city places strong emphasis on engaging businesses and academic institutions as drivers of innovation and emissions reduction, ensuring that economic development aligns with long-term climate goals. These measures are complemented by governance tools such as a municipal climate budget, which helps guide decision-making and prioritise investments based on their emissions impact.

Beyond sectoral measures, Münster explicitly frames climate neutrality within the concept of a carbon budget, recognising that percentage reductions alone are insufficient to meet the Paris Agreement objectives. The city adopts a per-capita carbon budget approach aligned with recommendations from the German Advisory Council on the Environment, aiming to limit cumulative emissions in line with a 1.5°C pathway. Education, food systems, and broader cultural change are therefore integral components of the strategy, supporting behavioural shifts alongside technical solutions. Together, these actions position Münster's climate strategy as both technically robust and socially grounded, with a strong focus on absolute emissions limits, long-term resilience, and quality of life.

MEL Framework & Indicators

To track progress toward climate neutrality and ensure accountability, Münster has embedded these indicators within a structured monitoring, evaluation, and learning (MEL) system aligned with its 2030 climate neutrality pathway. The MEL framework is designed to move beyond high-level targets by systematically measuring sector-specific emissions reductions, the energy transition across electricity and heat, and the treatment of residual emissions within a carbon-budget logic. By combining technical emissions data with sectoral performance indicators, the system enables regular assessment of whether implemented measures are delivering the required absolute CO_2 reductions.

Main indicators

- CO2 Reduction
- Share of RE in total electricity consumption

- Share of RE in total heat consumption
- CO2 reduction in the stationary sector
- CO2 reduction in the transport/mobility sector
- CO2 reduction of grid-bound energy sources
- Waste and Circular Economy
- CO2 reduction in the industry sector
- CO2 reduction in the agricultural sector
- Remaining residual emissions

Additionally, the city is participating in the Pilot Project CoLAB project, which focuses on the quantitative determination of co-benefits.

4.4.2 MEL processes and application

Processes/Collaboration in design and operationalisation of MEL

Münster's MEL system is not the result of a single, discrete design phase but rather the outcome of long-term institutional learning embedded in decades of climate governance. While broad co-creation has played a significant role in shaping Münster's climate ambitions and strategic direction, the design of MEL frameworks and impact pathways has remained largely expert-led due to their methodological complexity.

A key participatory milestone occurred in 2017, when Münster organised a large-scale conference process linked to the development of its "Master Plan 100% Climate Protection." More than 1,000 participants contributed to articulating a shared long-term vision for the city's development. This process did not focus on indicators or impact pathways themselves but instead defined the strategic foundations upon which subsequent technical analyses were built. This visioning exercise later informed greenhouse gas modelling, scenario development, and the recalculation of targets following the City Council's 2019 decision to advance climate neutrality from 2050 to 2030.

Collaboration in Münster's MEL system is strongest at the institutional and expert level, involving a network of research partners, municipal companies, and data providers. A central partner is the Institute for Energy and Environmental Research (ifeu), which developed the emissions accounting tool used by the city. This tool is based on the German BISKO standard, enabling consistent, comparable greenhouse gas inventories across municipalities. While the inventory itself is produced in-house by a dedicated municipal staff member, ifeu provides methodological support, tool development, and periodic updates.

Beyond research institutions, Münster relies on a broad ecosystem of data providers. These include the municipally owned energy utility (Stadtwerke), private energy suppliers, universities, and technical service actors, who supply data on heating systems. This distributed data landscape reflects the city-wide scope of emissions accounting and requires strong informal coordination and trust-based relationships rather than rigid contractual arrangements.

Measurement and Monitoring

At the core of Münster's MEL system is an annual greenhouse gas inventory, produced consistently over many years using a standardised methodology (BISKO-Standard). The inventory covers emissions across all major sectors and serves as the primary instrument for tracking progress toward climate neutrality. Its annual repetition allows the city to assess trends, identify structural challenges, and communicate the scale of remaining emissions reductions required.

In parallel, Münster uses implementation monitoring through its climate controlling process. Rather than attempting to quantify the precise emissions impact of each individual measure, the city tracks whether measures have been implemented as planned, are delayed, or require additional resources. For indirect measures, such as cycling infrastructure, monitoring focuses on outputs within municipal control (e.g. kilometres of bike lanes built) rather than behavioural outcomes that depend on external factors

External stakeholders play a crucial role in providing data, though monitoring itself remains institutionally anchored within the municipality. Energy consumption data, for example, is supplied by utilities and system operators, while mobility-related data may come from sensors or infrastructure operators. The city also collaborates with research partners to maintain methodological consistency and ensure alignment with national standards.

Ownership of core datasets remains with the municipality, while external partners contribute specific inputs under established professional norms. Interoperability is achieved through the use of standardised methodologies (notably BISKO), which facilitate comparison with other German cities and support benchmarking. This comparability is politically valuable, as it helps decision-makers understand what can realistically be achieved at the municipal level versus what depends on national or regional frameworks

Indicators and Metrics

Münster's indicators are derived from existing planning and reporting practices, rather than being developed solely for the Climate City Contract. Core indicators focus on absolute and sectoral greenhouse gas emissions, energy consumption, and selected structural variables such as renewable energy installations or vehicle density. These indicators are directly aligned with the city's climate neutrality objectives and carbon budget logic.

For implementation monitoring, Münster uses qualitative and semi-quantitative indicators, such as implementation status and estimated impact levels (e.g. high, medium, low). These are assessed using a structured framework that considers both the reach of a measure (how many people or actors it potentially affects) and the type of intervention, ranging from information provision to regulation

While Münster acknowledges the importance of co-benefits such as air quality, health, or energy poverty reduction, the city chooses a cautious approach to measuring them. The city avoids making strong causal claims unless robust data is available, prioritising transparency over political storytelling. Co-benefits may be described in project-level proposals or contextual reporting but are not systematically quantified within the MEL system.

Use/Application of MEL Processes

MEL data in Münster is designed to support political and administrative decision-making, rather than academic evaluation. The annual climate controlling report is a key mechanism in the city's MEL process, designed to provide a clear overview of what has been implemented, what is delayed, and what resources are required to continue progress.

The annual climate controlling reports explicitly link emissions monitoring, project implementation, and financial governance into a single, recurring decision-support instrument. As mandated by the City Council, the climate controlling report is updated every year and timed to coincide with municipal budget deliberations, ensuring that climate progress is assessed alongside fiscal priorities. The report is structured around three core elements:

1. The energy and greenhouse gas balance, which provides a consistent, city-wide assessment of emissions trends since 1990
2. A status report on strategic climate projects, presented through standardised project "fact sheets" that document implementation progress, planned next steps, and expected direct or indirect CO_2 impacts
3. An entry point into a climate-oriented budget ("Klimahaushalt"), which transparently links strategic projects to specific budget lines and financial allocations

Importantly, the report adopts an explicitly iterative and agile approach, refining indicators, project templates, and impact classifications over time as data availability and governance needs evolve. Rather than functioning as a static monitoring tool, climate controlling is designed to help political and administrative leadership identify delays, resource gaps, and prioritisation needs, while also acknowledging the limits of municipal influence and the dependence on broader societal and multi-level transformations to achieve climate neutrality.

The primary purpose of Münster's MEL system is strategic steering and accountability, not precise impact attribution. The greenhouse gas inventory illustrates the scale of the challenge, while implementation monitoring ensures follow-through on political commitments.

Münster operates a public climate dashboard (Klimadashboard Münster), which presents selected indicators and real-time data (e.g. bicycle counts) to citizens and decision-makers. The dashboard's primary function is transparency and communication, rather than formal MEL. Nonetheless, it complements internal reporting by increasing visibility and public awareness.

Learning and Adaptation

Learning in Münster's MEL system is incremental and governance-driven rather than experimental. Indicators and measures are revised as part of annual reporting cycles, and new actions can be added to the action plan as strategic projects evolve. This creates a dynamic system without constant methodological upheaval. A digital Kanban board is used to track who is responsible for evaluating challenges and deciding if something needs to be done.

New evidence is incorporated primarily through updates to inventories, planning studies, and national regulatory developments. However, the city recognises strong path dependency: once major infrastructure or regulatory measures are underway, annual data is more likely to inform implementation adjustments than fundamental strategy changes.

Outcomes and Impact

The clearest impact of MEL in Münster is its role in securing sustained political attention and funding. By linking climate controlling to budget decisions, the city ensures that climate action remains embedded in core governance processes.

Successes include long-term continuity, institutional learning, and strong integration with governance. Challenges include limited capacity to attribute impacts to individual measures and dependence on national policy frameworks. For example, when it comes to a clean transition in the heating sector,

narratives have played a large role in shaping national legislation, and the municipality depends on the national level to achieve its goals when it comes to transforming how buildings are heated. The municipality uses its monitoring data to contribute to the narrative and communicate real results to citizens using tools such as the Klimadashboard.

