Urban Sustainability in Europe

What is driving cities' environmental change?

European Environment Agency

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The EEA would like to acknowledge the essential contribution of the European Topic Centres (ETCs) as well as the wider urban stakeholder group that contributed to the study design and scrutinised the research findings via multiple in-person and virtual stakeholder meetings, and provided constructive feedback that supported the development of this final report. Some institutional stakeholders from the European Commission have supported this project since its inception, including DG REGIO, DG CLIMA, DG ENV and the JRC. The EEA would also like to thank the cities that supported this work by participating in the survey on urban sustainability transitions: Barcelona, Cornellà de Llobregat, Essen, Freiburg, Gabrovo, Ghent, Glasgow, Hamburg, Horst aan de Maas, Lahti, Leuven, Lisbon, Ludwigsburg, Malmö, Mechelen, Mikkeli, Nantes, Nijmegen, Oslo, Reykjavík, Stockholm, Tallinn, Torres Vedras, Växjö, Vitoria-Gasteiz, Umeå. Special thanks go to the city officials from Cornellà de Llobregat, Gabrovo, Leuven, Lisbon, Mikkeli, Stockholm and Tallinn that took time out of their busy schedules to participate in the semi-structured interviews and thereby enabled a deeper understanding of the specific drivers and barriers these cities are facing in their sustainability transition.

The EEA project manager was Ivone Pereira Martins.

COVID-19 preamble

The coronavirus crisis has had wide-ranging impacts on cities and is likely to remain deeply intertwined with efforts to transition towards more environmentally sustainable urbanisation patterns for years to come. However, the research for this report, including the survey and interviews with city representatives, were finalised just as the coronavirus emerged in Europe. As such, the data do not capture how COVID-19 and its aftermath may be affecting the profiled cities and their perspectives on the urban sustainability transition.

Wherever possible, this report reflects briefly on the ways some of the observed drivers and barriers may be shaped by the coronavirus crisis. However, it should be noted that this is purely speculative and is not based on empirical evidence from any of the participating cities. Follow-up research would be required to understand if and how their answers may have changed in light of this new reality.

The present report is both a prototype and a benchmark. What is presented here — with the involvement of a limited number of cities — serves to test our methodology, before use with a larger number of participant cities. Meanwhile, given that it depicts cities' concerns and perspectives immediately before the outbreak of the pandemic, this report is also a perfect benchmark to assess how the new reality has changed key cities' views about what is driving their sustainability transformations.

We know that cities have been at the forefront of the health crisis from the very beginning, not only bearing the worst impacts but also becoming essential actors in proactively and innovatively addressing the health emergency, as well as dealing with the wider social and economic ramifications. It is clear that city, national and EU budgets will come under strain as a result of the economic crisis, which may result in reduced budgets for core environmental initiatives in the years ahead.

At the same time, many policies that have been implemented primarily to deal with the health emergency will also have long-term environmental benefits (e.g. improved active travel infrastructure) and there is a growing movement of cities in Europe actively committing to a green recovery from the crisis — supported by initiatives at the EU level, such as the European Green Deal.

As regards cultural shifts, similar uncertainties exist. While people may be more attuned to the importance of clean air and high-quality green spaces, we are also seeing, for example, growth in single-use plastics, and a renewed preference for the use of private cars over public transport, which may have serious environmental consequences.

What is clear is that for most Europeans, the pandemic has caused abrupt changes in daily routines that will have far-reaching consequences for cities. For many urban dwellers, working from home has become the new normal, video conferences have replaced face-to-face meetings (and related business travel), online shopping is taking over from physical retail, and people are becoming better acquainted with their immediate neighbourhoods and local green spaces.

The coronavirus crisis is clearly a challenge of unprecedented proportions, while also offering a window of opportunity that may accelerate sustainability transformations in cities. From the perspective of both research and practice, it is clear that there is a long agenda of issues that will have to be tackled in the months and years ahead. These include, for example: what a green recovery looks like for different cities; the meaning of urbanity and the appropriate mix of land uses; new requirements for the design of the public realm and green spaces; opportunities and challenges presented by new modes of transport; changes in urban functions (e.g. homes becoming the hub of day-to-day life and office buildings being converted to housing); the impact on local business and service providers (e.g. less inner-city footfall); the role of technology and digital futures; urban and regional production and value chains; and considerations of new forms of urban decision-making.

While current efforts are rightly focused on tackling the immediate challenges posed by the pandemic, it is important to swiftly put in place recovery pathways that align with wider sustainability objectives. The EU's ambition of climate neutrality by 2050 and its European Green Deal must stay on track, while continuing to recognise the profound societal changes we are undergoing.

Moving forward, it will be ever more important to ensure a fair transition for all while rebuilding our economies sustainably. One important legacy of this crisis is likely to be the realisation that behaviours, institutions and even infrastructure can be changed a lot faster than may have previously been assumed. We are not as 'locked-in' to certain ways of doing things as we thought and, if needed, can radically transform how our cities operate and how we operate within them. This has important implications for cities when it comes to the transformation of systems that will be required to tackle the climate and ecological crisis in the years to come.

Executive Summary

Background and policy context

The EEA's *European Environment – State and Outlook 2020 Report (SOER 2020)* emphasises that cities are key drivers of change when it comes to wider sustainability transitions across Europe. Cities are hubs of creativity, innovation and learning and have the capacity to effect systemic changes across a range of critical environmental issues (EEA, 2019). Cities concentrate people, jobs and economic activity, however, this also means that they are disproportionately impacted by social challenges such as segregation, poverty and inequality (EC, 2016). Vulnerabilities from climate change and other environmental stresses will also be felt most acutely in urban areas due to higher densities of people and infrastructure, and the dependence of cities on their hinterlands for food, water, energy and other resources (EEA, 2019). The EEA's in-depth analysis of drivers of change of relevance for Europe's environment and sustainability (EEA, 2020) emphasised that cities have a primary role in pushing forward societal change by harbouring the circulation of ideas and encouraging social and technological innovations, experiments and changes in values, lifestyles and approaches to governance.

Cities are therefore both places where systemic challenges must be met, and places of opportunity to address these challenges. Of course, cities differ enormously in the challenges they face and the tools they have available to address these. Sharing concrete examples of the many different expressions of urban sustainability can help to inspire cities, irrespective of their context, to recognise that there is a transition pathway that is right for them.

This report provides some initial ideas about how progress towards this goal can be accelerated by identifying common factors that can either enable or hinder urban sustainability transitions. Understanding the underlying factors that have allowed some European cities to address complex environmental challenges while simultaneously thriving economically and strengthening their social fabric has relevance far beyond the case of individual cities. Across the EU, the important role of cities as champions for environmental sustainability is being recognised, and yet there is not enough information about what actually allows some cities to engage in transformative change in this arena. Understanding the right enabling conditions and drivers of these changes is important, but so too is a clearer sense of the barriers that may be preventing some cities from reaching their sustainability potential or overcoming long-standing economic, institutional and cultural challenges that may be leading to sub-optimal environmental outcomes. This report also aims to provide important lessons about the way in which cities and national governments can foster more sustainable urban growth that protects environmental quality and creates thriving, low-carbon and climate-resilient communities that promote economic vitality, health, wellbeing and social inclusion. This report is the first in a series of EEA outputs focusing on urban sustainability transitions.

Research approach

Drawing on the expertise of a wide range of stakeholders, the EEA has developed an overarching conceptual framework for urban environmental sustainability to provide the basis for future assessments. The conceptual framework is based on four main components: lenses; context; enabling factors; and building blocks.

This report focuses on one initial dimension — an analysis of drivers of and barriers to transitions towards urban environmental sustainability — using the context and enabling factors as entry points into the discussion.

The research is based on a mixed-method approach that combines a literature review, survey and interviews with city authorities to provide a well-rounded picture of the different factors that are driving environmental sustainability in European cities. The survey was conducted with a selection of 'frontrunner' cities that have either won or been selected as finalists in the European Green Capital Awards (EGCA) or the European Green Leaf Awards (EGLA).

This is a relatively small-scale pilot study to test the approach and results should therefore not be seen as capturing the full spectrum of drivers and barriers experienced by the case study cities, but as an entry point to a wider conversation about the drivers of and barriers to urban sustainability transitions.

Urban environmental sustainability transitions: drivers and barriers

This exploratory piece of work delivers important findings in relation to the key drivers of and barriers to urban sustainability transitions. Looking across all of the enabling factors identified in this research, certain factors stand out. While some factors provided a level of consensus, there was also divergence in how cities assessed the importance of different factors. Factors that were identified as extremely important to achieving sustainability transitions by some cities, were highlighted as barriers or seen as a less relevant by others, indicating that there is no 'one-size-fits-all' approach.

Both drivers and barriers were identified within seven key areas: context; governance; knowledge; culture; technology, data and information; and finance. These are examined in detail within the report.

Key lessons emerging from this research

There are a number of specific lessons that emerge from this research. These lessons may be helpful to policy-makers but also other urban stakeholders, including local citizens, NGOs and the research community to accelerate urban environmental sustainability transitions across European cities.

- **Cities are heterogeneous and transitions pathways need to be tailored to local contexts**, as drivers and barriers can differ greatly between cities. In order to achieve successful urban sustainability transitions across Europe, the diverse needs and capacities of individual cities, as well as different policy and sectoral priorities, need to be taken into account and supported by flexible EU, national and regional governance and legislative systems.

- **Some contextual factors are fixed and hard to change** (e.g. climate, geographical context), **but many are dynamic and evolving** (e.g. demographics, GDP, infrastructure) and can be influenced by agile policy-making and targeted policy interventions. Understanding the complex relationships between the existing urban context and cities' constantly evolving sustainability efforts can help them prioritise the most appropriate environmental policies for their individual circumstances.

- **City governments' sustainability visions and strategic plans are vital as foundations for further action.** Coupled with clear and measurable targets and committed leadership they can play an important role in advancing ambitious environmental goals. Visions and plans should include clear development trajectories and need to be aligned with wider programmes set at national and EU level.

- **EU laws and policy frameworks have a key role to play in accelerating sustainability changes in cities**. Cities are strongly incentivised, supported and even inspired by EU laws, standards, regulations and funding opportunities. The European Green Deal, the Urban Agenda for the EU and various EU Directives (e.g. Water Framework Directive, Energy Efficiency Directive, Energy Performance of Buildings Directive) all play a critical role in shaping city action.

- **National and supranational governments can facilitate, as well as inhibit, systemic change** towards urban sustainability transitions in cities. Whilst they are crucial in fostering knowledge exchange and supporting strong networks that enable peer-to-peer learning (e.g. European Green Capital Award, European Green Leaf Award), some cities highlighted that a lack of alignment between local, national and supranational priorities and objectives can undermine progress.

- **Cities benefit from greater decision-making powers and fiscal autonomy**, particularly when it comes to policy sectors that most acutely influence local sustainability outcomes. A lack of fiscal autonomy was repeatedly highlighted as a barrier that constrains cities in accelerating their sustainability transitions, particularly when it comes to large-scale investments such as new transport infrastructure.

- **City networks and focused partnerships can add value**, for example through knowledge sharing and creating spaces for cities to learn from each other's experiences. The networks work best when they encourage collaboration rather than competition and when it is very clear what their value-added is for individual member cities. Having a safe space to not only share successes but also failures was highlighted as an important aspect of such networks.

- **Local research and experimentation can accelerate innovation** and is critical to identifying locally appropriate solutions by using the city as a testbed for new ideas. It also allows cities to think about the different sustainability nexuses that they want to address and to find solutions that can lead to co-benefits across different critical policy sectors.

- **Involving various stakeholders and supporting effective public engagement in decision-making processes leads to better sustainability outcomes**. A sense of ownership and shared responsibility can help to create a common understanding of sustainability issues across various government sectors and levels, while also fostering buy-in from the private sector and the general public, encouraging behavioural changes in support of the sustainability transition.

- **New technologies can play an important role but need to be inclusive and fit for purpose**. While new technologies are not a panacea for all environmental challenges, and care must be taken to account for possible unintended consequences or side-effects (e.g. social exclusion and inequality in access to goods and services), technological developments play an important role in accelerating sustainability transitions.

- **Updated and accessible data and information is needed to monitor progress**. This leads to better environmental management and makes it easier to demonstrate how a city is advancing towards specific goals. Collaboration with national and EU statistics offices, along with EU directives and memberships of other EU networks, helps cities to identify areas where they may be lagging behind and incentivises them to improve their data and information collection processes. Using new technologies to improve data collection and analysis is also essential.

- **Communicating information effectively and innovatively is an important part of engaging the public**. Thinking in innovative ways about how data and information can be presented to highlight challenges or new initiatives can ensure that the public is clear about what the city is aiming to achieve and how they can be part of the sustainability transition. Innovative ways of communication include more qualitative storytelling, having high-profile 'champions' to promote more sustainable behaviours, accessible and attractive methods of data visualisation and presentation, as well as better availability of open data.

- **Accessing EU, national and private funding plays a critical role** in supporting cities' sustainably transitions. Governments can accelerate systemic change by reorienting financial flows towards sustainable investments and by developing relevant knowledge systems and skills to support these. While wealthier cities usually have more control over their investments, for cities with less own-source revenues, knowing how to access other sources of funding at EU and national level can be an important driver of progress.

- **Green procurement processes and sustainable consumption are important drivers of change.** Green procurement practices provide an opportunity for cities to align public spending with core environmental objectives, so these processes need to be simplified and streamlined. Ensuring that individuals use their purchasing power for good can be a challenging area for cities to influence, but more sustainable consumption patterns within wider society was seen as an important complement to local government efforts.

Future research opportunities

The findings and emerging lessons from this study provide an entry point to a wider conversation about the drivers of urban sustainability transitions. Further research will be needed to develop a more definitive overview of the multitude of complex and interrelated factors that shape sustainability outcomes in European cities. Looking ahead, there are a number of important areas of work that emerge from this initial analysis, including:

- Expanding the survey to include more cities

- Interviewing a wider range of cities or using interviews as deep dives into specific topics

- Linking the findings to major new EU policy initiatives as well as the coronavirus pandemic

- Exploring wider themes and subject areas that may be driving the sustainability transition

1   Introduction

1.1   Background

It is becoming increasingly clear that the complex and interrelated challenges of climate change, environmental degradation and rising inequality will not be solved without a fundamental transformation of our societies. Far-reaching changes are needed to our technologies and infrastructures, cultures and lifestyles, as well as adaptations to the corresponding governance and institutional frameworks. Around the world, these important system innovations are converging in cities.

Cities are places with an increased urgency for sustainability transitions. Many systemic environmental and social challenges are focused on cities and, in absolute terms, they have disproportionately high energy consumption and greenhouse gas (GHG) emissions. At the same time, many of the most important innovations designed to counteract unsustainable behaviours and practices are originating in cities (GCEC, 2014). These include emerging social innovations such as sharing and the circular economy, shifts towards sustainable mobility, 'prosumerism', slow-food movements and community-oriented ways of living (EEA, 2020) as well as energy-efficient housing, urban farming, and renewable decentralised energy systems (Frantzeskaki et al., 2017). There is also a wider trend related to the empowerment of city governments, with city networks and associations playing an increasingly important role in shaping global climate and sustainability agreements (EEA, 2020). Such systemic realignments can be referred to as urban sustainability transitions: fundamental and structural changes in urban systems through which persistent environmental and societal challenges are addressed.