4.4.3 Conclusion and lessons learned

Münster's experience illustrates a well-established approach to monitoring, evaluation, and learning (MEL) that has evolved over decades rather than being designed solely in response to the Climate City Contract or the EU Mission framework. A central insight from this case is that effective MEL does not depend on highly sophisticated or real-time impact attribution models, but on institutional continuity, political relevance, and strategic clarity. Münster's system prioritises consistency in data collection, transparency in reporting, and strong links between monitoring outputs and decision-making arenas, particularly the municipal budget process.

One of the most significant lessons from Münster is the deliberate separation between participatory processes and technical MEL design. Citizen engagement has played a decisive role in shaping long-term visions and legitimising ambitious climate targets, most notably through large-scale participatory processes such the development of the 2017 master plan. However, the city has consciously avoided participatory co-creation of indicators or impact pathways, recognising the methodological complexity and uncertainty inherent in emissions modelling. This distinction helps maintain trust and credibility in that political and societal buy-in is generated through inclusive engagement processes, while monitoring and evaluation rely on expert knowledge and standardised methodologies. For other cities, this highlights the value of being explicit about what can and cannot be meaningfully co-created.

Another key lesson lies in Münster's pragmatic understanding of what MEL can realistically achieve at the municipal level. Rather than attempting to causally link individual measures to specific emissions outcomes, which carries with it many confounding variables, the city focuses on two complementary pillars: (1) an annual, standardised greenhouse gas inventory that shows overall progress and remaining challenges, and (2) an implementation-oriented monitoring report that tracks whether planned measures are actually being delivered. This approach acknowledges uncertainty while still providing actionable information to decision-makers. It also avoids the risk of false precision, which can undermine confidence in MEL systems.

Münster's integration of MEL into core governance and financial processes emerges as a critical success factor. The alignment of annual climate controlling reports with City Council budget discussions ensures that monitoring results directly inform resource allocation and political prioritisation. This linkage transforms MEL from a reporting obligation into a strategic steering instrument, reinforcing accountability across departments. The city's governance model distributes climate responsibility across all municipal offices, coordinated by a central climate unit reporting to the mayor. This further strengthens MEL integration and prevents climate action from being siloed.

At the same time, the case reveals important limitations and ongoing challenges. Data availability and methodological constraints limit the city's ability to systematically capture co-benefits such as health, social equity, or energy poverty reduction. While Münster deliberately errs on the side of transparency and methodological caution, this can make it harder to communicate the full value of climate action to the public and political stakeholders. In addition, strong path dependencies mean that MEL is more effective at tracking implementation and highlighting structural challenges than at enabling rapid strategic course correction. Finally, many decisive levers remain dependent on national legislation, constraining the scope of municipal action and learning.

Looking ahead, Münster's future MEL development would benefit from greater alignment at national and European levels, particularly around methodologies for carbon budgets, residual emissions, and

co-benefits. External support in the form of shared tools, harmonised indicators, and peer-learning platforms could help cities like Münster deepen their learning without increasing administrative burden. For other cities pursuing climate neutrality, Münster's experience showcases the value in designing MEL systems that are politically useful, institutionally embedded, and methodologically honest.

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4.5 Bergamo

Disclaimer: This case study follows the section sequence of the other city cases, but is compiled from the Bergamo Climate City Contract Action Plan (Municipality of Bergamo, 2023), existing materials and Bergamo MEL desk-based research conducted by the co-author, but is not supported by interview evidence, workshop participation, or direct review from the city officials.

4.5.1 City context

Bergamo's climate neutrality work is situated in the uploaded Climate City Contract Action Plan as part of a wider period of civic resilience, institutional mobilisation and environmental ambition. The Action Plan links the city's climate neutrality pathway to the idea of a "lighthouse city", a framing associated with leadership, tolerance, creativity, research and technological development. This civic framing is important because the Climate City Contract is not presented only as a technical emissions-reduction programme. It is positioned as a territorial transition that connects cultural, environmental, social and economic renewal with the European Mission objective of climate neutrality by 2030 (Municipality of Bergamo, 2023).

The city's climate neutrality approach is rooted in existing municipal planning instruments. The Action Plan states that the Climate City Contract is designed to fit into the city's main strategic plans through synergy and non-overlap. Relevant frameworks include the Climate Transition Strategy, the Circular Economy Strategy, the Sustainable Urban Mobility Plan, the Territory Government Plan, and the Sustainable Energy and Climate Action Plan. This matters for city-driven MEL because the monitoring and learning system does not begin from an empty institutional field. It is built on prior planning processes, energy and emissions inventories, mobility planning, circular economy work, territorial planning and climate transition strategy (Municipality of Bergamo, 2023).

The Sustainable Energy and Climate Action Plan provides the starting point for the Climate City Contract baseline. The municipality joined the Covenant of Mayors in 2009, prepared an initial Sustainable Energy Action Plan in 2011, and developed the Sustainable Energy and Climate Action Plan in 2023 with the support of TerrAria. The Climate City Contract baseline uses the SECAP inventory as its basis while adapting it to NetZeroCities guidance, including the addition of the waste sector. This continuity between SECAP and the Climate City Contract is significant for MEL because it creates a bridge between established emissions accounting routines and the more portfolio-oriented logic of mission implementation (Municipality of Bergamo, 2023).

The 2030 climate neutrality boundary corresponds to the municipal administrative boundary. Stationary energy and transport are included under scopes 1 and 2, with transport scope 3 excluded in line with NetZeroCities guidance. Waste and wastewater are included under scope 1 and scope 3. IPPU and AFOLU are analysed in the Action Plan but are not included in the core Climate City Contract baseline because their estimated emissions fall below the applied threshold. This boundary-setting is a key governance decision because it determines what is formally tracked within the neutrality pathway, while still making additional sectors analytically visible for possible future integration (Municipality of Bergamo, 2023).

The 2021 Climate City Contract baseline is estimated at 465,645 tCO2eq, net of IPPU and AFOLU. Buildings dominate the profile, accounting for approximately 377,960 tCO2eq, or around 80 percent of emissions. Transport accounts for approximately 83,895 tCO2eq, or around 18 percent. Within buildings, the residential sector accounts for 149,314 tCO2eq, the tertiary sector including municipal services for 143,596 tCO2eq, and industry and agriculture for 85,050 tCO2eq. Private and commercial transport is the main transport subcategory, with 80,417 tCO2eq. The emissions profile therefore indicates that a city-driven MEL system must be able to monitor high-impact building and transport

actions while also capturing enabling actions that affect implementation conditions across the wider portfolio (Municipality of Bergamo, 2023).

The co-planned action portfolio is central to Bergamo's city context. During the co-planning phase, 217 actions were collected from around 40 stakeholders. These included 85 actions in buildings, 32 in transport, five in AFOLU, 30 in waste, and 65 transversal actions. This distribution reflects the emissions profile but also shows that the Climate City Contract is broader than the largest emitting sectors alone. The portfolio includes sectoral and transversal actions that require coordination across municipal departments, external stakeholders, utilities, transport actors, healthcare institutions, universities, private companies, associations and foundations (Municipality of Bergamo, 2023).

The Action Plan states that the implementation of the Climate City Contract follows the NetZeroCities transition map, structured around building a strong mandate, understanding the system, co-designing a portfolio, and activating an inclusive ecosystem for a just climate transition. These elements establish the governance context for MEL. Monitoring, evaluation and learning must therefore support not only the measurement of emissions reductions, but also the coordination of a distributed action portfolio, stakeholder commitments, investment needs, co-benefits, and learning processes required to sustain implementation through 2030 (Municipality of Bergamo, 2023).

4.5.2 MEL as a governance mechanism in Bergamo

In Bergamo, city-driven monitoring, evaluation and learning is best understood as an emerging governance mechanism that connects planning, implementation, stakeholder coordination and adaptation. The Bergamo MEL notes identify four central characteristics of the city's approach: MEL is integrated with the Action and Investment Plans; MEL supports decision-making; ForImpact.ai enables monitoring, aggregation and storytelling; and data gaps are addressed through proxies and learning-by-doing. These characteristics indicate that MEL is not framed as a separate reporting layer, but as a connective function within the Climate City Contract architecture.

The governance relevance of MEL is visible in the relationship between the Action Plan, Investment Plan and Commitment Plan. The Action Plan defines actions, expected impacts, timelines and responsibilities. The Investment Plan translates actions into capital needs, financing sources, risks and cost-effectiveness considerations. The Commitment Plan formalises the roles and commitments of actors involved in the transition. MEL functions across these elements by helping to assess whether priority actions are progressing, whether investment flows align with impact pathways, and where sequencing or support mechanisms may need to be adjusted (Municipality of Bergamo, 2023).

This arrangement means that MEL has both strategic and operational roles. Strategically, it supports the city's ability to understand whether the action portfolio remains aligned with the 2030 neutrality pathway. Operationally, it helps track action implementation status, investment mobilisation, delivery readiness and emerging barriers. Its relevance therefore lies not only in accounting for emissions reductions after implementation, but in providing implementation intelligence while actions are being developed, financed, adjusted and delivered.

The ForImpact digital platform is central to this governance function. The Action Plan describes the platform as an innovation tool introduced with the Mission and made available to the municipality to support continuous engagement of Mission partners, governance of the Climate City Contract, monitoring of actions, direct and indirect impacts, developments over time, and achievement of city objectives. The MEL notes further describe ForImpact.ai as a digital backbone for structuring and aggregating action-level data, monitoring implementation progress, visualising emissions reductions, investment volumes and qualitative co-benefits, and providing a shared digital environment for collaboration across the Climate City Contract ecosystem (Municipality of Bergamo, 2023).

Governance architecture and institutional set-up

Bergamo's MEL governance architecture is anchored in the Transition Team. The Action Plan states that responsibility for governance of the Mission within the municipal administration lies with the Ecology and Environment Department, with four officials and a manager actively involved. The Head of Department acts as Climate Transition Manager, while the Mobility Manager and Energy Manager are also members of the Transition Team. This gives the mission process an administrative centre while connecting it to key technical functions for mobility and energy (Municipality of Bergamo, 2023).

The Transition Team extends across municipal departments through designated contact persons. Departments involved include Mobility and Transport, Public Green, Botanical Garden, Buildings and Monuments, Technological Systems, School and Sports Buildings, Major Requalification Works, Contracts and Tenders, Planning of administrative activities and public works, Network Structures and Hydraulic Works, Housing Service, Heritage, and European Planning. This configuration is important because the emissions profile and action portfolio require competencies distributed across the administration. MEL therefore depends on cross-departmental data generation and coordination, not only on the environmental unit (Municipality of Bergamo, 2023).

Political leadership is also part of the governance architecture. The Action Plan states that the Mayor directly involved the relevant sectors to ensure full engagement and that both the Mayor and the Councillor for Environment and Mobility are actively involved at political level. The MEL notes similarly identify strong political backing from the Mayor and the Councillor for Environment and Mobility. This matters because city-driven MEL is only useful as a governance mechanism if information can inform political and administrative prioritisation, resource allocation and stakeholder engagement (Municipality of Bergamo, 2023).

External support strengthens the institutional set-up. NetZeroCities advisors supported the drafting of documentation through discussions and remote working sessions. TerrAria, already involved in the Sustainable Energy and Climate Action Plan, contributed technical expertise and acts as Energy Manager for the municipality. AESS supported implementation of the Action and Investment Plans, including stakeholder meetings, portfolio development, emissions and investment analysis, identification of barriers and opportunities, governance lines, strategic planning and impact pathway analysis. These actors provide methodological and technical capacity while the municipality retains the coordinating role (Municipality of Bergamo, 2023).

The Action Plan describes the Urban Ecosystem as the extension of the Transition Team to all actors in the city involved in the Mission, including citizens, the public and private sectors, trade associations, and the world of research and education. This distinction between the internal Transition Team and the broader Urban Ecosystem is central to Bergamo's governance model. The former provides municipal coordination; the latter reflects the distributed actors whose actions, data and investments are necessary for achieving the 2030 target (Municipality of Bergamo, 2023).

Co-creation has been a foundational mechanism for building this ecosystem. The external process began with a public expression of interest approved by managerial resolution on 30 August 2023. This invited large companies, SMEs, startups, third sector bodies, universities, research centres and other stakeholders to express willingness to join the Climate City Contract pathway. A public event was held on 11 October 2023 in Palazzo Frizzoni with 16 local organisations, followed by one-to-one meetings to co-create the action portfolio. The Action Plan presents the expression of interest as an innovative governance action aligned with transparency principles in Italy's public contracts framework (Municipality of Bergamo, 2023).

For MEL, the importance of this process is that stakeholders did not simply endorse a municipal strategy. They contributed actions, information, expected impacts and potential co-benefits. The MEL notes state that this co-creation process helped ground emissions reduction estimates in stakeholder-owned actions, identify interdependencies across sectors, surface implementation barriers and enabling conditions early, and ensure that pathways reflected real investment intentions rather than

only technical scenarios. The governance architecture therefore links participation, action design, data generation and future monitoring.

Measurement architecture and data governance

Bergamo's measurement architecture is built around the aggregation of action-level data. The MEL notes state that indicators were developed in parallel with the Action Plan rather than as a standalone exercise. They emerged from stakeholder-provided action data, particularly emissions reduction estimates, investment volumes, implementation timelines and qualitative co-benefits. This gives the indicator framework a direct connection to the portfolio used to model the transition and supports the use of MEL for implementation management rather than only ex-post reporting.

The core quantitative indicators focus on greenhouse gas emissions reductions in tCO2eq per year, investment volumes mobilised by sector and stakeholder type, and action implementation status over time. These are appropriate indicators for the stage of the Bergamo Climate City Contract because they connect the baseline, the action portfolio and the investment logic. They also allow the municipality to distinguish between actions that are high-impact, actions that are investment-critical, and actions that are important enabling conditions even when their direct emissions reductions are less easily quantified.

The baseline inventory provides the main reference point for emissions-related measurement. It is based primarily on the 2021 SECAP inventory, with methodological adjustments to comply with NetZeroCities guidance. The Action Plan applies IPCC emission factors in tCO2eq/MWh, adopts the national 2021 electricity emission factor, retains the local emission factor for district heating, and includes the waste sector while excluding IPPU and AFOLU from the core baseline because they remain below the relevant threshold. This methodological adaptation shows that Bergamo's measurement architecture must reconcile continuity with prior local planning and alignment with Mission-specific accounting requirements (Municipality of Bergamo, 2023).

Measurement is more robust in some sectors than in others. The MEL notes state that reliable quantitative data are more available for energy systems, transport infrastructure and large building projects. By contrast, softer or enabling actions, including awareness, governance and behavioural change, require proxy and process indicators. This reflects a common challenge in city climate governance: the most easily measured indicators are often material or technical, while many necessary conditions for implementation concern institutional routines, stakeholder engagement, social acceptance and learning.

The platform-based architecture is designed to improve data governance across a distributed ecosystem. ForImpact.ai structures data inputs, enables aggregation at sector and city level, and provides a shared reporting environment where public and private stakeholders can document actions, update implementation status and report expected or realised impacts. This reduces reliance on fragmented bilateral reporting and supports traceability of commitments. However, the MEL notes also state that a fully formalised standards or data playbook is still under development. The platform therefore supports consistency, but further methodological standardisation is needed to strengthen comparability and reliability.

Data gaps are treated as a structural feature of the Climate City Contract process rather than as a reason to delay implementation. Robust data are generally available for municipal assets and services, large infrastructure and energy projects, and actions implemented by regulated or technically mature actors such as utilities and transport operators. More significant gaps persist in privately owned buildings, industrial processes, behavioural and lifestyle-related actions, socio-economic co-benefits, and real-time performance data from private-sector actors.

The main barriers to data availability include fragmented data ownership, limited standardisation, confidentiality constraints and uneven technical capacity among stakeholders. Bergamo's response is

adaptive monitoring: phased refinement of indicators, triangulation of data sources, and iterative improvement of assumptions as implementation progresses. Where direct measurement is not available, the city uses proxies and qualitative assessment. Uncertainty is addressed through transparent documentation of assumptions, the use of ranges rather than point estimates where appropriate, and updates as new information becomes available.

Indicators, co-benefits and distribution

Bergamo's indicator set combines quantitative, proxy, process and qualitative elements. Quantitative greenhouse gas indicators remain central because they provide accountability against the 2030 neutrality trajectory. However, the MEL notes state that the indicator set is complemented by early-outcome indicators, process indicators and qualitative descriptors of co-benefits. This balance is significant because the Climate City Contract depends not only on measurable emissions reductions but also on governance milestones, stakeholder engagement, infrastructure delivery, investment mobilisation and social acceptance.

The Action Plan's impact pathways are organised by sectors and systemic levers of change. The relevant sectors include energy systems, mobility and transport, built environment, waste and circular economy, and green infrastructure and nature-based solutions. The levers include technology, governance, social innovation, democracy and participation, finance and investments, and training and information. This structure widens the indicator challenge. It requires the city to monitor sectoral change while also tracking transversal conditions that influence whether actions can be implemented at the pace required for climate neutrality (Municipality of Bergamo, 2023).

Co-benefits are a central part of the Bergamo case, especially for stakeholder engagement and political legitimacy. The MEL notes identify improved air quality, increased urban liveability, health benefits, social inclusion and economic development as co-benefits associated with the action portfolio. At the current stage, co-benefits are primarily identified qualitatively at action level and aggregated narratively by sector. This approach allows the city to recognise wider value beyond emissions reduction, but it also indicates that co-benefit measurement remains less mature than emissions and investment tracking.