Research into sustainability transitions aims to understand the long-term, multidimensional and fundamental transformation processes through which established socio-technical systems may begin to shift towards more sustainable modes of production and consumption. Understanding how such transformations can be accelerated in cities will be vital to ensuring that we are able to adequately address the climate and ecological emergency. Given the European Environment Agency's remit and interests, the focus of this research is on urban *environmental* sustainability

transitions. Note that throughout the report, where the term 'sustainability transitions' is used, the principal focus is on the environmental dimension of sustainability transitions within an urban context. This is not to say that environmental transitions do not also rely to a great extent on social, economic and political transformations, but just that these will be framed in the context of environmental sustainability.

The *European environment — state and outlook 2020* report (SOER 2020) shows that there is a rapidly closing window of opportunity for such transformational change to take place, and that cities are a vital resource in this context. We have now entered a critical decade during which we must intensify our efforts to enable and improve the quality of life for future generations by protecting the environment, biodiversity and ecosystems, lessening the impacts of climate change and radically reducing our consumption of natural resources. The good news is that we already have a lot of the knowledge, technologies and tools we need for sustainability transitions to take place — the question now is how to accelerate and scale up this process (EEA, 2019).

Understanding the sustainability innovations that have allowed some European cities to address complex environmental challenges while simultaneously thriving economically and strengthening their social fabric has relevance far beyond the case of individual cities. Across the EU, the important role of cities as champions for environmental sustainability is being recognised. Yet, there is insufficient information about what allows some cities to engage in transformative change. Understanding the enabling conditions and drivers of these changes is important. So, too, is a clearer sense of the barriers that may be preventing some cities from reaching their sustainability potential or overcoming long-standing economic, institutional and cultural challenges leading to suboptimal environmental outcomes and preventing more radical change from taking place.

It should be noted that all cities that participated in this research were either winners or finalists of two prestigious awards and, as such, can be seen in many ways as leaders when it comes to urban sustainability.

This might contribute to the overall positive view of the factors influencing urban environmental transitions. If cities that are less successful in making progress towards sustainability had been included in this research, the factors tested may have seemed to be less supportive of urban environmental sustainability transitions than implied in this study. Moreover, key drivers and barriers identified might have been different. Nevertheless, this does not make the research approach less applicable to any given city.

1.1.1 The EEA's activities on urban sustainability

This report is the first in a series of EEA reports and outputs focusing on the topic of urban environmental sustainability transitions to be published in 2021 and 2021 (see Figure 1.1). It explores some of the key factors driving urban environmental sustainability transitions in selected cities, with the hope that their

experiences can provide useful lessons. Alongside this report, a briefing on *COVID-19 and urban sustainability in Europe* has been published to highlight some of the impacts of the pandemic and features of a green recovery if the Green Deal is to be successful in engaging cities.

The EEA will be publishing a report on *Urban sustainability in Europe – Avenues for change* (EEA, forthcoming). This will present the EEA's urban environmental sustainability conceptual framework (as presented in Figure 1.2) and an overview of the analysis of some priority urban sustainability nexuses. These nexuses aim to help understand aspects of complex urban systems and to better identify coordinated polices and actions to support urban environmental sustainability. More details of this analysis will be presented in a standalone *Urban sustainability in Europe – Learning from nexus analysis* report (EEA, forthcoming).

Figure 1.1   EEA reports and outputs focusing on the topic of urban environmental sustainability transitions
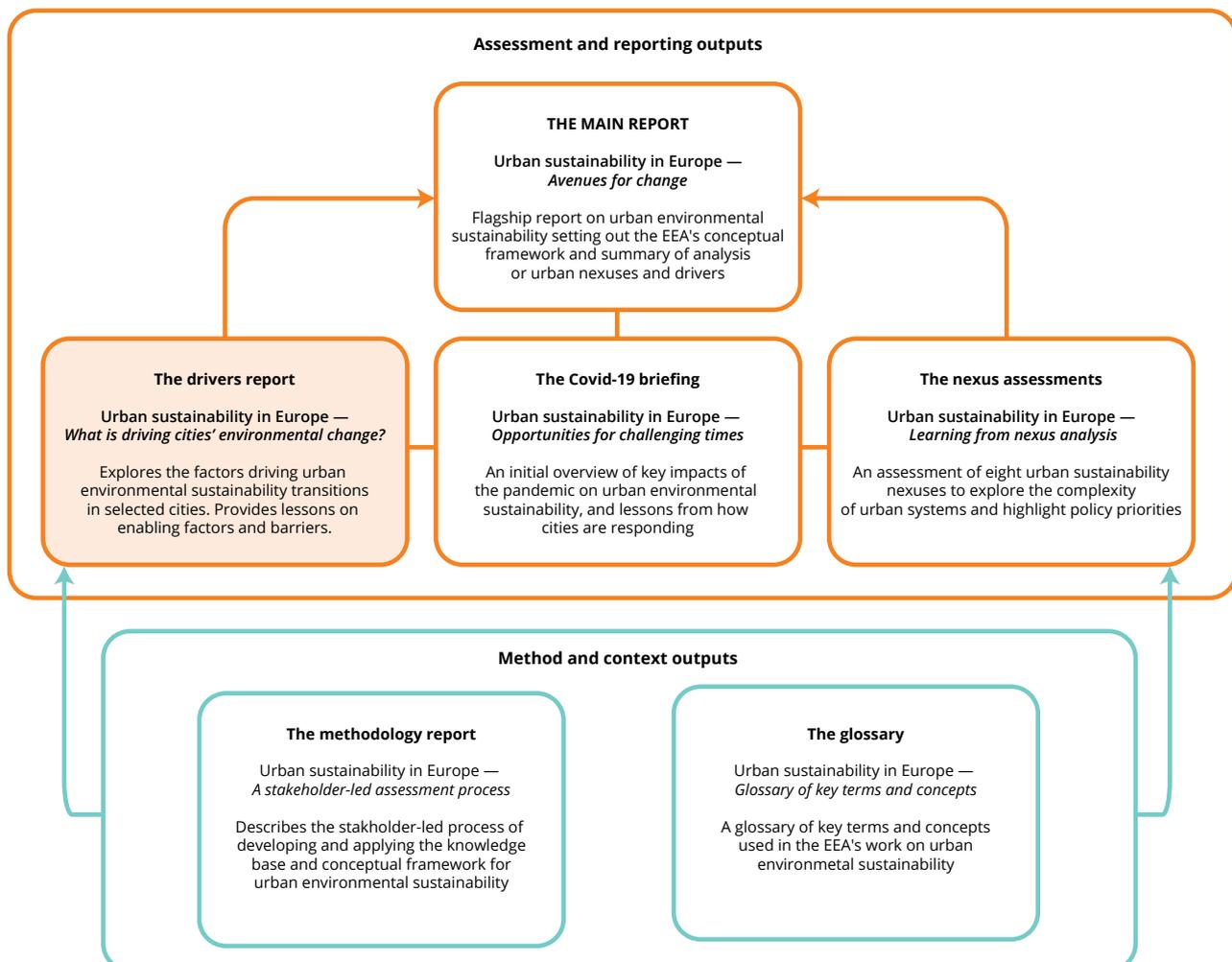
Other reports will include an *Urban sustainability in Europe - A stakeholder-led assessment process* (EEA, forthcoming), a methodological report which will outline the approach adopted by the EEA's work on urban environmental sustainability transitions. In addition, an *Urban sustainability in Europe - Glossary of key terms and concepts (EEA, forthcoming)* will aim to help ensure the consistent use of terms and provide a harmonised reference source and resource for future urban sustainability assessments across the EEA. It will draw on key sources, such as the Local Governments for Sustainability (ICLEI), among others.

The EEA has developed, in collaboration with stakeholders, an overarching conceptual framework for urban environmental sustainability to provide the basis for its assessments. This framework is based on four main components:

- **Lenses:** a range of perspectives on urban environmental sustainability that represent priority issues/concerns reflecting the EEA's environmental remit and can be used to guide/focus assessment and analysis.

- **Context**: the range of current and historical, physical, social and institutional characteristics, which create and shape the setting in which a specific city exists, develops and functions. Each city's context will have a considerable influence on its transition to urban environmental sustainability.

- **Enabling factors:** relatively high-level forces that can facilitate (drivers) or hinder (barriers) the transition towards urban environmental sustainability.

- **Building blocks:** key qualities that contribute to urban environmental sustainability. Depending on the context and enabling factors, different building blocks will be required to transition towards urban environmental sustainability.

The conceptual framework can be operationalised using different forms of analysis to assess urban environmental sustainability transitions. The analysis presented in this report focuses on one initial dimension, an analysis of drivers and barriers to support transitions towards urban environmental sustainability, using enabling factors and context as an entry point into the discussion. Subsequent EEA publications will look in more detail at the other elements of the conceptual framework.

This report presents the results of a meta-analysis of the drivers and barriers of urban sustainability transitions in European cities. It brings together the findings from the *EEA survey on urban transitions towards environmental sustainability* as well as the results of a series of semi-structured interviews with seven case-study cities that help to intensify and contextualise the survey results. The aim is to help improve understanding of the drivers for and barriers to the achievement of urban environmental sustainability in Europe. The overarching objectives of this report are:

- to identify and analyse a selection of factors that may help determine why some cities have been more successful in achieving greater environmental sustainability;

- to identify lessons about how to overcome barriers and foster more sustainable urban development that protects environmental quality and creates thriving, low-carbon and climate-resilient communities.

The methodologies and analysis in this report are very much an initial prototype. In the spirit of design thinking, where non-linear, iterative processes are used to try and redefine problems and identify innovative solutions, this initial foray lays the groundwork for future more in-depth work on this subject. In this study, the approach was tested by the EEA on a small number of a specific category of European cities (i.e. winners and finalists of two European urban sustainability awards). However, in future, it could usefully be refined and applied to a larger and/or different sample of cities by the EEA or other organisations interested in exploring urban sustainability transitions (see Section 5.2). This report should be seen as a first exploration, and an attempt to identify different possible methodological approaches to understanding the underlying factors that either accelerate or hinder environmental sustainability transitions in cities.

This research also informs the USiE report. It aims to provide some early insights into the way in which cities and national governments can foster more sustainable urban development, which protects environmental quality and creates thriving, low-carbon and climate-resilient communities that promote economic vitality, health, well-being and social inclusion.

Figure 1.2   Conceptual framework for urban environmental sustainability

Green city lens

Low carbon city lens

Resilient city lens

CONTEXT

GOVERNANCE

KNOWLEDGE

CULTURE

Collaborative and community-led initiatives

Participation and empowerment

Efficient material use and zero waste

Social and environmental justice

Energy efficiency

Environmental quality

Adaptive capacity

Resource efficiency

Low energy consumption

THE (SUSTAINABLE) CITY

Public open space

Integrated planning

Renewable energy

Green and blue infrastructure

Sustainable mobility

Housing planning

Sustainable urban agriculture

Ecological multi-functionality

Green economy

Built environmental quality

TECHNOLOGY

FINANCE

DATA AND INFORMATION

Circular city lens

Inclusive city lens

Healthy city lens

Lenses

Context (the geography of a particular city as well as its urban form, infrastructure, people, institutions, etc.)

Enabling factors

Building blocks

1.2 Methodological approach

The following section describes the approach that underlies this research. It uses a mixed method approach including a literature review, a survey and interviews with city authorities to provide a well-rounded picture of the different factors driving environmental sustainability in European cities today.

1.2.1 Identifying potential drivers to be tested via the survey

The survey (see Appendix A) is structured around a series of potential drivers and barriers (actions that are 'supporting or inhibiting' transitions to urban environmental sustainability) that were identified during the feasibility study. These, in turn, are grouped under the context and enabling factors defined within the urban environmental sustainability conceptual framework (i.e. governance, culture, finance, knowledge, data and information, and technology). See Section 1.1.1 for an overview of the conceptual framework for urban environmental sustainability.

Testing these enabling factors empirically through surveys and interviews also confirms that these elements of the conceptual framework for urban sustainability sufficiently capture the main driving forces that impact sustainability outcomes in cities.

An initial set of drivers related to each enabling factor was proposed before being tested and refined through discussions and feedback from the EEA and external stakeholders. The initial list was then supplemented through a review of academic and grey literature to identify examples of the identification and/or assessment of drivers and barriers of urban sustainability change around the world.

Drivers and barriers were categorised under the six enabling factors identified in the overall conceptual

framework. In addition, 'context' was also used to frame drivers and barriers to account for the wider contextual factors that shape urban sustainability outcomes (e.g. gross domestic product (GDP) per capita, climatic conditions, etc.).

1.2.2 Selecting case-study cities for the survey

Previous work concluded that case-study cities would be selected based on their participation in sustainability awards or indices. After reviewing a wide range of possible sustainability awards and indices, both within Europe and globally, the European Green Capital Award (EGCA) and its sister award, the European Green Leaf Award (EGLA), were identified as the most relevant and appropriate benchmarks for this research. Table 1.1 presents the full list of awards and rankings that were considered. Please note that this is not an exhaustive list of all possible awards and rankings, but merely a list of those that were identified through a literature review and conversations with the EEA and the stakeholder group.

The assessment criteria underlying these awards broadly align with the core environmental sustainability objectives set out in key European policy documents, including the Seventh Environment Action Programme (7th EAP) (EC, 2014). The awards also build on other important initiatives such as the European Reference Framework for Sustainable Cities (RFSC) and the EU's wider environmental policies. As such, a closer investigation of the award-winning cities provides an opportunity to assess the integration of the awards with wider environmental policy goals.

Table 1.2 lists the winners and finalists of the awards chosen to help identify the cities to be surveyed. In total, there are 40 eligible case-study cities across the two awards. The cities that responded to the survey are highlighted in light blue below.

Table 1.1   Overview of sustainability awards/schemes reviewed

European awards	Global awards	Global rankings
European Green Capital Award	C40 Cities Awards	Siemens Green Cities Index
European Green Leaf Award	Rockefeller 100 Resilient Cities	Arcadis Sustainable Cities Index
Transformative Action Award	Metropolis Awards	Sustainable Cities Mobility Index
Urbanism Awards - European City of the Year	World Smart Cities Award	Sustainable Cities Mobility Index
Eurocities Awards	World Smart Cities Award	

Table 1.2   **Winners and finalists of the EGCA and EGLA (respondents to the survey are highlighted in light blue)**

#	City	Country	Winning year	Number of inhabitants* (rounded to the nearest thousand)
		European Green Capital Award		
		Winners		
1	Lahti	Finland	2021	120 000
2	Lisbon	Portugal	2020	548 000
3	Oslo	Norway	2019	650 000
4	Nijmegen	Netherlands	2018	159 000
5	Essen	Germany	2017	583 000
6	Ljubljana	Slovenia	2016	276 000
7	Bristol	United Kingdom	2015	536 000
8	Copenhagen	Denmark	2014	602 000
9	Nantes	France	2013	303 000
10	Vitoria-Gasteiz	Spain	2012	249 000
11	Hamburg	Germany	2011	1 899 000
12	Stockholm	Sweden	2010	976 000
		Finalists		
13	Amsterdam	Netherlands		822 000
14	Barcelona	Spain		1 620 000
15	Brussels	Belgium		174 000
16	Frankfurt	Germany		753 000
17	Freiburg	Germany		229 000
18	Ghent	Belgium		248 000
19	Glasgow	United Kingdom		599 000
20	Malmö	Sweden		317 000
21	Münster	Germany		310 000
22	Nuremberg	Germany		518 000
23	Reykjavík	Iceland		123 000
24	s'-Hertogenbosch	Netherlands		150 889
25	Tallinn	Estonia		427 000
26	Umeå	Sweden		90 000
		European Green Leaf Award		
		Winners		
1	Mechelen	Belgium	2021	86 000
2	Limerick	Ireland	2021	192 000
3	Cornellà de Llobregat	Spain	2019	87 000
4	Horst aan de Maas	Netherlands	2019	42 000
5	Leuven	Belgium	2018	100 000
6	Växjö	Sweden	2018	66 000
7	Galway	Ireland	2017	80 000
8	Mollet del Vallès	Spain	2015	51 000
9	Torres Vedras	Portugal	2015	79 000
		Finalists		
10	Gabrovo	Bulgaria		108 000
11	Joensuu	Finland		77 000
12	Lappeenranta	Finland		73 000
13	Ludwigsburg	Germany		544 000
14	Mikkeli	Finland		49 000

Notes: * The figures presented are from various sources (e.g. UNdata, Eurostat, municipal census data). They indicate a rough impression of current cities' sizes but do not necessarily reflect the exact number of inhabitants.