The uneven measurement of co-benefits is especially important for issues such as job creation, reduced energy poverty and socio-economic effects. These require data from external actors, including health authorities, utilities and social services. The MEL notes state that partnerships and memoranda of understanding are in place, but systematic data collection and harmonised methodologies are still under development. This suggests that Bergamo's MEL system has begun to identify distributional and social dimensions, but it still needs stronger methods and data-sharing routines to assess these effects consistently.

The Climate City Contract contains several social and governance innovation actions that relate to co-benefits. The Action Plan refers to district networks created to promote and spread practices of citizen involvement, the Clic.Bergamo project focused on strengthening social cohesion as an enabling factor for transition and new urban welfare, and the involvement of the Guarantor of Children's Rights to extend sustainable practices to minors and families. These initiatives show that social cohesion, participation and intergenerational engagement are part of the transition architecture, even if their effects are not yet fully captured through quantitative indicators (Municipality of Bergamo, 2023).

Green infrastructure is another area where co-benefits are visible. The Action Plan notes that the city's green space planning, design and management draws on data from the municipal green space plan and that the municipal administration has planned the planting of 20,000 new trees over seven years to improve air quality. This type of action can contribute to climate, air quality, liveability and adaptation-related benefits. For MEL, it illustrates the need to connect action implementation

indicators, such as trees planted or green space managed, with wider environmental and social outcome indicators where data are available (Municipality of Bergamo, 2023).

Use of MEL in decision-making and implementation

The intended use of MEL in Bergamo is clearly governance-oriented. The MEL notes state that the system is intended to support strategic and operational decision-making, guide prioritisation and sequencing of actions, inform investment discussions with public and private actors, and enable learning and adaptation over time. Baseline and monitoring data are expected to be used internally by the Transition Team and political leadership, and externally for Mission reporting, stakeholder engagement and communication.

Prioritisation is one of the main uses of MEL. The notes state that priority actions for closer monitoring are those that deliver large shares of emissions reductions, involve significant capital investments, or act as enablers for multiple downstream actions. Examples include energy systems, transport infrastructure, district heating, electrification infrastructure and governance platforms. Monitoring intensity is therefore expected to be proportionate to systemic importance rather than uniform across all actions. This is an important principle for mission governance because it allows attention to be directed to actions that shape the feasibility of the whole portfolio.

MEL also informs the selection of key actions from the broader portfolio. The criteria identified in the notes include emissions impact magnitude, readiness and feasibility, investment leverage, and strategic relevance to the 2030 pathway. These criteria show that the system combines impact logic with implementation logic. An action may be important because it reduces emissions directly, because it unlocks finance, because it enables later actions, or because it is sufficiently ready to move into implementation. City-driven MEL therefore supports the practical sequencing of transition activity.

The integration of MEL with the Investment Plan is particularly important. The Climate City Contract portfolio requires significant mobilisation of public and private investment. The MEL notes describe investment volume, capital expenditure, financing sources, risks and cost-effectiveness considerations as part of the information landscape. This means that MEL can support investment discussions by showing whether actions with high emissions potential are matched with credible financing pathways, whether investment gaps are emerging, and whether stakeholder commitments are being translated into delivery.

Different stakeholder groups use MEL outputs differently. The MEL notes indicate that political leaders focus on progress, risks and priorities; technical departments use data for implementation management; external partners use MEL to align investments and commitments; and citizens engage primarily through simplified indicators and narratives. This differentiation is important because a single MEL system must serve multiple governance functions. The same data architecture must support political accountability, technical coordination, partnership management and public communication.

The use of MEL in implementation is still developing. The case materials show a strong architecture for action-level monitoring, but they also indicate that data standards, co-benefit measurement and uncertainty management are not yet fully mature. This means that Bergamo's use of MEL is currently formative and adaptive. It supports implementation while simultaneously revealing where the governance and data infrastructure require further development. The value of MEL therefore lies not only in providing answers, but in making the conditions for effective implementation more visible.

Learning, reflexivity and adaptation

Learning is embedded in Bergamo's MEL approach through the explicit acceptance that data, indicators and assumptions will need to improve over time. The MEL notes describe the approach as learning-by-doing, using proxies and qualitative assessment where robust data are not yet available. This is a pragmatic response to the realities of mission implementation. Waiting for perfect data would risk delaying action, while acting without monitoring would weaken accountability. Bergamo's current model attempts to hold these requirements together through adaptive monitoring.

Reflexivity is visible in the way the city treats uncertainty. The notes state that ease of analysis varies by indicator. Quantitative indicators linked to emissions reductions and investment are relatively straightforward to aggregate when structured through ForImpact.ai. More complex challenges arise where estimates rely on assumptions, actions are in feasibility or early implementation stages, or impacts depend on behavioural uptake. The city responds by documenting assumptions transparently, using ranges where appropriate, and updating indicators as new information becomes available .

The co-planning process also created a learning function before implementation. Workshops, bilateral meetings and thematic roundtables enabled stakeholders to propose actions, contribute data, and discuss impacts, barriers, risks and co-benefits. This helped identify interdependencies and enabling conditions early. In governance terms, the process transformed MEL from a later reporting activity into a formative design practice. Learning occurred as the city and stakeholders jointly clarified what actions were possible, what data existed, what barriers were likely, and what co-benefits could be expected (Municipality of Bergamo, 2023).

The Action Plan explicitly recognises the challenge of building a systemic Theory of Change across different organisations, sectors and actor groups. This is a key reflexive insight. A mission portfolio cannot be governed as a simple list of projects because actions interact across systems, depend on enabling conditions and require sequencing. MEL can support this by tracking whether assumptions about interdependencies, feasibility, investment and stakeholder roles remain valid during implementation. In this sense, learning is not only about improving indicators; it is about testing and adjusting the transition logic itself (Municipality of Bergamo, 2023).

The case notes identify several areas where external support would strengthen learning and adaptation. These include shared methodologies for co-benefit measurement, improved access to private-sector and utility data, and stronger uncertainty management and scenario analysis at city scale. These needs are not peripheral technical issues. They directly affect the ability of MEL to guide prioritisation, investment and communication. They also suggest areas where Mission-wide learning could support Bergamo and other cities facing similar methodological constraints.

Learning is also connected to governance routines. The Action Plan states that the ForImpact platform, together with the permanence and strengthening of the Transition Team, is intended to support the sustainability of the project by 2030 and the continued engagement of the urban ecosystem. This indicates that learning is expected to be institutionalised through repeated monitoring, review and engagement rather than through one-off evaluation. The challenge for the next phase is to translate platform data and stakeholder reporting into regular cycles of reflection, decision-making and adaptation (Municipality of Bergamo, 2023).

Outcomes and emerging signs of institutional change

The uploaded materials do not provide a summative evaluation of implemented outcomes. They present Bergamo at a stage where the Climate City Contract has created a co-planned portfolio, institutional structures and monitoring architecture for implementation. For this reason, the most appropriate outcomes to identify are early governance and process outcomes rather than verified emissions outcomes. These early outcomes are nonetheless important because they indicate whether the city is building the capacities needed for climate-neutrality delivery (Municipality of Bergamo, 2023).

The first emerging outcome is the establishment of a cross-departmental Transition Team. The Action Plan describes the Ecology and Environment Department, Climate Transition Manager, Mobility Manager, Energy Manager and designated contact persons across multiple departments as part of the institutional architecture. This represents a shift from climate action as a sectoral environmental responsibility toward a broader administrative coordination model involving mobility, buildings, public works, green space, procurement, housing, heritage and European planning. For MEL, this provides the organisational basis for data collection, action monitoring and cross-sector learning (Municipality of Bergamo, 2023).

The second outcome is the mobilisation of the Urban Ecosystem around the Climate City Contract. The expression of interest, public event, workshops and bilateral meetings produced a portfolio of 217 actions from around 40 stakeholders. This is a tangible process outcome because it converts broad mission ambition into a structured action portfolio with stakeholder inputs. It also creates a basis for accountability because actions can be monitored through their expected impacts, investment needs, timelines and implementation status (Municipality of Bergamo, 2023).

The third outcome is the integration of emissions, investment and implementation data. The MEL notes state that Bergamo's indicator framework emerged from action-level data on emissions reductions, investment volumes, implementation timelines and qualitative co-benefits. This is a significant governance development because many climate planning processes separate emissions modelling from investment planning and stakeholder commitments. Bergamo's model attempts to connect these elements through the Action Plan, Investment Plan and ForImpact.ai, making it possible to assess whether the portfolio is not only ambitious but also financially and operationally credible.

The fourth outcome is the establishment of a shared digital infrastructure for portfolio monitoring. ForImpact.ai provides a common space for structuring and aggregating action-level data, visualising emissions reductions, investment volumes and co-benefits, and supporting traceability of commitments. This is an institutional outcome because it changes how information can circulate across the municipality and stakeholder ecosystem. It also creates the potential for more transparent and adaptive portfolio governance if the platform becomes embedded in regular review and decision-making routines (Municipality of Bergamo, 2023).