1.2.3   Survey design and dissemination

The survey was structured to reflect the conceptual framework for urban environmental sustainability (see Section 1.1.1.). It also built on work LSE Cities conducted together with ICLEI and the Global Green Growth Institute in 2011 and 2012 to survey cities about their transitions to a green economy (Rode and Floater, 2013). The full survey questionnaire is included in Appendix A. The survey was intended to be fairly high level and designed to take respondents no more than 20 minutes to complete. In addition to asking about the general sustainability background of each city, the bulk of the survey comprised structured questions asking respondents to provide more details on the factors they deemed most significant in having promoted (or hindered) a shift towards greater environmental sustainability in their city.

With the support of the European Commission's DG Environment (which manage both awards) and the EEA, contacts were identified in 40 cities to ensure that the survey was addressed to the most relevant city officials. While the general background of the survey respondents was collected and analysed (see Section 2.1), no differentiation was made between political and technical staff, and city officials were allowed to nominate a colleague if they felt he or she would be better suited to completing the survey. The EGCA and EGLA networks were used to reach out to these individuals. Individual emails and up to three follow-up emails were used to ensure that the survey benefited from a high response rate (65 %, see Section 2.1).

1.2.4   Selection of cities for semi-structured interviews

Following completion of the survey and analysis of its results, semi-structured interviews were carried out among a selection of cities that responded to the survey. While it would have been ideal to interview all cities that completed the survey, these interviews are very resource intensive and such an effort would have been beyond the scope of this relatively small, exploratory pilot project.

In total, seven cities were interviewed. They were selected to provide a geographical distribution across eastern, western, northern and southern Europe and to include larger cities (above 100 000 inhabitants — drawn from the EGCA respondents) and smaller cities/towns (between 20 000 and 100 000 inhabitants — drawn from the EGLA respondents), see Table 1.3. While attempts were made to contact a large western European city from the survey respondents, it was not possible to arrange an interview before the end of the research period. All interviews were conducted with just a single city representative, with the exception of Gabrovo, Bulgaria, where the interview was conducted with two individuals.

Table 1.3   Cities that participated in the semi-structured interviews

#	City	Country	Category	Number of inhabitants* (rounded to the nearest thousand)
1	Leuven	Belgium	Small western	100 000
2	Stockholm	Sweden	Large northern	976 000
3	Mikkeli	Finland	Small northern	49 000
4	Lisbon	Portugal	Large southern	548 000
5	Cornellà de Llobregat	Spain	Small southern	87 000
6	Tallinn	Estonia	Large eastern	427 000
7	Gabrovo	Bulgaria	Small eastern	108 000

Notes: * The figures presented are from various sources and not all from the same year (e.g. UNdata, Eurostat, municipal census data). They are shown to give a rough impression of current cities' sizes and do not necessarily reflect the exact number of inhabitants.

1.2.5 Focus of the semi-structured interviews

The interviews allowed for a more nuanced understanding of key enablers, drivers and barriers to sustainability transitions in European cities. The objective of the semi-structured interviews was to complement the findings from the survey and enable a more profound examination of some of the specific drivers and barriers identified as playing a major role in shaping their transition towards greater environmental sustainability. The questions were developed and agreed in consultation with the EEA and in conjunction with feedback from the external stakeholders (see Appendix B for the interview questions).

The interviews identified concrete examples of how individual cities have been able to use a range of enabling factors to their advantage and overcome specific barriers to achieve their policy objectives. This provided transferable lessons, which will be relevant for other European cities that may be at earlier stages of their sustainability journey. They highlighted patterns that are common to all cities, and also clarified whether any of the drivers identified as significant via the survey are more essential than others. The interviews also provided deeper insights regarding the enabling conditions at national and EU level that can provide cities with the relevant framework to fully realise their environmental sustainability potential.

1.2.6 Integration of the interview results

When all the interviews had been completed, findings were analysed to identify any interesting patterns across all seven case-study cities, including major differences and similarities in the drivers and barriers identified. These were then used to complement the survey results. Combined with the literature review on enabling factors, the interviews rounded out the analysis and provided a perspective of the importance of various enabling factors for achieving greater urban environmental sustainability.

1.3 Reflections on the research methodology

There are important limitations to this research. As this is a relatively small-scale pilot study, the results should not be seen as capturing the full spectrum of drivers and barriers experienced by the case-study cities. The sample of cities both for the survey and the interviews is also not representative of all European cities. This study is an initial attempt to provide insights into the relative importance of different enabling factors and barriers in the context of urban environmental sustainability. As such, its primary

purpose is to open up the conversation rather than to provide definitive answers to these complex questions. What it is able to show is whether there are commonalities in the factors that have helped different cities to transition more rapidly or more successfully towards environmental sustainability. The work is based on the expert opinions of a small number of municipal employees and, as such, is inevitably biased to some extent. It is a subjective assessment of relative importance rather than an objective breakdown of every single factor that may have helped or hindered a city's progress.

Selection bias

• Factors listed in the survey and discussed in the interviews were identified as important for urban environmental sustainability through the literature review as well as consultations with external stakeholders during the preliminary stages of this project. It is therefore not surprising that the factors listed were mainly recognised as supporting cities' environmental sustainability transitions.

• All cities participating in this research were either winners or finalists of two fairly prestigious awards and can in many ways be seen as leaders as regards sustainability. This might also contribute to the overall positive view of the importance of the factors tested. Nevertheless, the findings reveal that even in cities that are doing well in terms of achieving urban sustainability there are still barriers and challenges to overcome.

• In most instances, one person from each of the case-study cities participated in the interviews. While the interviewees' responses were fact checked wherever possible, many elements of the key drivers and barriers discussed and presented in this report inevitably remain subjective by nature. Thus, some statements may reflect a particular perspective of the individual interviewed.

Sample size

• Given the relatively small sample size (26 cities for the survey and a subset of seven cities for the interviews), the analysis focuses on the overall results and does not try to compare results by geographic region or city size since any inferences drawn from this would be of limited use. Future studies should consider expanding the sample and ensuring it is more geographically diverse, which would enable interesting comparisons of drivers and barriers based on city types.

- While the most important supporting/inhibiting factors have been identified for the purpose of the survey, it should be noted that sometimes the differences between these top factors and the rest are only minimal. This is probably due to the relatively small sample and comparatively uniform profile of the cities.

Prioritisation

- Factors not identified through the survey as 'key' should not necessarily be dismissed as less important. The same may be true for the interview results where the fact that a particular factor was not raised should not be taken to mean that this factor is not important in that particular urban context, merely that it did not arise during the conversation.

- The survey did not ask cities to rank the different factors in terms of their relative importance. This makes it impossible to say whether any of the overarching enabling factors played a more essential role in a city's sustainability story. Given that the survey was completed by a single individual (albeit often with input from a wider team of people) this focus on prioritising factors was seen as too subjective.

- The relative importance of different drivers and barriers was discussed during the semi-structured interviews, in the context of specific sustainability challenges the city has faced. However, it is important to keep in mind that these assessments are subjective and cannot provide a full and objective overview of complex causal feedback loops between inputs, outputs and outcomes of sustainability actions.

- Presentation of the discussion on the key drivers of urban sustainability transitions (Section 2.2) mirrors the layout of the survey and serves the purpose of structuring the report. The ordering of factors in this way does not suggest any kind of hierarchy of importance. Furthermore, the demarcation of the factors does not reflect how they exist in reality. These factors are not isolated components but overlap and interlink with each other to create a city's surrounding context and to influence their urban sustainability transitions.

Correlation vs. causation

- One of the reasons why it is so challenging to pinpoint the exact factors that drive environmental sustainability in cities is because it can be very difficult to demonstrate causality within complex urban systems. Many factors shape sustainability outcomes and it can be difficult sometimes to know if they are the actual reason that change takes place or just a correlating factor.

- Complex causal feedback loops also mean that it is sometimes difficult to know if a particular factor was primarily an input to or an outcome of a particular policy. A good example of this is urban form, which can act as both a contextual driver of environmental sustainability (e.g. by making the inner city walkable) or an outcome of specific environmental sustainability (e.g. policies that encourage urban densification and mixed land use).

2 About the cities

This section provides a brief overview of the cities that participated in the survey and the interviews. After completing the survey, seven of these cities (Leuven, Stockholm, Mikkeli, Lisbon, Cornellà de Llobregat, Tallinn and Gabrovo) were interviewed to provide a more nuanced understanding of what drives urban environmental sustainability transitions in some European cities. Of all the eligible cities, those that responded to the survey and those that were interviewed are presented in Figure 2.1.

Figure 2.1 **European Green Capital and European Green Leaf Award winners and finalists, and survey respondents**
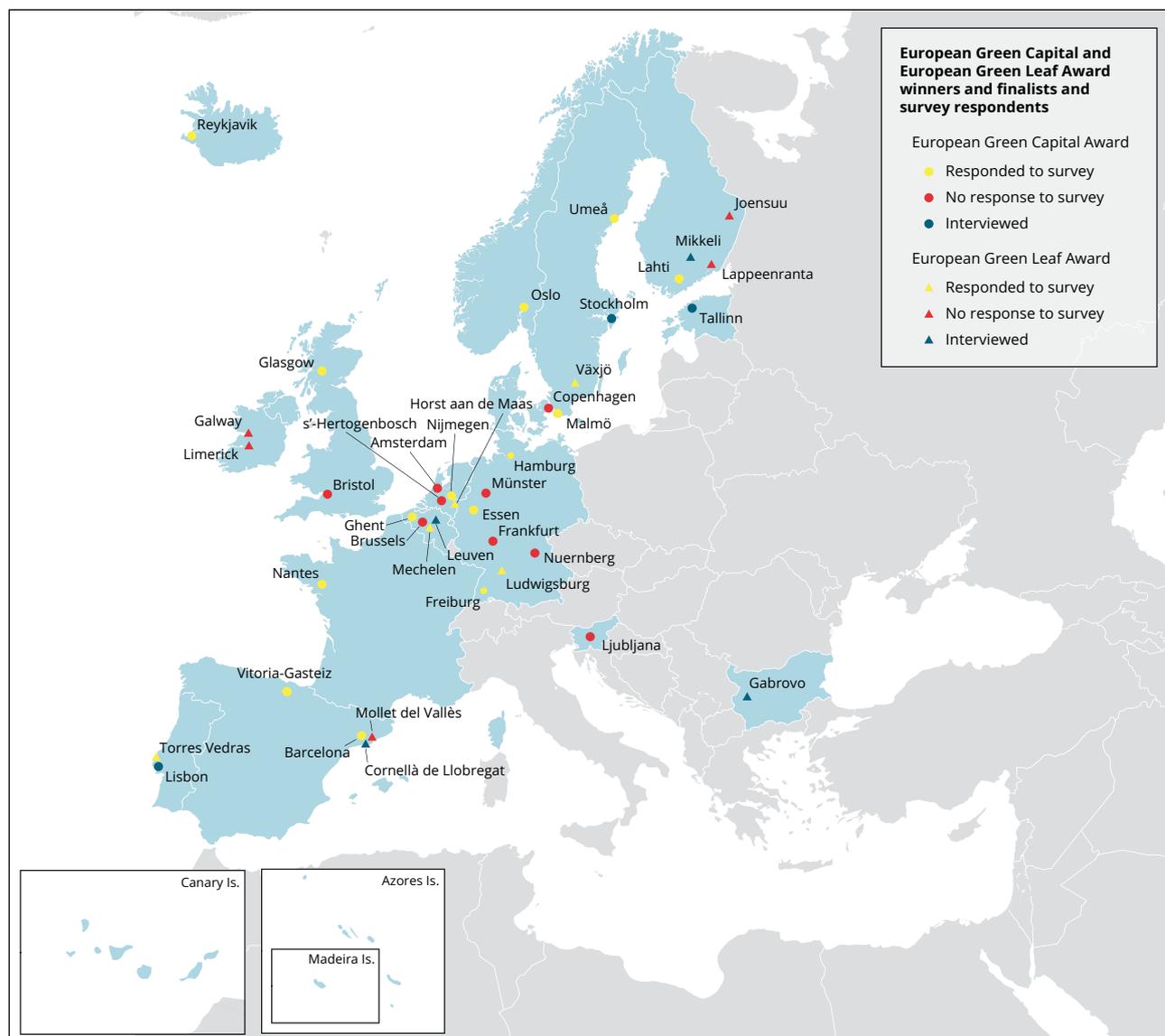
Reference data: ©ESRI

Figure 2.2   Winners and finalist of the EGCA/EGLA (left) and all survey respondents (right) by geographic location

All (40) winners and finalists of EGCA and EGLA by geographic location
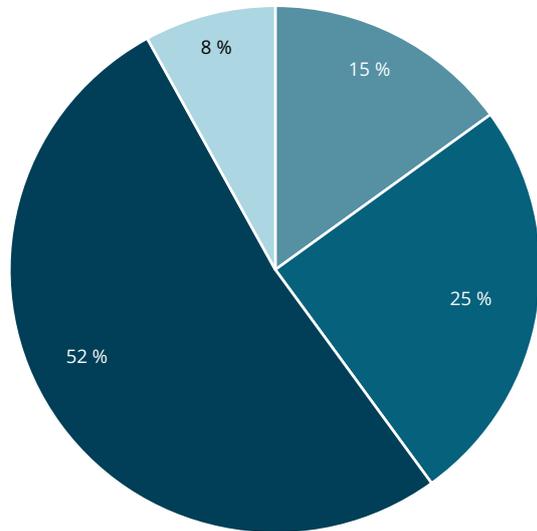
All (26) survey respondents by geographic location
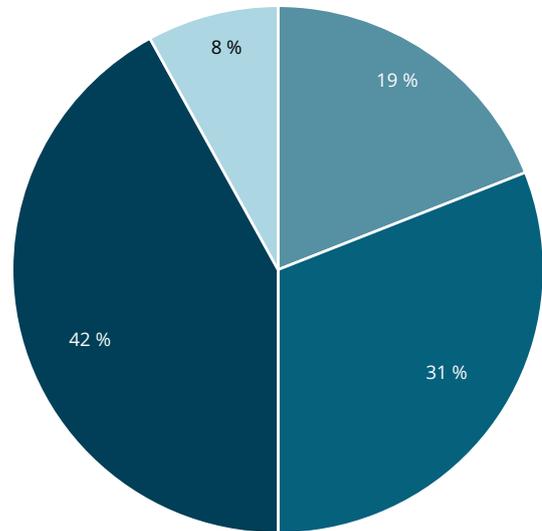
■ Southern   ■ Northern   ■ Western   ■ Eastern

In total, 26 of the 40 eligible cities (65 %) responded to the survey. The geographic spread of respondents broadly mirrored that of the awards. Eastern European cities are the least represented, followed by southern, northern and western cities. Western European cities have the highest proportion of respondents (42 %), although this is lower than the proportion of winners and finalists of the EGCA and EGLA (52 %). There was a slightly higher proportion of respondents from southern (19 %) and northern European cities (31 %) compared to the distribution across all eligible cities (15 % and 25 %, respectively).

Figure 2.3   Department/sector of the city administration where survey respondents work

Frequency of responses
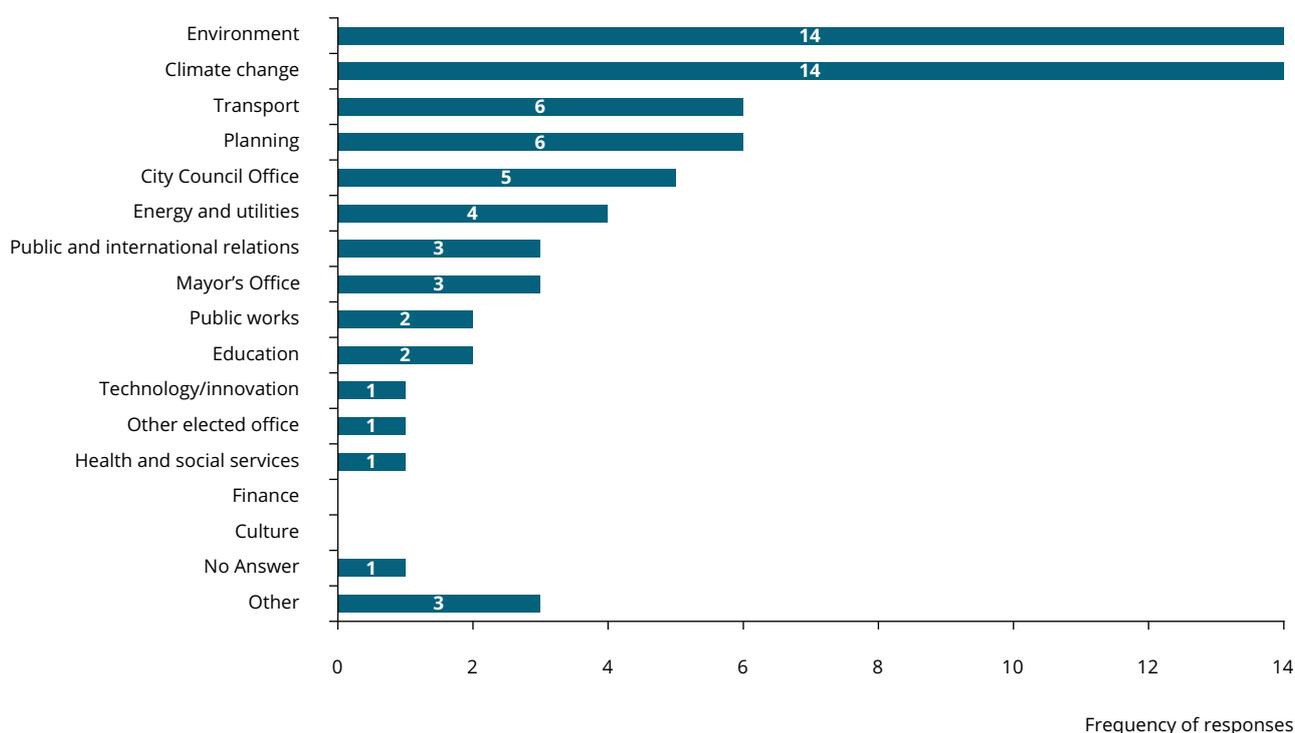
2.1   Survey respondents

Figure 2.3 presents the city authority department represented by the survey respondents. Most of the city representatives who responded to the survey work in their city's environment or climate change departments (both selected by just over a half of the respondents). The other most common departments/ sectors are transport and planning (both selected by just over a quarter of respondents). This result makes

sense given that people responding to the survey were frequently also the main contact points for the EGCA and EGLA networks. 'Other' departments/sectors that responded included EU affairs, economic development and sustainability. Several respondents selected more than one department, either because they did not answer the survey alone but consulted colleagues from other departments or because their departments are integrated across various thematic areas.

Figure 2.4 **Responses to survey question** *'How significant are the following environmental challenges for your city and its region?'*

Frequency of responses

■ Very significant ■ Somewhat significant ▫ Not significant ■ I don't know ■ No answer
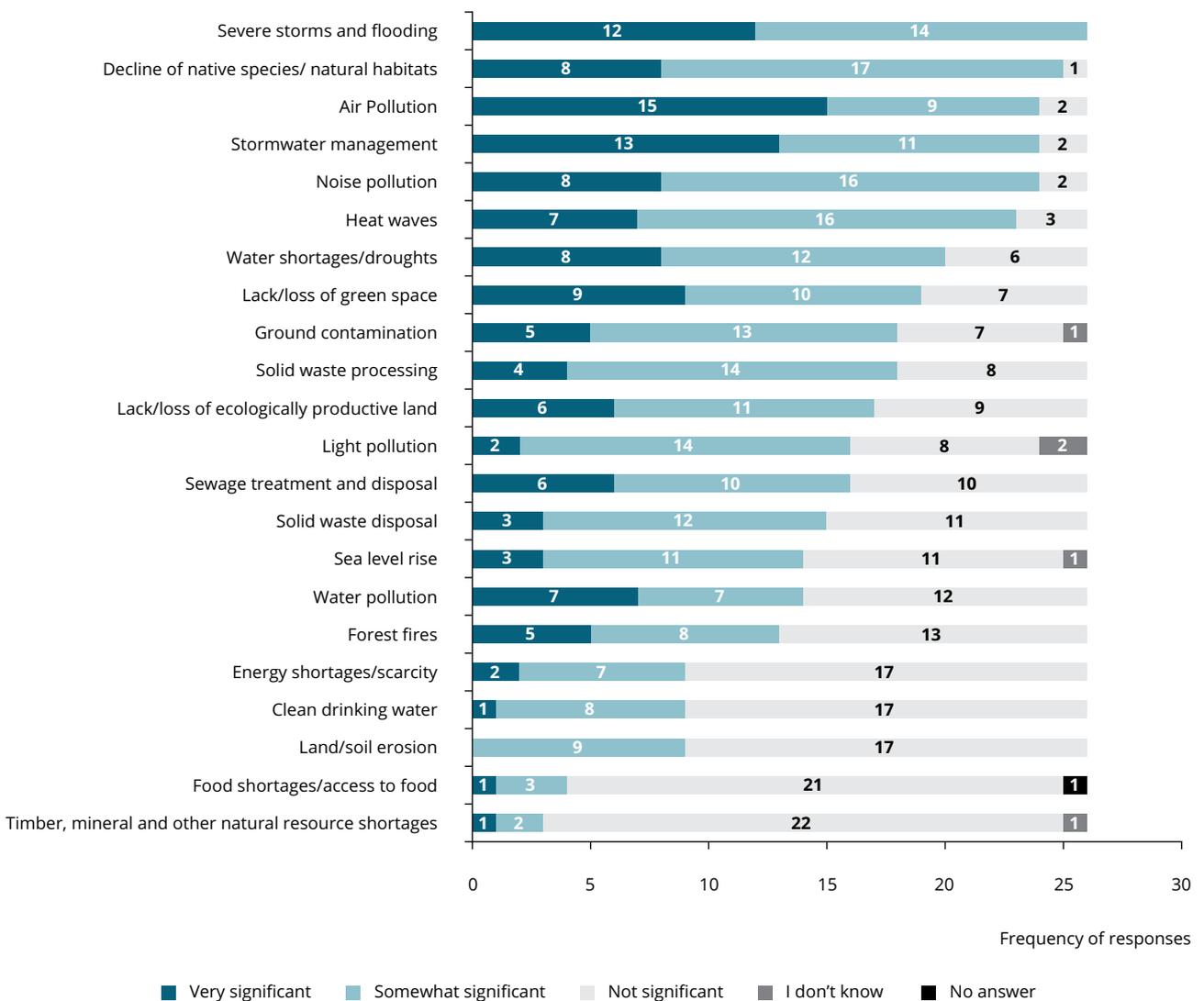
2.2   Environmental challenges

Cities are facing a wide range of environmental challenges. Figure 2.4 shows the challenges most frequently identified as significant for the cities and their wider regions: *Severe storms and flooding* (identified by all survey respondents); *decline of native species/natural habitats*; *air pollution* (identified by the highest number of cities as a 'very significant' challenge); *storm water management*; *noise pollution*; and *heatwaves*. Naturally, most cities face many different environmental challenges simultaneously, some of which (such as heatwaves, air pollution and lack of green space) may compound one another, making disaster risk management and mitigation more complicated. Although the survey did not explore these interactions in more detail, this is an important area for further study, to identify interventions that can

have co-benefits across many different environmental challenges that cities may be facing.

Water shortages/droughts, *ground contamination*, *solid-waste processing*, *lack/loss of ecologically productive land*, and *light pollution* also pose a challenge for most of the cities.

Timber, mineral and other natural resource shortages and food shortages/access to food are the two challenges the cities mostly frequently identified as not significant, followed by land/soil erosion, clean drinking water and energy shortages/scarcity. While this survey indicates that some challenges were only considered significant by a few cities, it is important to note that four cities face food-related challenges and about a third of the cities are tackling energy shortages/scarcity and drinking water issues. Since the research

was completed before cities were confronted with the various challenges brought on by the coronavirus pandemic, it would be interesting to repeat the survey now to see whether some issues, such as food shortages/access to food, have risen up their agendas.

The environmental challenges highlighted by the survey also emerged frequently in the interviews. Cities mentioned the importance of dealing with stormwater management and flooding (e.g. Lisbon, Portugal and Stockholm, Sweden), increasingly frequent droughts and lack of water, dangerous levels of air pollution, heatwaves (e.g. Stockholm) and urban heat island effects (e.g. Tallinn, Estonia), and lack of green spaces (e.g. Cornellà de Llobregat, Spain).

It should also be noted that not all of the challenges identified are within the immediate remit of city governments as some may be shaped by higher tiers of government or external forces beyond the city's control. Thus, understanding what cities can effectively influence (and what requires input from other governments, the private sector or the public) is an important part of designing successful urban sustainability strategies.

2.3 Emergence of environmental sustainability objectives

Figure 2.5 presents the survey responses on how long environmental sustainability objectives have been part of the political agenda of responding cities. Over half of the cities surveyed have considered environmental

sustainability objectives as an important part of their political agenda during the period between 1992 (the Rio Conference) and 2000, which means they have had several decades to mainstream these considerations into their wider policy-making processes. The second largest group of cities have only considered sustainability in their policies since the turn of the millennium (2001-2019). A few 'early mover' cities indicated that this agenda emerged in the period between 1973 and 1992, and two cities since before the Stockholm UN conference in 1972.

In the interviews, several cities mentioned that environmental sustainability has only really emerged as an important priority in their cities over the past 10 years or so. Tallinn highlighted the national government's changing relationship with the EU in the past year as having removed a previous barrier to greater sustainability. For Gabrovo, the accession of Bulgaria to the EU was a core factor that pushed sustainability up the political agenda. For Lisbon, it was the election of a new government following the financial crisis in 2008/2009. In Cornellà de Llobregat, the influence of the metropolitan area of Barcelona has accelerated progress on sustainability in the past 10 years. Other cities, such as Stockholm, suggested that integration of environmental sustainability had begun in the wider urban decision-making process many decades ago. All cities highlighted a renewed urgency in recent years due to climate change and various associated international and national targets.

Figure 2.5 **Responses to survey question *'How long have environmental sustainability objectives been an important part of your city's political agenda?'***

- Only in the last decades (2001-2019)
- Since the period between 1992 (The Rio Conference) and 2000
- Since the period between 1973 (the Oil Crisis) and 1992
- Since before 1972 (the Stockholm UN Conference)
- Environmental sustainability objectives are an important part of my city's political agenda, but I can't specify when they became important
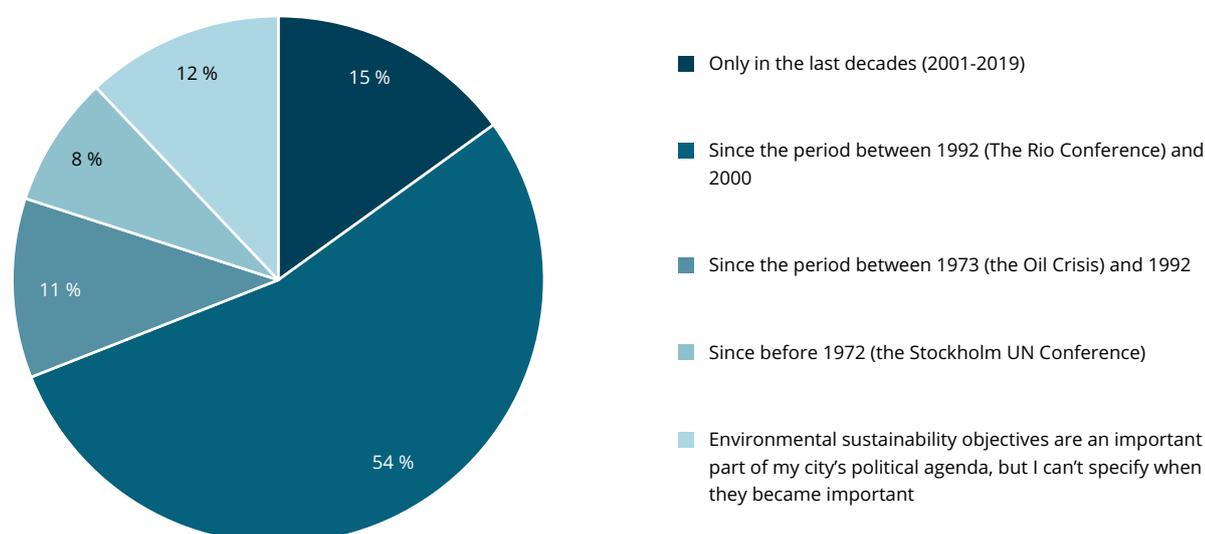
In addition to the question about the emergence of environmental sustainability on their political agendas, two further free-form questions asked cities to list any specific policies that have either supported or undermined their sustainability objectives. The supporting policies that cities identified were wide-ranging in terms of their scope. They included broader, more strategic and longer-term factors, such as the development of urban master plans, or more specific policies focused on one or two sustainability objectives. These objectives included storm water management, climate protection and greening the city. For the question on policies that undermined a city's progress, none were identified by half of the survey respondents — they either explicitly expressed this or did not answer. The policies highlighted as barriers tended to focus on transport and infrastructure that perpetuate car-centricity or on ways in which existing land use and spatial planning is hampering sustainability, such as through the absence of green infrastructure. The impact of historical policies that have created particular urban form and infrastructure was a key factor also highlighted in interviews (see Section 3.1).