The fifth outcome is the identification of data gaps and methodological needs. The case notes explicitly identify gaps in privately owned buildings, industrial processes, behavioural and lifestyle-related actions, socio-economic co-benefits and real-time performance data from private-sector actors. Making these gaps visible is itself a governance outcome. It helps the city identify where data-sharing agreements, memoranda of understanding, common reporting templates, co-benefit methodologies and technical support are needed. This is a necessary step in moving from initial portfolio design toward a more robust implementation and learning system.

4.5.3 Conclusion and lessons learned

Bergamo's case shows how city-driven MEL can be constructed as a governance mechanism for a mission-oriented climate transition. The central feature of the case is integration. MEL is not treated as a separate reporting requirement but as a connective function linking the Action Plan, Investment Plan, Commitment Plan, Transition Team, stakeholder ecosystem and ForImpact.ai platform. This enables the city to connect emissions reductions, investment mobilisation, action implementation status, co-benefits, barriers and learning in one emerging governance architecture (Municipality of Bergamo, 2023).

The first lesson is that MEL can be designed from the action portfolio rather than added after planning. Bergamo's indicators were developed in parallel with the Action Plan and derived from stakeholder-provided action data. This creates a stronger connection between impact pathways and

implementation monitoring than would be possible if indicators were developed separately. For mission cities, this suggests that the design of MEL should begin during co-creation, when actions, responsibilities, investment needs, assumptions and expected co-benefits are being defined .

The second lesson is that stakeholder-owned data can strengthen the realism of transition pathways. Bergamo's co-planning process collected actions from external and internal stakeholders and used these to ground emissions reduction estimates, identify interdependencies and surface barriers. This helps avoid a purely technical scenario that is disconnected from investment intentions and implementation capacities. However, it also creates a need for common data standards, reporting fields and validation routines so that stakeholder inputs can be aggregated credibly over time (Municipality of Bergamo, 2023).

The third lesson is that digital infrastructure can reduce fragmentation, but only when embedded in governance routines. ForImpact.ai provides a shared environment for monitoring action-level data, impacts, investment volumes and co-benefits. It supports transparency and traceability across the Climate City Contract ecosystem. Yet its effectiveness depends on the Transition Team, municipal departments and external stakeholders using the platform consistently, updating data, interpreting results and connecting findings to decisions. The platform is therefore an enabler of MEL governance, not a substitute for institutional responsibility.

The fourth lesson is that co-benefits need earlier and more systematic methodological attention. Bergamo recognises co-benefits as important for engagement and legitimacy, but current assessment remains mainly qualitative and action-level. This is understandable at an early stage, particularly where data on health, energy poverty, employment and socio-economic effects depend on external sources. Nevertheless, if co-benefits are to inform prioritisation and public communication, they require clearer methods, data-sharing arrangements and a stronger distinction between outputs, early outcomes and longer-term effects.

The fifth lesson is that data gaps should be treated as governance signals. Bergamo's approach does not assume complete data availability at the outset. Instead, it uses proxy indicators, qualitative assessment, transparent assumptions and iterative refinement. This is appropriate for a mission portfolio in which many actions are at different stages of maturity. The identification of gaps in private buildings, industrial processes, behavioural change, co-benefits and private-sector performance data can guide the next generation of institutional agreements and methodological development.

The sixth lesson is that city-driven MEL must connect accountability with learning. Bergamo needs to maintain accountability to the 2030 neutrality pathway through emissions, investment and implementation indicators. At the same time, it needs to support learning about feasibility, sequencing, stakeholder roles, data quality and co-benefits. A rigid system focused only on final emissions outcomes would be insufficient for implementation. A loose system based only on qualitative learning would be insufficient for accountability. Bergamo's emerging model attempts to balance these demands through structured platform-based monitoring and adaptive refinement (Municipality of Bergamo, 2023).

In conclusion, Bergamo provides an example of city-driven MEL at a formative but strategically important stage. The city has created a co-planned action portfolio, established a Transition Team, mobilised an Urban Ecosystem, connected the Climate City Contract to existing municipal strategies, and introduced a digital platform for monitoring and engagement. The main task ahead is to consolidate this architecture into repeated cycles of data collection, review, decision-making, adaptation and communication. If this is achieved, MEL can become a practical governance mechanism for steering the climate neutrality transition rather than a narrow reporting function (Municipality of Bergamo, 2023).

4.6 Turin

Disclaimer: This case study follows the section sequence of the other city cases, but is compiled from the Turin Climate City Contract Action Plan (Città di Torino, 2024), existing materials, and Turin MEL desk-based research conducted by the co-author, but is not supported by interview evidence, workshop participation, or direct review from the city officials.

4.6.1 City context

Turin is the capital of the Regione Piemonte and the Città Metropolitana di Torino. The Climate City Contract describes the municipality as having 860,973 inhabitants at the end of 2023, covering an area of 130 km2 and being divided into eight districts. It is also presented as Italy's fourth-largest economic and productive complex, with strong roles in industry, universities, arts, tourism, science and culture. This urban profile matters for monitoring, evaluation and learning (MEL) because the transition to climate neutrality must operate across a city with a complex socio-economic structure, legacy industrial systems, major knowledge institutions, extensive service sectors and important metropolitan interdependencies (Città di Torino, 2024).

The city context is also marked by demographic and economic change. The Climate City Contract reports that Turin's resident population has declined since its peak in 2012, while the age structure shows a decrease in younger cohorts and an increase in the population aged 65 and over. Employment increased in 2022 compared with the previous year, but remained below the last pre-COVID year of 2019. The document also notes the structural effects of deindustrialisation, while emphasising that manufacturing remains significant in comparison with other European metropolitan cities and that the local enterprise structure is strongly characterised by small and micro-enterprises. These conditions shape the governance relevance of MEL because the climate transition depends not only on technical measures but also on the city's ability to align investment, employment, industrial restructuring, skills development and social inclusion (Città di Torino, 2024).

The current municipal administration, elected in 2021 and led by Mayor Stefano Lo Russo, frames ecological transition as part of a wider set of energy, digital, economic-productive and socio-cultural transitions. The Climate City Contract situates this agenda within a metropolitan Green Deal orientation, with attention to renewable energy production, energy communities, reduced energy demand, upgrading public and private building stocks, separate waste collection, emission reduction, air quality, electric mobility and green infrastructure. It also emphasises the role of investee companies and metropolitan coordination, indicating that climate neutrality is treated as a multi-actor and multi-level governance challenge rather than as an exclusively municipal operational programme (Città di Torino, 2024).

Turin's Climate City Contract is anchored in a 2019 reference year. The Action Plan explains that 2019 was selected because it was the most recent year with available data and because 2020 was excluded to avoid anomalous trends associated with the COVID-19 pandemic. The 2019 CO_2 emissions inventory accounted for 2.4 MtCO2 per year. These emissions were mainly concentrated in residential, tertiary, industrial and private transport sectors, which together accounted for about 82% of emissions. By energy commodity, natural gas accounted for 33% and refined petroleum products for 25%. These baseline figures provide the core measurement reference for the city's climate-neutrality pathway and establish the quantitative basis for monitoring implementation progress (Città di Torino, 2024).

The city had already developed several climate and sustainability instruments before the Mission process, including the Piano d'Azione per l'Energia Sostenibile e il Clima (PAESC), the Torino Action Plan for Energy (TAPE), the Piano Regolatore per l'Illuminazione Comunale (PRIC), the Piano Urbano per la Mobilità Sostenibile (PUMS), and the Piano Strategico dell'Infrastruttura Verde. The Climate City Contract positions these instruments as part of an existing trajectory that had already contributed to an observed reduction trend in the city's emissions inventory. The EU Mission therefore appears in the Action Plan as an opportunity to accelerate and integrate this trajectory, rather than as the first climate policy framework used by the city (Città di Torino, 2024).

The Action Plan sets out a transition strategy organised around 30 macro-actions and a portfolio of 227 micro-actions. The macro-actions cover stationary energy, transport, waste and wastewater, and AFOLU, including urban green infrastructure as a CO_2 sink. They include energy requalification of residential, tertiary, industrial and municipal buildings; district heating expansion; electrification of heating through heat pumps; renewable energy communities; industrial efficiency improvements; public lighting efficiency; photovoltaic electricity production; electrification of private vehicles, buses and the municipal fleet; traffic limitation zones; bicycles, carsharing and carpooling; the second metro line; waste reduction and separate waste collection; carbon capture and storage on the waste-to-energy plant and district heating generation plants; urban forestry; and green roofs. The aggregated effect of implementing the macro-actions is estimated in the Action Plan as a reduction of 2 MtCO2 per year, equivalent to 85.2% of the 2019 reference value, with associated investment costs estimated at EUR 27.1 billion (Città di Torino, 2024).