2.4 Triggers for greater environmental sustainability

All of the specific triggers included in the survey to gauge what led to environmental sustainability objectives becoming an important part of cities'

political agendas were considered significant by at least half of the cities (see Figure 2.6). However, public opinion/awareness seems to be a key trigger that has driven environmental sustainability in cities (selected by 24 cities). As Section 3.4 explores in more detail, this was confirmed by the interviews with over half of all cities explicitly mentioning the importance of public awareness of environmental challenges. *A change in local political leadership, specific environmental crises* and *pressure from stakeholders* were also identified as being important triggers, each being considered very significant or significant by 20 or more cities. This was confirmed by the interviews, in which growing public awareness of environmental issues as well as the political vision of individual leaders were repeatedly highlighted as important triggers.

On the whole, cities did not feel that another particular crisis (not related to the environment) was a significant trigger in making environmental sustainability objectives an important part of their political agenda. It would be interesting to see whether cities might evaluate this differently in the context of COVID-19. Research into the impacts of COVID-19 is currently exploring to what extent the health crisis might be acting as a trigger for wider sustainability transitions in cities.

Figure 2.6   **Responses to survey question *'How important were/are the following triggers in making environmental sustainability objectives an important part of your city's political agenda?'***

Number of respondents

■ Very significant   ■ Somewhat significant   ■ Not significant   ■ I don't know   ■ No answer
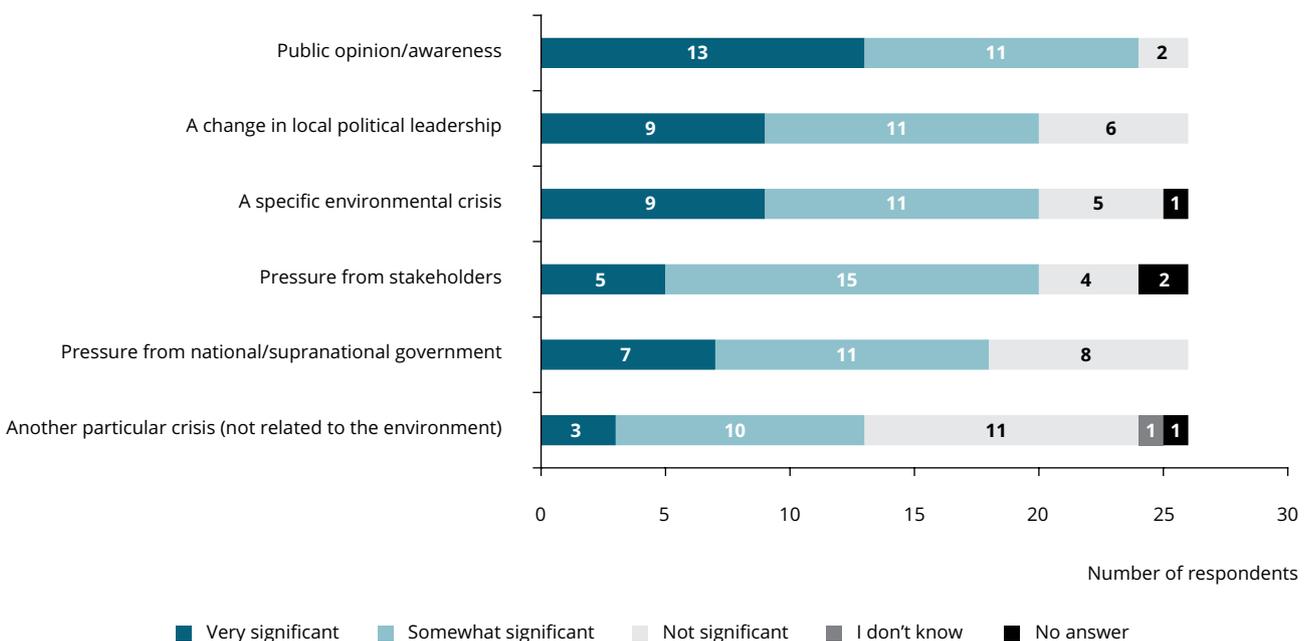
3 Understanding the factors that shape urban environmental sustainability transitions

The following section explores some of the key drivers of and barriers to urban environmental sustainability in European cities. In line with the conceptual framework for urban environmental sustainability (see Section 1.1.1.), the drivers and barriers investigated are structured under context (i.e. distinct context of every city) and a set of six 'enabling factors', including governance, knowledge, culture, technology, data and information, and finance. To allow for a more detailed analysis of how the enabling factors might act as either drivers or barriers, they were disaggregated into more specific factors in the survey. While many of these factors were discussed during the interviews, the analysis focuses on the most salient points emerging from those conversations, highlighting instances where the interviews either confirmed or contradicted the survey findings. The analysis is based on the findings from the survey as well as the perspectives of individual interviewees in the case-study cities.

It is important to note that a factor might be seen as a driver by one city and a barrier by another, which may also change depending on the specific context. This analysis does not explicitly explore how different drivers and barriers relate to each other. However, interlinkages and frictions between various supporting and inhibiting factors are areas that require further research, with drivers and barriers potentially combining to create either virtuous or vicious cycles in relation to a city's progress towards greater environmental sustainability.

3.1 Context

Every city has its own distinct context that will influence the nature of its urban sustainability transition. Contextual factors will influence the potential for, and may act to limit the options of, a city when it comes to environmental transformations that are feasible.

For the purpose of this report, context refers to the range of current and historic physical (e.g. geographic, environmental), cultural and institutional characteristics that create and shape the setting in which a specific city exists, develops and functions.

These characteristics may be relatively stable and slow to alter but can also be dynamic and changeable. While factors such as *natural assets* tend to be relatively fixed, others such as *existing infrastructure* and *demographics* are more variable. In addition, a contextual factor that is a key driver in one city may be less relevant in another. Even within a specific city, contexts may vary depending on the specific neighbourhood (e.g. inner city vs. suburb). It is therefore vital that cities carefully consider their unique contexts to understand how they may influence their urban sustainability transition.

A diverse array of contextual factors drives urban sustainability transitions

Contextual factors influence what kinds of sustainability issues are prioritised by a city and provide insight into the motivations that drive particular actions. Factors such as *geographic location* and *vulnerability to climate-related extreme weather events* can significantly influence the likelihood that cities will be proactive on mitigation and adaptation planning (Reckien et al., 2015). The literature suggests that motivation for sustainability actions may be just as much about economic and employment growth as it is about improving environmental performance (Joss, 2011). This recognition of co-benefits also emerged as a recurring theme in the interviews.

In the survey, the contextual factors considered to support sustainability transitions most strongly were *existing infrastructure* and *air/water/soil quality* followed by *city size* and *natural assets*.

Existing urban form, structure of the economy and *demographics* were the most frequently selected as inhibiting factors (see Figure 3.1). Some survey respondents noted that factor(s) can be supporting and inhibiting at the same time. For example, factors such as *existing urban form* (e.g. compactness) or *geographic location* may support some environmental initiatives (e.g. promotion of sustainable mobility) but may negatively impact other objectives (e.g. improving air quality, increasing the share of accessible green areas). These responses demonstrate that a wide range of contextual factors can drive urban sustainability in different ways.

Figure 3.1   **Responses to survey question *'Have the following contextual factors supported or inhibited the environmental sustainability transition in your city?'***
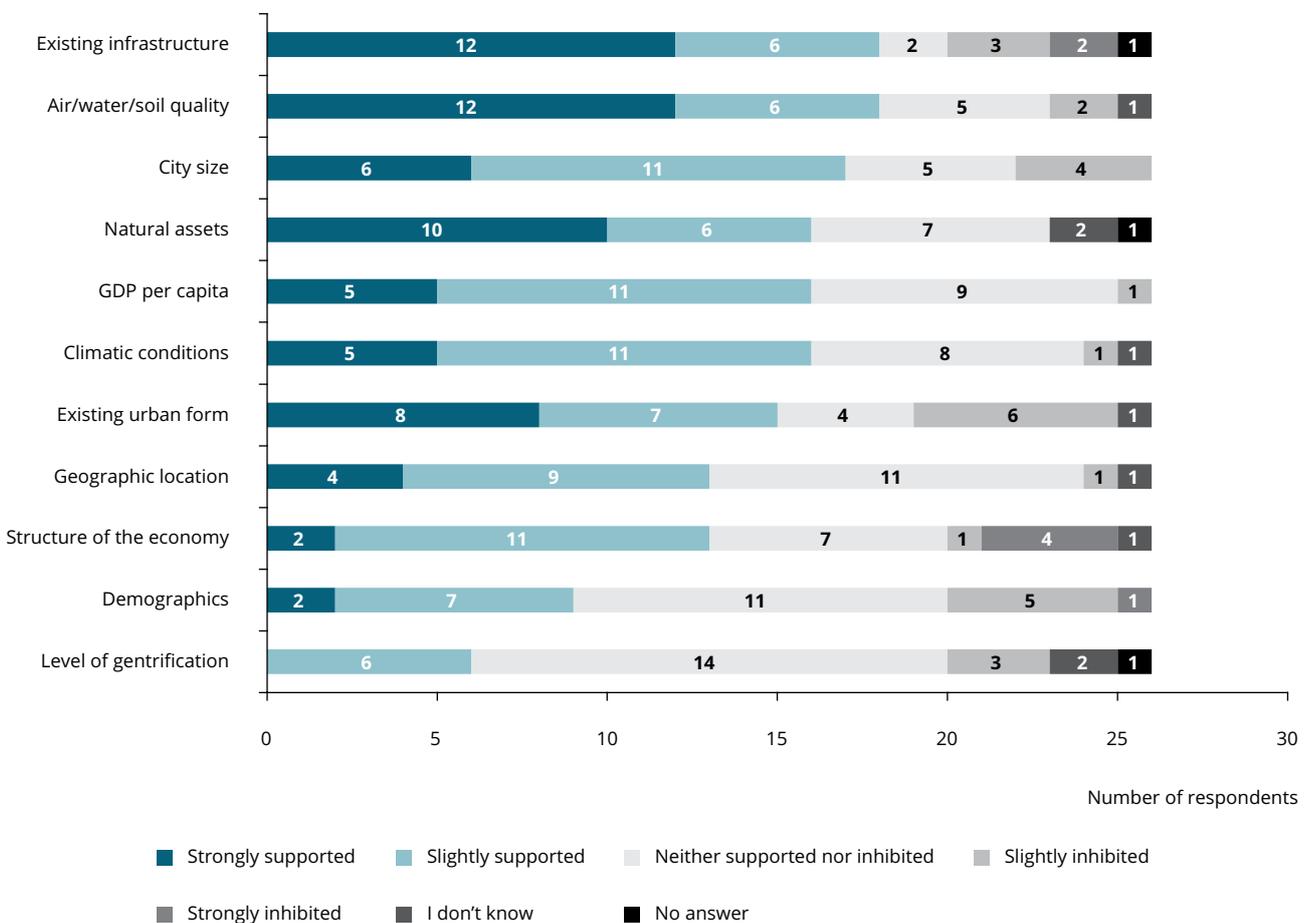
Demographic change is both a challenge and an opportunity for environmental sustainability

Europe as a whole is faced with the issues of ageing and declining populations, and these impacts are unevenly distributed across European cities (EEA, 2019). Although globally, urban populations are continuing to grow at an exponential rate, in Europe, urbanisation rates have slowed considerably and growth tends to be focused in larger cities, with many smaller cities and rural areas experiencing or projected to experience a contraction in their population of up to 30 % (Vandecasteele et al., 2019, EEA, 2020).

The survey results indicated that demographics is one of the most polarising contextual factors. This finding was echoed in interviews (see Box 3.1). The interviews suggested that urbanisation and population pressures intensified environmental challenges in cities by increasing housing needs and putting green spaces at risk. This is not just because of actual urbanisation, but

also due to consumer preferences and planning and zoning laws. Across Europe, urban sprawl continues to be a major challenge, even in countries with declining populations, with housing, industry and infrastructure development continuing to put pressure on peri-urban land (EEA, 2016).

Cities also spoke of how challenges related to an ageing, shrinking or sparse population have inhibited urban sustainability transitions. This has had a number of impacts. For instance, public transport systems are challenging to organise and implement in areas of the city with lower population densities.

The interviews revealed that the way in which *demographics* acts as an inhibiting factor varies across cities and reflects differences in trends across Europe. Like all factors, *demographics* takes on a different resonance when combined with the other contextual factors that shape a city's urban sustainability transition. In some instances, these challenges can bring opportunities to further such transitions.

> **Box 3.1   Reversing brain drain seen as key to sustainable future for Gabrovo**
>
> Gabrovo (Bulgaria) is a relatively small city (> 60 000 residents) with an industrial past in the centre of the country. An ageing population and the 'brain drain' caused by the migration of younger residents were identified as the biggest challenges facing the city. The brain drain problem involves young people leaving for bigger cities where there are more employment opportunities and higher salaries in Bulgaria or other EU countries.
>
> Recognising these contextual challenges, which are rooted in Bulgaria's history and decades of deindustrialisation, Gabrovo has decided to tap into its entrepreneurial spirit and natural assets to advance the city's green agenda and make itself more attractive to the younger generation. Energy efficiency improvements and upgrades to the transport system as well as maintenance of the city's green and public spaces have been central to this. The city's strategic vision ('Gabrovo: Green, Innovative, Sustainable') explicitly aims to link environmental sustainability and economic prosperity. It is part of the city's determination to promote a new image for itself, raising awareness of its high quality of life, cultural events and sustainable initiatives, to attract young people to stay in the city or to return from elsewhere. Gabrovo has also worked closely with local businesses and educational establishments to ensure that skills development and employment opportunities are expanded locally. It ranks second after Sofia for economic and social development, with steadily rising wages and low unemployment rates (URBACT, n.d.).

Existing grey infrastructure can lock cities into particular development pathways

Like *demographics*, existing grey infrastructure is more dynamic and changeable than stable contextual factors, such as certain *natural assets, climatic conditions* and, most importantly, *geographic location*. Of course, even natural assets, like forests, rivers, arable land or public green spaces, are changeable to an extent, given that blue and green infrastructure is also shaped by human decisions and land-use changes. Understanding what can and cannot be changed, and how to tailor policies to take advantage of and adapt current infrastructure, is a powerful tool that cities should not underestimate. It varies greatly across cities: for example, in the building sector, efficient policy implementation will depend on the state of the existing building stock (e.g. age, type, tenure, etc.), speed of new construction and renovation, and the capacity and skills of the construction industry.

In the interviews, the majority of cities spoke about grey infrastructure in the context of improvement plans and local government visions for the creation of a more sustainable city. Some of the initiatives highlighted include: introducing electric buses; adding cycling infrastructure and pedestrianising streets; improving waste systems; and retrofitting buildings.

Infrastructure improvements were both implicitly or explicitly linked to historic developments that created urban environments and systems now requiring significant changes to align them with sustainability objectives. Cities gave examples of the kinds of infrastructure and associated plans and policies that, at times, have inhibited urban sustainability transitions. These include outdated water and sewage systems, decades of car-centric planning, and the absence of green and blue infrastructure. Generally, cities identified *existing grey infrastructure* as a challenge that needs to be overcome to further their transition, although in some cities, this infrastructure has turned out to be a positive driver (see Box 3.2). This demonstrates that contemporary urban environments are often rooted in historic policies and plans, models and traditions that differ from the sustainability principles that may guide decision-making today.

Although infrastructure can act as a barrier to transitions in cities, it is also a contextual factor that can be altered. Infrastructure is one factor that cities can directly influence, which may explain its status in the survey as the top supporting factor. The interviews suggested that infrastructure can be repurposed to support contemporary sustainability objectives. For example, even after decades of car-centric development in cities, steps can be taken to stop the promotion of car dependency and to expand public transport networks and cycling routes.