This context makes Turin a relevant case for city-driven MEL because the city's challenge is not simply to report emissions. The Climate City Contract requires the city to track whether a large and differentiated portfolio of actions, distributed across multiple sectors and actors, is moving the urban system towards a demanding 2030 trajectory. The submitted MEL material therefore frames the Climate City Contract as a dynamic and multilayer model: integrated across environmental, social and economic domains; science-based through modelling and quantitative assessment; dynamic in comparing actual trajectories with target trajectories; quantitative through indicators and key performance indicators; inclusive through dialogue with the social fabric; and transversal in integrating communication and stakeholder competences (Città di Torino, 2024).

4.6.2 MEL as a governance mechanism in Turin

Monitoring, evaluation and learning in Turin is presented as an integrated governance instrument rather than a narrow reporting procedure. The submitted MEL material describes a system that connects scientific modelling, stakeholder engagement, financial oversight, adaptive management and public communication into a single architecture. This is consistent with the Climate City Contract's own description of a work process based on three pillars: process governance, city actors' involvement and transition co-design, and science-based support to policy decision-making. MEL therefore functions as a means of governing the transition, because it links the emission baseline, impact pathways, action portfolio, data infrastructure, investment plan and stakeholder accountability (Città di Torino, 2024).

The governance significance of MEL lies in how evidence is intended to be used. In the Turin case, monitoring does not stop at measuring annual emissions or counting actions. It is intended to compare the evolving urban trajectory with the trajectory required for climate neutrality, identify deviations, interpret why deviations occur and support corrective actions. This means that MEL is explicitly connected to adaptive management. The Climate City Contract describes the CLICC platform as a tool that will track the evolution of urban systems and related emissions, check their coherence with what is expected by the Climate City Contract, and support corrective actions when needed to realign the city's trajectory with its targets (Città di Torino, 2024).

Governance architecture and institutional set-up

Turin's MEL governance architecture is organised around an integrated Mission Team. The Climate City Contract states that this Mission Team was created to manage the definition of decarbonisation pathways, assess impacts and costs, and monitor the city's evolutionary trajectories towards its goals. The Mission Team merges two working groups. The first is the municipal Transition Team, involving the Environment and Ecological Transition Department and the European Funds and PNRR Department, supported by the Interdepartmental Working Group on Climate Change. The second is the working group established at the Energy Center of the Politecnico di Torino under the scientific coordination of the EST@energycenter Lab (Città di Torino, 2024).

This institutional arrangement gives the MEL system a dual character. On one side, it is embedded within municipal departments responsible for ecological transition, European funds and recovery funding. On the other side, it is supported by a multidisciplinary scientific team with expertise in energy systems modelling, environmental impact assessment, urban green infrastructure, building physics, urban morphology and regulation. The submitted MEL material confirms that the partnership with EST@energycenter is central to modelling, indicator specification, data architecture and validation. The governance model therefore does not treat scientific support as an external consultancy detached from implementation. Instead, it embeds analytical capacity within the institutional machinery of the Climate City Contract (Città di Torino, 2024).

Roles and responsibilities for MEL are differentiated across departments and partners. The submitted case material identifies the Environment and Ecological Transition Department as responsible for environmental metrics and the European Funds and PNRR Department as responsible for financial performance tracking. Sectoral leads manage domain-specific data streams across buildings, mobility, waste and other fields. EST@energycenter provides scientific oversight and methodological validation, while utilities and partner organisations contribute operational data. This division of labour is important because the transition is distributed across the city system. MEL must therefore draw on data from multiple delivery settings while maintaining enough central coordination to allow portfolio-level interpretation.

Stakeholder involvement is a constitutive feature of the governance architecture. The Climate City Contract describes a co-design process involving local stakeholders and building on three framework initiatives: Torino City Lab, CTE Next and Torino Social Impact. The local ecosystem includes institutional bodies beyond the municipality, including Regione Piemonte and the Città Metropolitana di Torino, public multi-utility companies, private sector actors, the banking system, trade associations, third sector entities, non-profit organisations, the academic world and citizens, with specific attention to younger generations and vulnerable groups. The submitted MEL material further specifies that the co-creation process between April 2022 and March 2024 involved the Municipal Transition Team, the Interdepartmental Working Group on Climate Change, EST@energycenter, public utilities, financial institutions, industry associations, third sector organisations, youth representatives, vulnerable groups, corporate actors and SMEs (Città di Torino, 2024).

The co-design process is directly relevant to MEL because stakeholders were not only invited to validate predefined measures. The submitted material indicates that they contributed to identifying systemic barriers, feasibility constraints, investment needs and co-benefits associated with macro-actions. The process informed the definition of macro-actions, the modelling of decarbonisation pathways, the selection of indicators under Module B-3 and the structuring of the Investment Plan. This sequence matters analytically because it means that the MEL system was not added after the action portfolio had already been finalised. It was developed in interaction with the pathways, actions and investment logic that it would later be expected to monitor.

The governance architecture also has a multi-level dimension. The Climate City Contract identifies the Regione Piemonte and the Città Metropolitana di Torino as part of the local ecosystem, providing a form of vertical external governance. This is important for a city such as Turin because many relevant systems, including transport, energy infrastructure, economic development and environmental regulation, extend beyond the municipal boundary. MEL can therefore help make visible where

climate-neutrality implementation depends on metropolitan, regional or national conditions. In this sense, the governance architecture positions MEL not only as an internal management process but also as an evidence base for coordination across levels of governance (Città di Torino, 2024).

Measurement architecture and data governance

Turin's measurement architecture is built around a direct connection between baseline emissions, impact pathways, macro-actions, indicators and investment planning. The submitted MEL material states that indicators were developed through a science-based methodology led by EST@energycenter and integrated into the CLICC platform. They are aligned with the 2019 baseline emissions inventory of 2.4 MtCO2 per year, sectoral emission-reduction targets, the 30 macro-actions identified in the Action Plan and the investment tracking structure defined in the Investment Plan. This alignment is central to the case because it allows monitoring to assess not only whether emissions are changing, but whether implementation variables and financial mobilisation are consistent with the pathway required for 2030 climate neutrality.

The Climate City Contract presents the CLICC platform as a web-based IT platform designed to assess ex ante and in silico the impacts of possible policy actions and strategies in terms of avoided CO_2 emissions and associated costs. It is based on ad hoc models and algorithms, allowing decision-makers to compare policy options quantitatively and objectively. The platform also supports the automatic compilation of sections of the Climate City Contract. When connected to the Energy & Transition Data Room, it is intended to track the evolution of the urban system and its emissions, compare observed and expected trajectories, and support corrective interventions (Città di Torino, 2024).

The Energy & Transition Data Room is the second major component of Turin's measurement architecture. The Climate City Contract describes it as a research mirror located at the Energy Center of the Politecnico di Torino and intended to host a copy of relevant city data. It is based conceptually on coupling a data lakehouse approach, able to store and manage structured, semi-structured and unstructured data, with a distributed database approach intended to improve resilience and performance. The infrastructure is described as a hyperconverged cluster with a distributed architecture of five nodes and three copies of all data distributed across those nodes. This technical design is important because MEL depends on the capacity to integrate heterogeneous data sources while ensuring continuity, redundancy and high-performance querying (Città di Torino, 2024).

Data governance is therefore treated as an institutional and technical requirement for climate-neutrality governance. The submitted MEL material states that the city has established structured data pipelines and is developing standardised reporting templates with key partners. Environmental data are overseen by the Environment and Ecological Transition Department, financial data by the European Funds and PNRR Department, sectoral data by dedicated technical leads, and scientific validation by EST@energycenter. These arrangements respond to the practical reality that different datasets originate from municipal departments, utilities, regional agencies, national statistics, private companies and research organisations.

The case material also makes clear that data availability is uneven. In areas such as public building renovation and district heating expansion, indicator calculations are relatively more straightforward because activity data and emission factors are more established. In more dynamic domains, including private mobility behaviour, private fleet electrification and distributed renewable generation, aggregation and verification require additional modelling and cross-validation. The submitted material also identifies gaps around granular building-level energy performance, behavioural shifts in mobility, private sector data and co-benefits such as energy poverty alleviation or green-sector job creation. These gaps demonstrate why the measurement system must be adaptive and why modelled estimates, proxy indicators and periodic methodological updates are part of the MEL architecture.

Uncertainty is explicitly recognised. The submitted MEL material describes three main ways of managing it: scenario modelling and sensitivity analysis within CLICC; periodic updating of emission

factors and modelling parameters using more recent national and European data; and a distinction between measured data and estimated projections. This is an important feature of robust MEL because it prevents the system from treating all indicators as if they had the same evidentiary status. It also enables collective interpretation when observed performance diverges from projections. Deviations can then be assessed as possible implementation delays, unrealistic assumptions, structural constraints or data-quality effects.