> **Box 3.2   Historic infrastructure investments ensure low-carbon heating for Stockholm**
>
> Stockholm (Sweden) is a good example of a city where an historic infrastructure decision is currently supporting the city's sustainability objectives. Forty years ago, after the 1973 OPEC crisis sent oil prices through the roof, Stockholm developed a vast network of underground district heating. Today, the city has 28 000 km of underground pipes connecting over 10 000 buildings (Beatley, 2017). The district heating system was, and remains, an attractive option because of its convenience and competitive prices (Ericsson, 2009).
>
> From a climate mitigation perspective, this district heating system is crucial to Stockholm's sustainability transition. It now uses biofuels, household waste and heat recovered from Stockholm's data centres and industries (Beatley, 2017; WePower, 2020). In addition to producing much lower greenhouse gas emissions compared to traditional gas or electric heating, it does not use 'above ground' combustion, which has greatly improved the city's air quality. This example demonstrates how historic infrastructure decisions can lock cities into particular sustainability pathways — for better or worse.

Cities need to work around their fixed contextual factors to find solutions that work for them

Contextual factors that cities are less able to influence (e.g. climate, geography) can restrict sustainable policy options and create barriers that are difficult to overcome. During the interviews, Mikkeli, Finland, noted how their freezing, wintry climate presents a barrier to the widespread adoption of electric vehicles because cold weather drains the vehicles' batteries and causes a loss of range. Lisbon's hilly terrain has limited the expansion of cycling as a popular transport mode, although the increased popularity of electric bicycles is helping the city to overcome this barrier. Although such factors themselves are essentially fixed, whether they support or inhibit urban sustainability transitions varies according to the city and its particular geographical setting (see Box 3.3).

Understanding the complex causal relationships between context and sustainability efforts can help cities prioritise the most appropriate environmental policies for their individual circumstances. The survey only tested a small number of the potentially myriad contextual factors. Although a contextual factor that acts as a major barrier in one city may be largely irrelevant in another, what emerges clearly from the research is that a good understanding of a city's context is an essential prerequisite to successful sustainability planning. Knowing that most aspects of a city's context are changeable (either through targeted policy intervention or by means of more large-scale external forces such as climate change) is also an important reminder that cities are living systems, constantly evolving and in a state of flux, and that policy-making must remain agile to respond to future challenges.

> **Box 3.3   Urban sustainability transitions: possible in both 'grey' and 'green' contexts**
>
> Gabrovo (Bulgaria) emphasised that proximity to nature has been a significant driver in its sustainability story. Being surrounded by mountains and forest and a pristine river has created a predisposition among citizens to protect the environment, which the municipality can tap into as it advances its sustainability transition.
>
> In contrast with Gabrovo, where forests cover over 50 % the city's territory (URBACT, n.d.), in Cornellà de Llobregat (part of the wider Barcelona metropolitan area), only around 12 % of the city is made up of natural areas (URBACT, n.d.; Cornellà de Llobregat Municipality, 2019). Yet in this case, the absence of **natural assets** and the higher urban density it enables are seen as positive drivers of sustainability. Rather than letting this lack of green space create a barrier, the city has embraced its dense urban fabric as a characteristic that can bring many benefits through high transport accessibility and the proximity of urban functions while still investing in green and blue infrastructure. Cornellà de Llobregat hopes to be an inspiration for other highly compact municipalities around Europe by showing that this characteristic can actually be a positive driver for sustainability. Both cities have recognised where their strengths lie and have been making the most of their natural assets and existing urban form to further their urban sustainability transitions.

Box 3.4   How COVID-19 may be impacting contextual drivers and barriers

Both existing infrastructure and current urban form are likely to be shaped significantly by the coronavirus pandemic, as a result of consumer preferences and active government intervention. Huge reductions in public transport use have been observed in most European cities, as many people are working from home. At the same time, there has been an increase in the use of private cars. However, the reduction in public transport use in many cities has been accompanied by renewed investment in walking and cycling infrastructure and resurging debates about the value of accessibility and the '15-minute city'. Going against this trend, the preference for single-family detached housing with private gardens persists in many European cities. In the wake of COVID-19, social distancing requirements and greater home working may lead to a perpetuation of this more sprawling urbanisation pattern, with potentially significant implications for environmental sustainability and land-use change.

Air quality is another contextual factor that has been hugely impacted by the pandemic, with many cities experiencing significant reductions in air pollution as a result of the lockdown restrictions. While pollution has rebounded as cities have opened up again, it seems likely that the experience of such drastic improvements in air quality will shape people's preferences in the future.

3.2   Governance

It is increasingly acknowledged that cities are key actors in implementing the EU's low-carbon economy and resource-efficiency objectives (EEA, 2019). They are crucial to improving waste and water management, public transport, adapting to climate change and enabling an efficient use of land by implementing integrated urban planning (EEA, 2015). As part of a wider trend (which is mainly evident in larger cities gaining autonomy and setting social and economic standards), city networks and associations are becoming increasingly important in shaping global climate and sustainability agreements (EEA, 2020). Despite the central role of urban authorities, they cannot tackle the complex challenges of urban sustainability transitions without the support of regional, national and supranational governments. Alongside this need for multi-level governance across the traditional structures of government, there is also recognition that the governance of transitions requires a redrawing of the boundaries between the state and society (Ehnert et al., 2018). This does not mean that government institutions do not continue to play an important role, but rather that effective governance of complex sustainability issues relies on collaboration with actors from academia, research, business and the rest of civil society (EEA and Eionet, 2016).

European citizens are extremely concerned about climate change and the environment (EC, 2019b) and believe their actions towards environmental protection matter (EC, 2017). This enables more proactive involvement of EU institutions and Member States in environmental matters and stronger engagement and support of citizens and local stakeholders for measures taken by the EU and national governments (EEA, 2019).

For the purpose of this report, governance refers to the structures and processes as well as the norms, values and rules through which affairs are conducted by political, business or community leaders exercising their authority.

3.2.1   EU governance

Analysis of the survey results and interviews suggests that the EU and its institutions, initiatives and networks make vital contributions to sustainability transitions in European cities. For example, an interviewee from Tallinn stated that, in the last year, Estonia's strengthened relationship with the EU has led to significant changes in its national government agenda, which now prioritises becoming climate neutral. Consequently, there is now strong national support for environmental initiatives in Estonia's cities. There is also greater support for environmental policies and projects, as public opinion has shifted in favour of more environmentally sound development. The interviewee suggested that political as well as public resistance to sustainability transitions seems to be declining. Similarly to Tallinn, an interviewee from Gabrovo also attributed positive cultural changes in public opinion and engagement to EU membership.

EU legislation supports cities' environmental and sustainability efforts

In the survey analysis, *international treaties and EU laws, standards and regulations* stand out as key supporting factors. These are considered as (either strongly or slightly) supporting by more than two thirds of the cities. This is also reflected in the interview results, which suggest that cities largely use EU strategies,

laws, standards and regulations to better implement environmental legislation and as a roadmap when developing their plans and policies.

For example, the changes that are being made to the Lisbon Municipal Master Plan (Portugal) are guided by the European Green Deal. The Green Deal has also been welcomed by Leuven (Belgium) to enable better alignment of different sectoral policies, boost its efforts to encourage sustainable mobility and, more broadly, to support the city's sustainability transition. Most interviewees mentioned that EU Directives such as the Water Framework Directive (WFD), Energy Efficiency Directive (EED) and Energy Performance of Buildings Directive (EPBD) are important in implementing environmental legislation and driving environmental technological innovations (e.g. nature-based solutions (NBS), smart grids, e-vehicles) in water, transport, housing, construction and waste-management sectors in their cities.

Initiatives and networks supported by the EU inspire positive actions

Most of the cities interviewed said that they benefit from membership of networks established and supported by the EU, a finding also noted in the survey results (see Section 3.3 Knowledge). Interviewees often mentioned the EU Covenant of Mayors and the European Committee of the Regions (CoR) as positive factors in their transition. The Covenant of Mayors for Climate & Energy ([1]) brings together more than 10 000 local governments in Europe voluntarily committed to implementing EU climate and energy objectives. The European CoR is the EU's assembly of local and regional representatives, which provides sub-national authorities (i.e. regions, counties, provinces, municipalities and cities) with a direct voice within the EU's institutional framework. For example, Gabrovo recognises the support of the CoR for their policy-making processes at the national, regional and local level. Several cities (e.g. Lisbon, Cornellà de Llobregat, Tallinn) say that membership of the Covenant of Mayors is crucial to their energy and climate agenda. The importance of city networks and peer-to-peer learning is further discussed in the knowledge section of this report (see Section 3.3 Knowledge).

Quite a few interviewees mentioned that the European Commission's urban sustainability awards EGLA and EGCA had been an inspiration and a catalyst for environmental changes in their cities, driving efforts and recognising the need for better cooperation

among governments, businesses and people to achieve environmental sustainability objectives, such as climate resilience and adaptation, energy efficiency, circular economy, etc. The importance of the awards is further discussed in the knowledge section (Section 3.3. Knowledge).

Both the survey and interviews suggest that access to EU funding is an important contribution to sustainability transitions in cities. Most mention benefits received from the European Investment Bank (EIB), EU programmes, projects and initiatives (e.g. Horizon 2020, Climate-KIC) and EU institutions' joint initiatives (e.g. URBACT, ELENA — a joint initiative of the EIB and the European Commission under the Horizon 2020 programme). The importance of access to multilateral funding is discussed in more detail in the finance section (Section 3.7 Finance).

The evidence gathered in the interviews indicates that in comparison to international environmental initiatives (e.g. United Nations' Sustainable Development Goals — UN SDGs, New Urban Agenda), European regulations and initiatives are considered significantly more relevant to cities when planning for sustainability transitions. Although some cities acknowledge the UN SDGs and use them as guidance for developing their policies (e.g. Stockholm, Lisbon), generally speaking, more weight is given to EU initiatives and in particular EU legislation. Some interviewees suggested that the reason for this is the non-binding nature of UN and other international multilateral agreements.

Implementing EU environmental regulations can be challenging

Although cities have found EU governance generally supportive and of significant importance to sustainability transitions, the interview analysis indicates there are some challenges mainly related to the implementation of EU legislation. Some cities mentioned financial challenges: for example, Gabrovo suggested that providing high-quality water and other services in compliance with strict EU standards in dispersed and sparsely populated settlements around the city is very expensive. Some cities have struggled with implementing EU guidance and regulations, which they believe are transposed into national law too 'literally' and thus are less appropriate or in conflict with cities' local geographical, topographic or climatic conditions. For example, Mikkeli mentioned it cannot apply the initiative to switch to electric transport as most of the year it is too cold for electric vehicles to run properly.

([1])   https://www.covenantofmayors.eu/en

3.2.2 National and regional governance

The survey results show that, in general, factors related to national and regional governance are seen by most cities (at least half of the respondents) as positive drivers of sustainability transitions (see Figure 3.2). Supporting factors frequently identified are *national laws, standards and regulations; distribution of state powers and the level of political decentralisation;* and *actions and policy objectives of the national/state government.* All these factors are also considered potential barriers by a smaller number of respondents. The interview results show a similar picture.

Multilevel governance can support cities in managing strategic sustainability actions

In relation to the *distribution of state powers and level of political decentralisation*, some interviewees highlighted the importance of and the need for regional-level governance when it comes to dealing with environmental issues. This is particularly important for cities that are part of larger metropolitan urban areas where coordination between a number of closely linked municipalities can be indispensable to advancing sustainability objectives (see Box 3.5).

The interviewee from Lisbon highlighted the need for a higher-level 'Lisbon city region' administrative authority that would enable policy- and decision-making across the whole Lisbon metropolitan area to better manage strategic decision-making, especially in relation to infrastructure (e.g. roads, public transport, water supply, etc.). The Lisbon metropolitan area currently comprises 18 municipalities, each with their own devolved powers and often competing interests, which sometimes hinder the achievement of sustainability objectives (e.g. municipalities compete against each other in bidding processes for funding projects that could bring substantial environmental benefits). While there has been some progress in coordinating metropolitan issues among the municipalities, there is currently no metropolitan governing body.

Another challenge related to the distribution of state powers was mentioned by the interviewee from Gabrovo in relation to the lack of fiscal decentralisation in the country and consequently limited funding and a small municipal budget.

Figure 3.2 **Responses to survey question *'Have the following factors related to national governance supported or inhibited the environmental sustainability transition in your city?'***

Number of respondents

Legend:
- Strongly supported
- Slightly supported
- Neither supported nor inhibited
- Slightly inhibited
- Strongly inhibited
- I don't know
- No answer
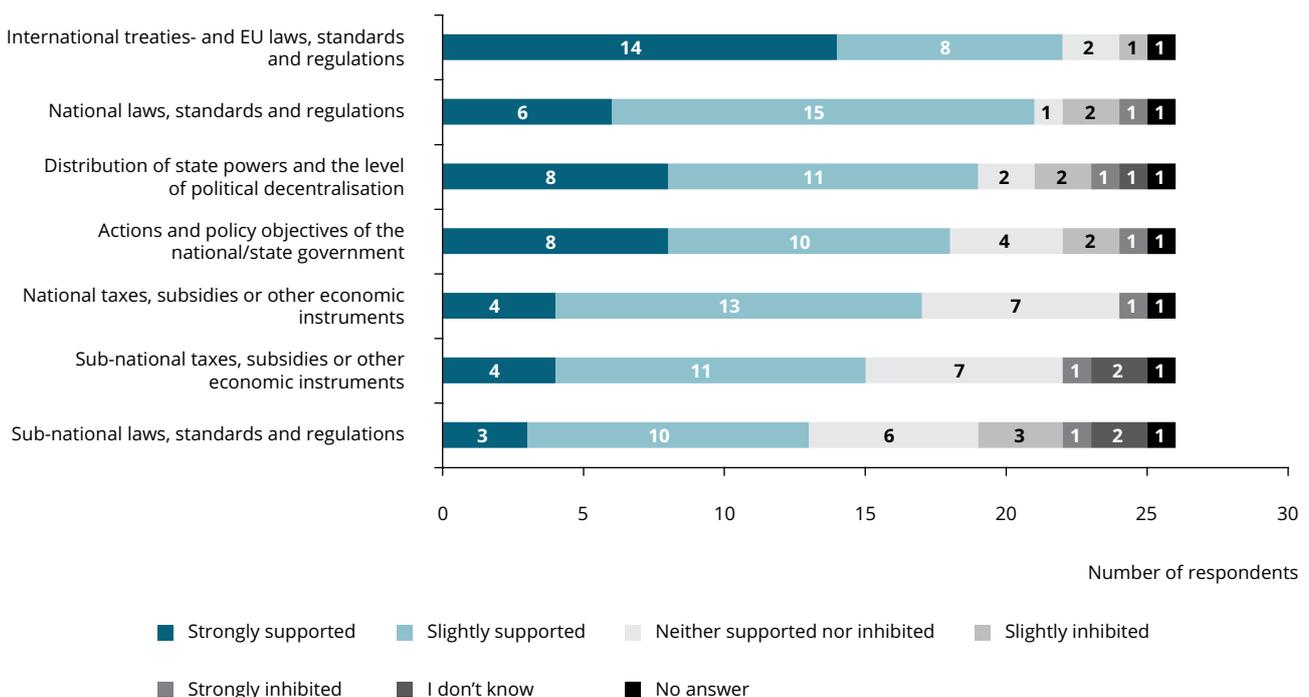
> **Box 3.5   Metropolitan governance supports sustainability transition in Cornellà de Llobregat**
>
> Spain has a decentralised system of governance with 17 autonomous regions each having the capabilities to create laws and manage their own budgets, regional parliaments and even more decentralised levels of government in the form of provinces and local authorities (Fernandez, 2018). As a result of this multi-level governance system, Cornellà de Llobregat's environmental and urban policies are mainly coordinated with the Autonomous Region of Catalonia, the Province of Barcelona and, most importantly, the Barcelona Metropolitan Area (AMB). The AMB is a public authority comprising the city of Barcelona along with 36 other municipalities. It is responsible for managing territorial and urban planning, mobility, housing, the environment, economic development and social cohesion (AMB, n.d.).
>
> Efforts by the AMB to comprehensively tackle the metropolitan area's environmental challenges have been one of the main drivers of sustainability transitions in Cornellà de Llobregat. The municipality is part of the continuous urban area of Barcelona, which means it makes sense for strategic areas such as transport to be planned in an integrated way. For a small municipality of less than 100 000 inhabitants, there are also important benefits in being part of a wider governance system that can provide support across a range of different policy sectors.
>
> Even though political parties may not be aligned across the municipal, metropolitan, provincial and regional levels, there is broad cross-party agreement about the importance of acting on climate change and other shared environmental priorities. This has helped to depoliticise the topic of sustainability and to ensure continuity in the strategic vision for all municipalities in the wider metropolitan area.