The measurement architecture is also closely linked to the city ontology developed for the CLICC approach. The Action Plan presents the science-based support pillar as a process of systematically collecting, cleaning, validating and updating data that characterise sectors and sub-sectors of the urban system. This implies a view of the city as an interconnected system in which emissions sources, energy carriers, infrastructures, actors, investments and policy actions must be represented coherently. MEL is therefore dependent on data architecture, but the purpose of data architecture is governance: to enable policy choices to be compared, implementation to be tracked and pathways to be recalibrated as evidence changes (Città di Torino, 2024).

Indicators, co-benefits and distribution

Turin's indicator set combines emissions metrics, implementation variables, financial indicators and process-oriented metrics. For each macro-area, including stationary energy, transport, waste and AFOLU, indicators quantify direct CO_2 reductions, track implementation variables and reflect financial performance. Examples from the submitted MEL material include square metres retrofitted, kilometres of district heating expansion, renewable generation capacity, electrification rates, capital expenditure mobilisation and leverage ratios. Indicators were selected on the basis of data availability, robustness, replicability and decision-making relevance. This selection logic connects technical feasibility with governance use, because an indicator is valuable only if it can support monitoring, interpretation and action .

The balance between quantitative and qualitative indicators is a notable feature of the case. Quantitative indicators focus on tonnes of CO_2 reduced, renewable generation capacity and electrification rates. Qualitative or process-oriented indicators include governance innovations implemented, stakeholder engagement milestones and social innovation deployment. Early proxy indicators include building renovation rates, modal-shift indicators and district heating penetration. The submitted material recognises that some outcomes, such as behavioural change and private sector cultural transition, remain difficult to quantify and are therefore tracked through proxy and participation metrics. This is consistent with the broader logic of city-driven MEL, where early signs of systemic change may precede measurable emissions reductions.

The Climate City Contract confirms the centrality of indicators through Module B-3, which is dedicated to indicators for monitoring, evaluation and learning, and through the listing of indicator metadata. The same document also connects indicators with the 30 macro-actions and the 227 micro-actions uploaded to the CLICC platform to monitor their evolution. This creates a layered monitoring structure: macro-actions define the city-wide levers required to alter the emissions inventory, while micro-actions provide more operationally specific activities already in progress or to be developed. This structure supports both strategic tracking and operational follow-up, provided that data streams are maintained across implementation partners (Città di Torino, 2024).

Co-benefits are integrated into the Action Plan and the MEL material. The Climate City Contract states that for each macro-action, related co-benefits were identified in fields including air-quality improvement, energy poverty and social inequalities, and health. The submitted MEL material expands this by identifying improved air quality, health outcomes, energy cost savings, job creation and equity impacts as co-benefits reflected in supporting indicators where feasible. Examples include workforce participation in deep renovation programmes and reductions in household energy expenditure as proxy indicators for employment and energy poverty outcomes. This approach

broadens the evaluative frame from emissions alone to the wider public value of climate action (Città di Torino, 2024).

The integration of co-benefits is important for distributional governance. Turin's city context includes an ageing population, ongoing economic restructuring and a business system dominated by small and micro-enterprises. A climate-neutrality pathway that depends on building renovation, transport transformation, heating electrification, district heating expansion and private investment will have social and economic implications. Co-benefit indicators can therefore help make visible whether implementation contributes to reduced energy expenditure, improved health, employment opportunities and more equitable outcomes. However, the submitted MEL material also indicates that the data required for co-benefit tracking are more complex and include socio-economic datasets, environmental monitoring and operational data from utilities and transport operators (Città di Torino, 2024).

Access to co-benefit data is uneven. Some datasets are routinely collected by public agencies such as ARPA Piemonte or ISTAT, while others require negotiation with private corporations or utilities. This raises issues of confidentiality, quality control and comparability. The Energy & Transition Data Room, data-sharing agreements and standardised reporting templates are therefore significant not only for emissions accounting but also for integrating wider social, economic and environmental indicators. The city's MEL system is presented as a way to connect these heterogeneous datasets into a common evidence base for adaptive management.

The indicator architecture also supports prioritisation. The submitted MEL material identifies deep renovation of existing buildings, decarbonisation and expansion of district heating, and electrification as among the most important macro-actions to monitor closely because they have high potential for emissions reduction, involve substantial public and private investment, and require alignment of technical, financial and regulatory mechanisms. Richer data layers and higher monitoring frequency are therefore assigned to these high-impact areas. In this way, indicators are not neutral reporting devices; they help determine where managerial attention, stakeholder engagement and resources need to be concentrated .

Use of MEL in decision-making and adaptive management

There are four interconnected purposes for Turin's MEL framework.

1. It tracks progress along the 2030 neutrality trajectory.
2. It informs adaptive governance by revealing bottlenecks and opportunities for correction.
3. It supports investment oversight and capital mobilisation.
4. It provides accountability to residents, investors and European institutions.

This multi-purpose orientation is consistent with the Climate City Contract's own framing of the CLICC platform as a tool for comparing strategies, assessing costs and impacts, tracking trajectories and supporting corrective interventions (Città di Torino, 2024).

MEL informs decision-making through scenario comparison and cost-effectiveness assessment. Data from CLICC and associated dashboards allow planners to compare alternative pathways, assess marginal abatement costs and evaluate investment readiness. Actions that demonstrate strong emission impact, implementation feasibility and robust co-benefits can be elevated in priority. Conversely, actions that underperform against indicators can trigger renewed analysis of barriers and corrective measures. This creates an adaptive threshold logic: indicators are used not simply to judge success or failure, but to decide when a strategy needs to be adjusted.

Financial decision-making is a particularly important dimension of the case. The Climate City Contract estimates the investment cost of the macro-action package at EUR 27.1 billion. The submitted MEL material indicates that economic and financial indicators from the Investment Plan are linked to environmental indicators, including capital expenditure mobilisation and leverage ratios. This linkage enables monitoring to assess whether the financial conditions for emissions reduction are being created. It also allows the city to identify where public budgets, European funds, PNRR resources, private finance or utility investment may need to be aligned more effectively with implementation priorities (Città di Torino, 2024).

Operational decision-making is also supported through sectoral monitoring. For building renovation, MEL can track renovation rates, associated emissions reductions, financial mobilisation and co-benefits such as energy cost savings. For district heating, MEL can track network expansion, decarbonisation of generation and interactions with electrification pathways. For mobility, MEL can monitor electrification rates, traffic limitation zones, alternative mobility uptake and public transport infrastructure. For waste, MEL can track waste reduction, separate collection and the possible contribution of carbon capture on waste-to-energy infrastructure. This sectoral use of MEL supports the city in interpreting implementation not as a list of isolated projects but as a portfolio of interacting interventions (Città di Torino, 2024).

Adaptive management is explicitly built into the system. The submitted MEL material states that findings from MEL can help reframe and adapt original assumptions and risks. If electrification rates depend on infrastructure expansion that lags behind schedule, the city can revisit sequencing strategies or complementary measures. If co-benefit indicators show uneven distribution of gains, corrective social policies may be considered. If updated data diverge from projected trajectories, the Transition Team can convene technical reviews to assess whether the divergence is due to implementation delays, assumptions or structural constraints. This positions MEL as a reflexive governance process rather than a compliance mechanism.

The capacity to revise indicators and assumptions is also institutionalised. The submitted material states that the Mission Team, supported by EST@energycenter, has scope to revise methodologies, indicators and reporting cycles where evidence suggests that changes would improve clarity, relevance or usability. Periodic review operates at multiple levels: EST@energycenter updates methods, emission factors, modelling parameters and scenario assumptions; the Mission Team reviews progress against the 2030 trajectory; and key stakeholders may be involved in consultative review sessions. This layered process maintains alignment between the baseline inventory, macro-action portfolio, investment commitments and long-term neutrality target .

This adaptive orientation is important because the Climate City Contract is based on a demanding and uncertain transition. Some high-impact measures depend on technological adoption, market conditions, private sector participation, regulatory frameworks and behavioural change. The city's MEL framework therefore cannot assume that the pathway designed ex ante will remain fully valid throughout implementation. It must instead provide a way to learn whether assumptions hold, identify which barriers are emerging and adjust the portfolio accordingly. The Turin case is thus a strong example of MEL as a navigational rather than purely retrospective tool (Città di Torino, 2024).

Learning, participation and communication

Learning in the Turin case is grounded in the connection between co-creation, modelling, data interpretation and revision. The co-design process described in the Climate City Contract involved working tables, workshops with thematic stakeholders, meetings addressed to young people and youth associations, and activities to engage vulnerable subjects. These activities were intended to inform participants about the Mission, create a common action perspective, co-create knowledge on the city's carbon footprint, initiate co-design of the action portfolio and engage stakeholders for

implementation. This means that learning was not restricted to internal technical teams; it was part of the process through which the Climate City Contract was developed (Città di Torino, 2024).

Participation is also relevant during implementation. The submitted MEL material states that different stakeholder groups use the MEL system in different ways. Municipal leaders use indicators for strategic performance and policy adjustment, utilities integrate them into operational reporting cycles, financial partners use them for risk and return assessment, and civil society actors use them for transparency and advocacy. Core indicators such as total GHG reductions, renovation rates and investment performance become shared reference points for dialogue and accountability. This shared reference function is important because climate-neutrality implementation depends on actors whose decisions are distributed across the city system.

Collective interpretation is another learning function. The submitted material states that assessment is not limited to technical calculation but includes structured interpretation involving internal and external stakeholders. At institutional level, the Mission Team reviews aggregated data outputs against impact pathways. Sectoral working groups examine individual macro-actions and identify cross-sector interactions. Sense-making is especially important where trade-offs arise, such as balancing district heating expansion with electrification strategies or reconciling transport decarbonisation with social equity considerations. In selected phases, interpretation extends to utilities, academic partners and organised civil society actors.

The digital infrastructure supports learning by enabling scenario testing and iterative recalculation. CLICC allows dynamic modelling, scenario comparison and automated documentation generation. While not all data streams are real-time, the system supports regular updates and recalculations. The Energy & Transition Data Room is intended to improve data integration and analytical capacity. The submitted MEL material notes that artificial intelligence is not yet systematically deployed across all sectors, although the modelling environment enables advanced algorithmic simulations and future opportunities may include predictive mobility analysis and building performance optimisation. These digital capacities are relevant only insofar as they feed into governance processes of interpretation and adaptation (Città di Torino, 2024).

Communication is treated as a differentiated governance function. The submitted material indicates that MEL outputs serve different audiences: European institutions and investors require credibility and evidence of progress; municipal leadership requires prioritisation and oversight; citizens require transparency; and private sector actors require signals about opportunities for alignment and partnership. The Climate City Contract's emphasis on inclusiveness and transversal communication is consistent with this, because the transition must be communicated not only as a technical decarbonisation programme but as a broader urban transformation agenda (Città di Torino, 2024).

Co-benefits are central to communication and narrative construction. Turin uses indicators related to air-quality improvements, job creation and reduced energy bills to present climate neutrality as a socio-economic transformation opportunity as well as an environmental imperative. Co-benefit evidence can also support investment by showing positive spillovers such as increased building value, reduced health costs or lower household energy expenditure. This narrative function matters because public and private support for implementation may depend on whether climate action is understood as delivering tangible benefits beyond carbon reduction.

The learning function is nevertheless still dependent on data quality, stakeholder participation and administrative capacity. The submitted material identifies ongoing challenges in data completeness, interoperability, private sector monitoring and co-benefit measurement. It also notes that high administrative workload can constrain the time available for revising methods and indicators, although the partnership with Politecnico di Torino helps mitigate this constraint. This suggests that learning must be actively resourced. Without time for synthesis, interpretation and revision, monitoring risks becoming stronger than learning even when the technical infrastructure is sophisticated.

Outcomes and impact

The outcomes of Turin's MEL system can be assessed in terms of governance capacity as well as projected emissions reduction. The Climate City Contract estimates that implementing the macro-action package would reduce emissions by 2 MtCO2 per year, equivalent to 85.2% of the 2019 baseline value of 2.4 MtCO2 per year. This quantified pathway is important, but the distinctive contribution of MEL lies in how the city has built a system to track whether the pathway remains credible as implementation proceeds. MEL supports the city in linking the target to actions, data, investment, actors and corrective governance processes (Città di Torino, 2024).

- **Integration of climate data and decision-making**. The CLICC platform and Energy & Transition Data Room provide the city with a structured way to organise evidence, test pathways, monitor actions and compare actual and expected trajectories. This reduces reliance on fragmented data handling and creates a common infrastructure for emission modelling, indicator calculation and documentation. The Climate City Contract presents this as part of a possible "Torino Model" for science-based support to cities in energy and environmental policy decision-making, potentially reproducible in other contexts (Città di Torino, 2024).
- **Integration of environmental and financial monitoring**. By linking CO_2 reduction indicators with capital mobilisation and investment readiness, the city can identify whether climate-neutrality implementation is being matched by the resources required. This is particularly significant given the EUR 27.1 billion estimated investment need. The MEL system can therefore support prioritisation, reveal financing gaps and provide evidence for engagement with investors, utilities, European institutions and national funding streams. In this sense, MEL contributes to the credibility of the Climate City Contract as an implementation framework rather than simply a strategic document (Città di Torino, 2024).
- **Stronger stakeholder accountability**. The co-design process created a basis for shared ownership of pathways and indicators, while standardised templates, data-sharing agreements and the CCC membership scheme described in the submitted material provide mechanisms for integrating private sector contributions. This is important because many relevant actions, including building renovation, private fleet electrification, renewable deployment and industrial efficiency, depend on actors outside direct municipal control. MEL can therefore help translate distributed contributions into a shared monitoring regime, though the submitted material also recognises that coverage and comparability of private sector data remain areas for improvement .
- **Improved capacity for adaptive management**. The system is designed to reveal deviations from the expected pathway and to support corrective actions. This can help the city identify where assumptions are unrealistic, where implementation is delayed, where enabling infrastructure is insufficient or where co-benefits are not being distributed as expected. The value of this outcome is not only technical; it is institutional. It gives the Mission Team, municipal departments and partners a structured reason to revisit choices, update models and reallocate attention or resources (Città di Torino, 2024).

Several limitations and risks remain. Data gaps persist in granular building-level energy performance, private mobility behaviour, distributed renewable generation, private sector emissions reductions and co-benefits such as energy poverty and green employment. Interoperability across legacy systems and partner databases requires ongoing coordination. Proxy indicators and scenario estimates must be used carefully to avoid overstating what has been measured. Administrative capacity must also be protected so that learning and adaptation are not displaced by reporting obligations. These limitations do not undermine the case; rather, they show why Turin's MEL approach must remain iterative and why indicators should be treated as navigational instruments rather than fixed benchmarks.

4.6.3 Conclusion and lessons learned

Turin's experience offers several lessons for mission-oriented city climate governance.

- **MEL is most effective when it is designed with the impact pathways, action portfolio and investment plan**, rather than added afterwards as a reporting layer. In Turin, the indicator system is aligned with the 2019 baseline inventory, sectoral targets, 30 macro-actions, 227 micro-actions and investment tracking. This gives MEL practical relevance because the system measures what the city intends to govern, finance and adapt (Città di Torino, 2024).
- **Scientific modelling can strengthen city-driven MEL when it is embedded in governance**. The partnership between the municipality and EST@energycenter provides methodological capacity, scenario modelling, data architecture and validation. The CLICC platform and Energy & Transition Data Room demonstrate how digital infrastructure can support decision-making, but their governance value depends on their connection to municipal departments, sectoral leads, utilities, investors and stakeholders. Technical modelling therefore becomes a governance capability when it supports interpretation, prioritisation and revision (Città di Torino, 2024).
- **City-driven MEL needs to operate across a distributed governance landscape**. Turin's transition depends on municipal departments, public utilities, regional and metropolitan actors, financial institutions, industry, SMEs, third sector organisations, citizens, young people and vulnerable groups. The co-design process strengthened the relevance of impact pathways and indicators by incorporating feasibility constraints, investment needs and co-benefits. For other mission cities, this suggests that MEL systems should include mechanisms for external data contribution, shared interpretation and stakeholder accountability, not only internal administrative reporting (Città di Torino, 2024).
- **Co-benefits and distributional effects need to be integrated from the beginning**. Turin identifies co-benefits for each macro-action and links environmental indicators to air quality, health, energy cost savings, job creation and equity where feasible. However, the case also shows that co-benefit data are more difficult to access and interpret than many technical emissions indicators. Mission cities should therefore treat co-benefit monitoring as a methodological and governance challenge, requiring socio-economic data, proxy indicators, public agency cooperation, private data-sharing and careful interpretation (Città di Torino, 2024).
- **MEL should be understood as an adaptive management system**. Turin's framework is designed to compare actual and expected trajectories, distinguish measured and estimated data, revise assumptions, update indicators and initiate corrective action where pathways diverge from expectations. This is essential for climate-neutrality implementation because cities must act under conditions of uncertainty, technological change, market fluctuation, regulatory dependency and behavioural complexity. MEL therefore provides a way to maintain accountability while still allowing the pathway to evolve.

Turin illustrates a relatively advanced model of city-driven MEL in which monitoring, evaluation and learning are embedded in the operational governance of a Climate City Contract. The system links a quantified emissions baseline with macro-actions, micro-actions, co-benefits, digital platforms, data governance, financial tracking, stakeholder engagement and adaptive review. Its main challenge will be to sustain the institutional, technical and participatory capacity required to keep the system useful during implementation. For other mission cities, the key lesson is that MEL can support climate neutrality when it is treated not as a compliance requirement but as a reflexive governance capability: a way to organise evidence, align actors, steer investment, communicate value and revise action as the transition unfolds.

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