Legislation and actions of national governments generally support cities' sustainability ambitions

National laws, standards and regulations also make an important contribution to cities' sustainability transitions. As suggested by the interviewee from Tallinn, the recent change in the national government agenda committing to the environmental goal to become carbon neutral by 2050 is a catalyst for the transition not only in the city but also across the country. On the other hand, the interviewee from Gabrovo highlights the positive experience and importance of the 'bottom-up' approach and the city's participation in policymaking at the national level. Representatives and experts of the municipality of Gabrovo are actively involved in national policymaking through various working groups.

The interviewees suggested several *actions and policy objectives of national/state governments* that contribute to cities' environmental and sustainability achievements. Renewable energy and Portugal's energy efficiency policy play a crucial role in Lisbon's energy-efficiency transition. The country has made large investments in renewable energy sources (in particular wind turbines) which have helped Lisbon to achieve a significant reduction in carbon dioxide (CO_2) emissions. In another example, the Estonian government is running an initiative to develop a 3D model (digital twin) of the whole country, including buildings, infrastructure, structures included below the ground, and even green infrastructure. A digital twin of a test area in Tallinn is already available. This model could help planners, developers, and state and municipal officials to make more informed decisions, supporting the pursuit of environmental objectives in Tallinn as well as across the whole country. Such solutions will become increasingly common in European cities, and the EU's Digital Europe programme will support the deployment of digital twins in at least 15 cities to increase cities' resilience and adaptation to climate change (EC, 2020a).

Some interviewees mentioned that the alignment of city-level environmental sustainability ambitions with national regulations can be challenging. One reason they suggested for this could be that cities (especially larger capitals) are sometimes ahead of national governments in taking action towards environmental sustainability and can help enhance ambition nationally as well as abroad. The interviewee from Lisbon felt that, at the end of the last decade, the city was taking the lead as regards environmental sustainability efforts, even while the financial crisis meant that these issues were temporarily deprioritised at the national level.

Due to high overall populations and population density, (larger) cities also have particular opportunities to deliver services (e.g. public transport, water, waste management, telecommunication, etc.) in a more sustainable, effective and efficient manner. Interviewees from Lisbon, Stockholm and Mikkeli suggested this might be another reason why the ambitions of city government are not always perfectly in tune with national laws.

Sub-national standards, regulations and taxes can harm cities' environmental efforts

Although still seen as positive drivers overall by the survey respondents, *sub-national laws, standards and regulations* and *sub-national taxes, subsidies or other economic instruments* are considered less relevant as drivers, with some cities also identifying them as barriers. Lisbon, Mikkeli and Stockholm have the authority to collect sub-national taxes. Interviewees from these cities considered these taxes to be a driver and an important source of funding for their cities' environmental initiatives. Conversely, the interviewee from Tallinn suggested that the inability of the city to collect tax because of national legislation and the distribution of state powers might hinder its ability to pursue some environmental objectives. For example, Tallinn cannot collect emissions tax for vehicles, which probably adversely affects efforts to reduce GHG emissions.

3.2.3   Local governance

The evidence gathered implies that factors related to local governance might be the most important when it comes to achieving urban sustainability transitions. The survey results indicate that many of the factors related to local governance were considered as (either strongly or slightly) supporting sustainability transitions in cities (see Figure 3.3). *Local government overall vision and strategic plans* play a crucial role in this process (almost all cities recognise it as strongly supporting), which was further confirmed by the interview analysis. Other supporting factors identified by nearly all the survey respondents and often mentioned by the interviewees are *level of civic engagement and public participation; individual political leadership; measurable targets and monitoring of policy objectives;* and *level of coordination and integration of environmental sustainability with other sectors.*

Figure 3.3   Responses to survey question *'Have the following factors related to local governance supported or inhibited the environmental sustainability transition in your city?'*
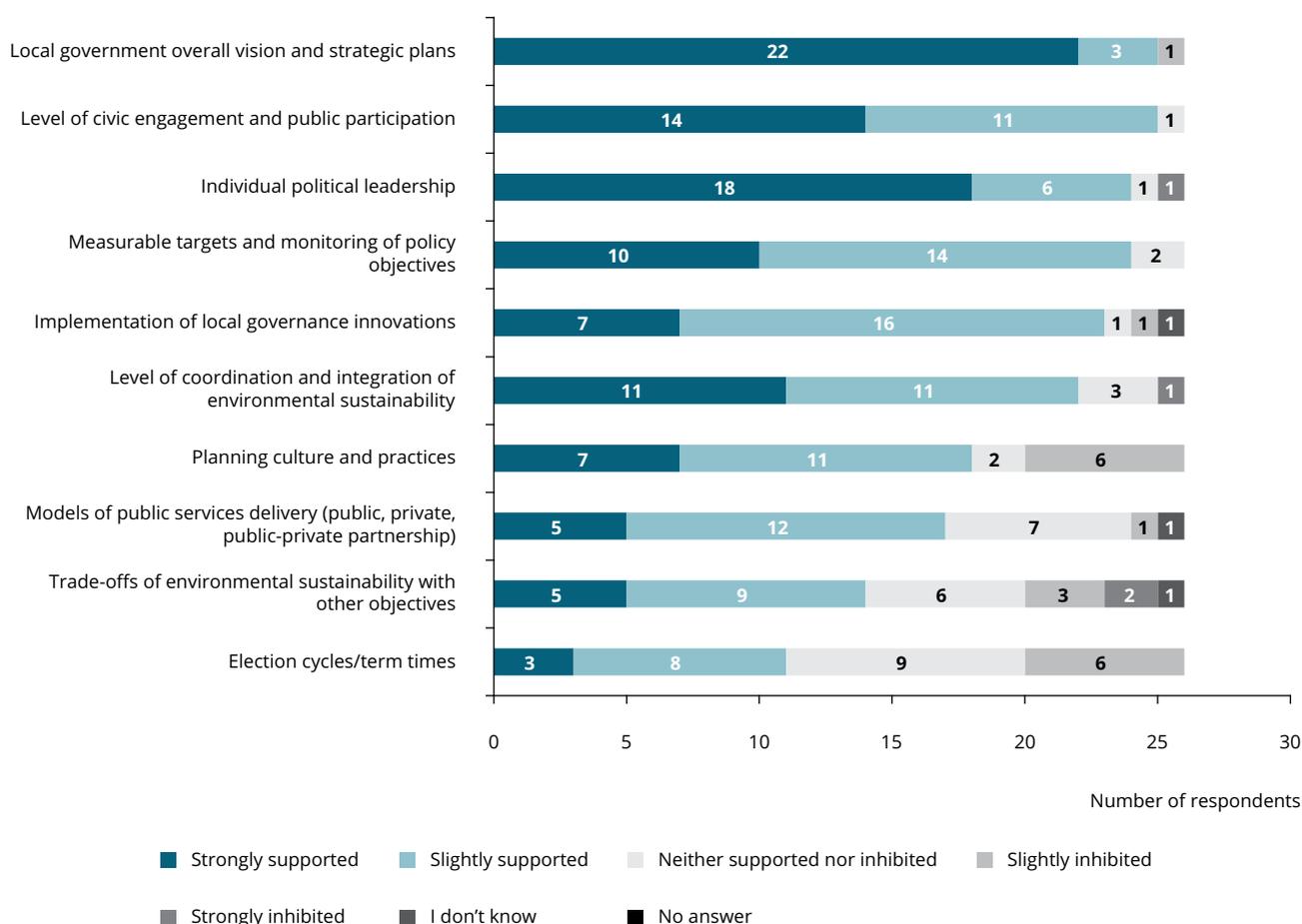
Cities use various models of governance and services provision

The analysis indicates that the cities interviewed use various governance models and approaches to achieve their environmental sustainability ambitions. These include top-down, bottom-up and multi-level approaches. While most cities' environmental matters are governed locally (i.e. by municipalities and/or regions), in the city of Leuven, the environmental sustainability agenda is being delivered by a non-governmental organisation (NGO), Leuven 2030. Cities also use and look for new models of (public) services provision (e.g. public, private, private-public partnerships and cooperatives) in order to deliver these in more a sustainable manner. Examples of services they provide include public transport, water management and supply, waste management, management of green and blue spaces, heating, electricity supply, etc. For example, Tallinn is looking into options for community-based energy production. Local governments also explore and provide new models of financing for community and other projects (e.g. participatory budgeting in Lisbon and Tallinn).

Sustainability achievements are built on cities' clear visions, strategic thinking and planning

The interviews suggest that *local government overall vision and strategic plans* are important in achieving sustainability transitions in cities. All cities list several strategic plans (e.g. visions, roadmaps, action plans, etc.) setting out their vision, objectives and actions to make progress towards environmental sustainability. The documents mainly address topics and set objectives related to carbon emissions; energy (green, renewable, efficiency, provision); climate (change, mitigation, adaptation, resilience); economy (green, circular, shared); transport (green, multimodal, public, planning of transport infrastructure); water (provision, circulation, quality); green infrastructure; as well as natural disasters (e.g. floods, heatwaves); housing (challenges, provisions, sustainable construction and design); and inclusion (social, intergenerational, digital).

The interviewees and survey respondents highlighted some strategic documents that have been crucial for progressing sustainability transition in their cities. Examples of these, which have either been published or are still being developed or updated, include:

- Gabrovo has an overall sustainability vision 'Green Gabrovo' and is working on Vision 2050, to be published next year.

- In Lisbon, the most important driver of environmental sustainability has been the Lisbon Master Development Plan (2012-2022) (see Box 3.6).

- In 2007, Stockholm adopted the 'Vision Stockholm 2030', which outlines several strategies central to its implementation. The new City Plan (2010), 'The Walkable City', seeks to improve urban green infrastructure and provides guidance on how Stockholm will meet the objectives of its Vision 2030.

- In Leuven, the sustainability trajectory is set by Roadmap 2025/2035/2050 (see Box 3.8).

- In Tallinn, an important driver of sustainability transition is the Sustainable Energy Action Plan 2011-2021 and a new strategic plan to 2030, which will also address environmental issues.

- Cornellà de Llobregat has developed a 10-year environmental strategy known as Cornellà Natura, which is focused on expanding green and blue infrastructure, enhancing sustainable mobility and improving environmental quality.

Monitoring measurable targets helps cities to better plan for the future

The interviewees from Stockholm and Leuven stressed the importance of *measurable targets and monitoring of policy objectives* to measure a city's performance towards environmental sustainability and identify areas and sectors (e.g. water, air, habitats, green space, climate, transport, energy provision, etc.) where actions for improvement are most needed. This enables better planning for the future and the setting of priorities and objectives in city strategies, plans and programmes (e.g. development, energy efficiency, climate, transport, etc.). Measurable evidence of improvement (e.g. better air quality) is usually 'more believable' and better understood by the public and other stakeholders, which might give environmental initiatives the momentum needed to progress further. For example, in Stockholm, as well as standard environmental parameters like air and water quality, the city also works closely with a local university to measure the resilience of implemented NBS (e.g. green roofs, sustainable drainage systems (SuDS), etc.), looking at how these preform over a period of time. The interviewees also mentioned several challenges related to monitoring

> **Box 3.6   Lisbon Municipal Master Plan**
>
> The current tiered spatial planning system in the Portuguese System of Territorial Management (Sistema Nacional de Gestão Territorial — SNGT) is hierarchical and based on the concept of a 'cascade of plans'. The plans/instruments at lower levels provide more detail on the spatial planning decisions/options set out in the higher-level plans. The municipal tier of the SNGT comprises Municipal Master Plans developed for all 308 municipalities in Portugal. They define land use (including location) and lay out a general municipal spatial development strategy (Serra et al., 2011).
>
> The overall objective of the Lisbon Municipal Master Plan (2012-2022) is to foster the city's green transition by implementing green infrastructure (GI) and NBS to mitigate the impacts of economic and demographic challenges in Lisbon. The key challenges the city has dealt with in the last decade include air pollution; reduced quality of life; uncontrolled urbanisation; heat-island effects; floods; lack of green space; and population decline.
>
> Building on the multiple (co)benefits of GI and NBS, the main sustainability objectives of the plan are:
>
> •   implementation of GI (i.e. green corridors, street trees, green spaces and allotments) to achieve connectivity of green spaces for recreation, biodiversity and protection of natural and cultural landscapes;
>
> •   rehabilitation of green spaces, buildings and city districts to achieve city regeneration and reverse depopulation; and
>
> •   increasing green areas to tackle flooding and climate change.
>
> Since its realisation, the plan has become a flagship example of good urban spatial planning practice, demonstrating that even during a financial crisis a city can improve its residents' well-being by implementing relatively cheap, small-scale and focused GI and NBS measures.

and indicators to measure performance towards sustainability transitions, notably scale (data are mainly available at the national level), but also timeliness (i.e. data are often too old to be useful), accessibility (e.g. format and ease of accessing) and quality (e.g. robustness, reliability, relevance, comparability, and compatibility) of data and information. These issues are discussed further in the section on data and information (Section 3.6 Data and information).

Cities call for political and community leaders to drive the systemic changes needed to achieve sustainability transitions

Most interviewees also stressed the importance of *individual political as well as community leadership* for the implementation of environmental sustainability visions, programmes, plans, policies and actions. For example, the most important catalyst for Lisbon in terms of sustainability transition was the victory of the Socialist Party in 2007 and their 'green plan', which set out very clear environmental and sustainability objectives. The former mayor who had put environmental issues at the heart of the city's development agenda, which also brought obvious economic and social benefits, was re-elected twice and is now prime minister of Portugal. The interviewee said that the former mayor's leadership was important in terms of investments in projects that brought environmental benefits (e.g. sustainable transport, renewable energy, etc.).

An interviewee from Leuven said that activating many local leaders who will take ownership of sustainability actions and initiatives is essential not only for cities but also for societies to make the more radical, systemic changes that are needed to achieve sustainability transitions. To address this, the NGO Leuven 2030 is looking for a new governance model. Ideally, the model would encourage and support community leadership in a way that gives the leaders enough autonomy while, at the same time, keeps them connected and close enough to 'core' governance. However, based on the experience of known governance models, freedom to act while simultaneously ensuring that everyone works towards the same collective objective has proven quite a challenge. Other cities mentioned noticing the trend towards more organised community actions in their cities (e.g. Lisbon, Gabrovo, Tallinn).

Cities are looking for ways to better engage with people, communities and institutions

The evidence suggests that the *level of civic engagement and public participation*, as well as coordination and cooperation among governmental and other institutions (e.g. businesses, universities, NGOs) make an important contribution to sustainability transitions in cities. Interviewees from all cities talked about different forms of public participation and interinstitutional cooperation, including participatory budgeting for community projects, regular meetings in the city's neighbourhoods and districts, running

projects and events that bring together governments, public, NGOs and businesses (e.g. ETI Climate-KIC in Leuven), and online platforms supporting citizens' engagement in decision-making and other processes. As suggested by most, citizens' demands are an important driver of environmental actions in cities, which also encourages coordination and cooperation from different stakeholders. Interviewees from Lisbon and Leuven highlighted the importance of clear and simple public communication for better buy-in on environmental policies, initiatives and actions by residents, communities, businesses and development sectors (e.g. housing, transport, water, waste). This is further explained in Section 3.6 Data and information.

Election cycles and results can either strongly support or hinder cities' sustainability transitions

The survey results suggest that the least supporting factors related to local governance include *election cycle/term times*; *planning culture and practices;* and *trade-offs of environmental sustainability with other objectives. Election cycles/term times* were also identified by more than a third of the survey respondents as not relevant to sustainability transitions in their city. However, according to the interview results, it seems that for some cities, election cycles and the continuity of local government and administration (i.e. civil servants) are important factors that can either support or hinder their sustainability transitions.

As explained by the interviewee from Lisbon, winning several consecutive elections (four to date) has enabled the local government to implement long-term projects

and action based on the Lisbon Municipal Master Plan. Similarly, Cornellà de Llobregat has been governed by the same party for over a decade, which was also mentioned as a positive driver. The interviewee from Leuven suggested that local election term times are crucial. At the moment, the Leuven government recognises the importance of and is strongly in favour of urban environmental sustainability. However, it is very important that by the end of its mandate the running sustainability projects and initiatives it supports deliver results. This is necessary to ensure political continuity as political disruption can be damaging and can slow down the process of sustainability transitions in the city. In Gabrovo, they emphasised the continuity of staff as important for carrying out long-term environmental ambitions, although the political leaders might change quite frequently.

Planning culture and practices were also mentioned by the interviewees as potential barriers to environmental sustainability. Past urban development patterns and doctrines made to support the lifestyle of people with different needs and values to those we have today (e.g. car-dependent sub-urban neighbourhoods developed in the 1950s) either still dominate in some cases or at least remain a significant part of existing urban structures, which can be a barrier to sustainability changes. Although cities are making impressive efforts, transforming outlived urban settlement doctrines is a slow process, strongly interwoven with the political, cultural and behavioural transformation of cities and their residents.

Box 3.7   How COVID-19 may be impacting governance drivers and barriers

City networks (e.g. Eurocities, Covenant of Mayors for Climate and Energy, UGCL — United Cities and Local Governments) may become even more important in shaping governance in the future as they play a vital role in supporting cities to deal with the challenges of the pandemic by cooperating and sharing valuable experience and knowledge.

With the emergence of COVID-19, European cities require even stronger cooperation with the EU as they want to be actively involved in the EU's post-pandemic recovery. In a joint declaration to the European Commission, mayors connected through the Eurocities network proposed more significant involvement by city governments in EU recovery programmes and demanded direct access to European funding (Eurocities, 2020).

Because of the COVID-19 pandemic, the ability to collect taxes and related financial autonomy might be of even greater importance for cities, especially in light of taking actions to foster environmental sustainability transitions. Due to changed priorities in national spending (e.g. the focus on health) and other long-lasting economic and social consequences of the pandemic, cities and municipalities are likely to endure further budget cuts. This could increase their financial dependence on national and other resources (e.g. EU financial support) and could possibly lead to a shift in priorities as regards their actions and political agendas, which may not be in favour of environmental sustainability transitions.

3.3 Knowledge

Cities across Europe are seeking to harness the power of knowledge to develop new visions of how sustainable urbanisation can and should look. The complexity and heterogeneity of urban systems means that identifying and implementing the most impactful policies and strategies for a particular urban context remains a challenge. The production and dissemination of knowledge are therefore key drivers of evidence-based policymaking for sustainability.

For the purposes of this report, knowledge is understood to mean the key insights, skills and expertise related to urban environmental sustainability processes, their management and options for action held by individuals within a group or among groups (2).

Knowledge can be shared between networks of actors directly involved in the creation, diffusion and use of scientific, technological and other forms of knowledge, as well as those organisations responsible for the coordination and support of these processes. The importance of knowledge as a positive driver of change was confirmed in the survey, with almost all knowledge-related factors being seen as very positive in terms of their impact on sustainability transitions. *Networks of cities and peer-to-peer learning*, *research and innovation*, and *levels of awareness of environmental sustainability* stand out as being the factors selected by most survey respondents as having 'strongly supported' their sustainability transitions (Figure 3.4).

Figure 3.4   **Responses to survey question *'Have the following factors related to knowledge supported or inhibited the environmental sustainability transition in your city?'***

Number of respondents

Legend:
- Strongly supported
- Slightly supported
- Neither supported nor inhibited
- Slightly inhibited
- Strongly inhibited
- I don't know
- No answer

(2)   This definition draws on the EEA MDIAK framework https://www.eea.europa.eu/publications/europes-environment-aoa/chapter1.xhtml
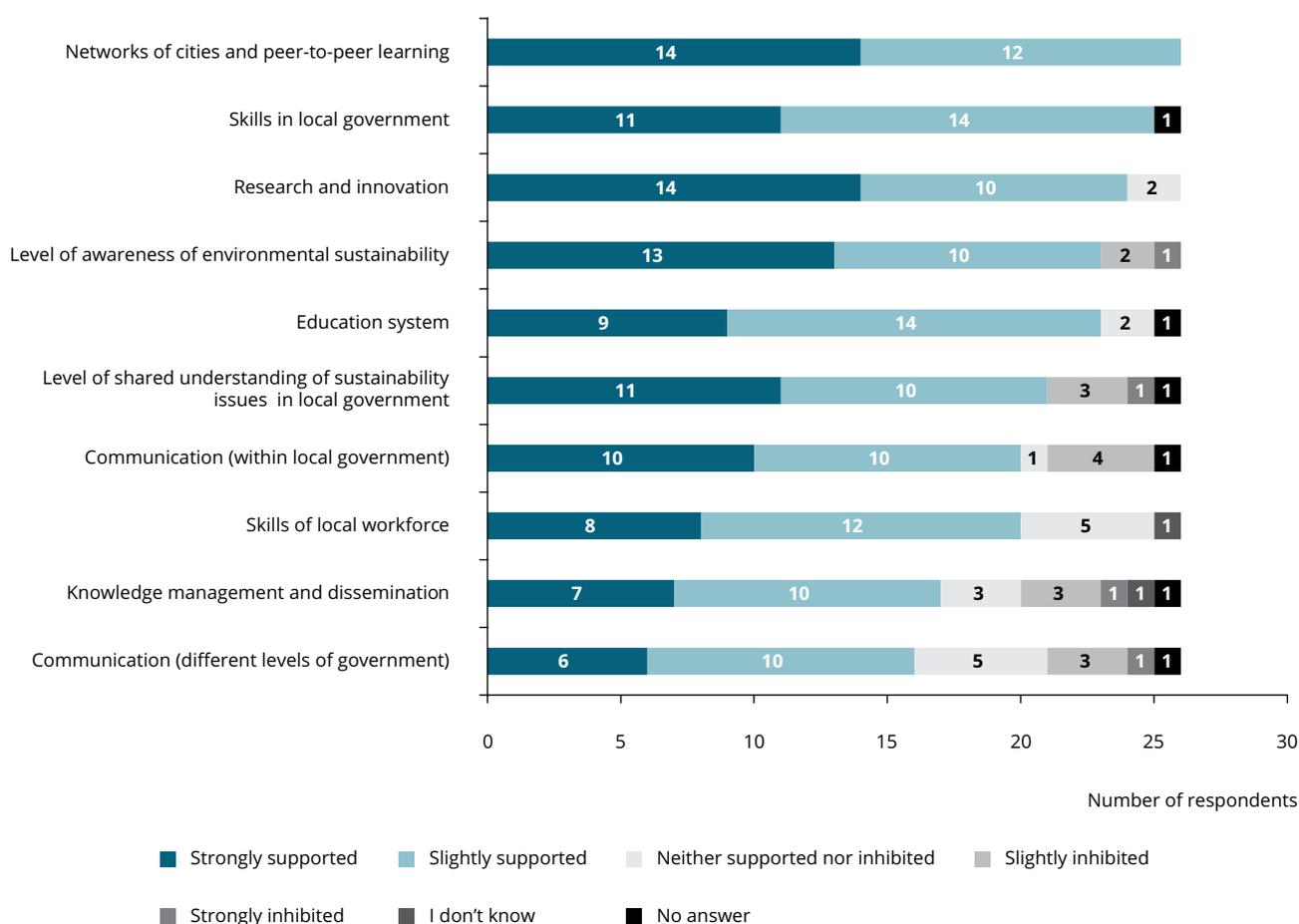
The knowledge factors that emerged as particularly important can be broadly differentiated as those that facilitate knowledge production and those that facilitate knowledge dissemination.

Knowledge production: innovation is critical to identifying local solutions

Research and innovation emerged as among the most important positive drivers in the survey and were also repeatedly highlighted as essential by the cities interviewed. Several mentioned the importance of having a culture of innovation that has accelerated their sustainability transitions (see Section 3.4). The importance of an innovation-led economy that is supported by the right education, industry promotion and infrastructure development was highlighted by Gabrovo, Leuven, Stockholm and Tallinn. Having a culture of entrepreneurialism clearly facilitates problem-solving around complex sustainability issues and can help to reframe environmental challenges as opportunities. Many of the cities reported that thinking of the urban environment as a perfect test bed to explore the viability of new solutions and technologies and to experiment with different ideas and approaches had driven their sustainability transitions (Leuven, Lisbon, Stockholm, Tallinn).

Cities pointed out that both local and international research collaborations had played an important role in ensuring that they were able to respond effectively to a range of environmental challenges. The EU was seen as an important broker of international research partnerships, for example by introducing Lisbon to the Fraunhofer Institute in Germany, which is now helping the city to review and adjust its environmental targets, or by connecting cities via EIT Climate-KIC, Europe's leading climate innovation initiative (Leuven, Lisbon). Such partnerships were seen as a way of learning from each other and progressing more quickly towards shared environmental objectives.

Including a diverse range of stakeholders improves knowledge production

All cities interviewed mentioned that collaborating with the private sector, universities and civil society is important, allowing them to draw on a diverse range of knowledge sources to find innovative solutions. This was considered essential in terms of early buy-in from all sectors of society and for ensuring that some of the more radical or controversial policy changes were co-created with those most impacted by them. There was an acknowledgement that the complex challenges facing cities as regards sustainability transitions require new ways of working with stakeholders and that traditional 'top-down' knowledge production needs to be complemented by more 'bottom-up' approaches (see Box 3.8). Solutions can often come from unexpected places and local initiatives can provide the inspiration for city-wide changes.

This also includes encouraging healthy competition among companies to improve their own sustainability behaviour, which can act as an important complement to governmental efforts. Creating an environment where the private sector is working closely with the city was generally seen as a vital way for municipalities to accelerate certain policy initiatives. For example, Cornellà de Llobregat highlighted a recent collaboration with a local shopping mall operator to establish a park-and-ride scheme, while in Lisbon, companies are being encouraged to remove parking spaces.

Box 3.8   Leuven's Carbon Neutral Roadmap driving collaborative innovation

To accelerate progress towards carbon neutrality, Leuven recently launched a new roadmap that was designed and is being implemented by a broad coalition of public, private and third-sector stakeholders. The roadmap comprises 13 programmes and more than 500 individual projects, covering everything from buildings to energy to mobility to sustainable consumption and climate adaptation (De Paep et al., 2019). Many of these objectives are linked to new research and pilot projects that build on the city's long history of knowledge production.

Shared agreement around the science across these different stakeholder groups is enabling technological as well as process innovation across all sectors. Clearly defined roles and responsibilities for all tiers of government, knowledge institutions, the private sector and civil society ensure that the roadmap is seen as a truly collaborative project for generating new knowledge that will enable the city to transition towards carbon neutrality.

Knowledge dissemination: sharing best practices with other cities accelerates change

Networks of cities and peer-to-peer learning were identified as a supporting factor by every city, making this the positive driver most universally agreed upon across the entire survey. The interviews strongly confirmed this, with all cities speaking at length about the importance of sharing best practice and how participating in various city networks had benefited their sustainability transition.

Many cities felt that it was useful to be connected to cities that share a similar context due to geographic proximity or shared governance structures, as well as to those facing very similar environmental challenges and risks. Such connections enable cities to work to identify shared solutions (e.g. Lisbon linking up with other Mediterranean cities that face water-scarcity challenges; Gabrovo connecting with other Bulgarian cities to advance energy-efficiency measures; and Mikkeli exchanging lessons with other cities across the Nordic region). Identifying the right stakeholder groups and partners to tackle specific challenges was also seen as important.

Networks are more about collaboration than competition

Joining organisations such as the Covenant of Mayors or the C40 Cities Climate Leadership Group can create the push cities need to improve data collection and advance towards specific environmental goals while providing a clear benchmark that cities can use to compare their progress.

Despite this, they felt that the main benefit of city networks was that they fostered a sense of collaboration and shared learning rather than competition (see Box 3.9). Many cities mentioned how useful it can be to exchange with like-minded individuals and learn from each other's successes and failures. A culture of openness and a willingness to share experiences was seen as one of the most positive aspects of these city networks. Being part of networks also creates accountability and, as Leuven pointed out, feeling part of a bigger movement of all cities working towards a shared goal can sometimes make all the difference.

Box 3.9   The European Green Capital and Green Leaf Awards: powerful drivers of change

The EGCA and EGLA emerge as important drivers of environmental sustainability for the award winners and finalists. All of the cities interviewed emphasised the central role these awards had played in accelerating their sustainability journey.

The benefits identified by cities can be grouped into three main driver categories:

1. **Benchmarking:** The stringent requirements of the award's application push cities to take stock of their current environmental performance and identify gaps in their knowledge. They are encouraged to systematically assess what they are doing and how they could improve. Many cities reported that this was an important driver to tackle the greatest environmental challenges with which they were struggling.

2. **Strategic thinking:** The award's application promotes more strategic thinking around environmental sustainability and how it is integrated into wider city visions, as well as how it links with other urban development challenges.

3. **Legitimacy and leadership:** Winning the awards has major reputational benefits and is seen as providing greater legitimacy, enabling cities to demonstrate to political leaders and the public that their environmental efforts are paying off. It also allows cities to take on greater leadership in different areas of environmental sustainability.

Some of the networks, institutions, schemes or awards that were mentioned by many of the cities as having been of particular importance when it comes to peer-to-peer learning and knowledge exchange include:

• C40 Cities

• Covenant of Mayors for Climate and Energy

• Energy Cities

• Eurocities

• European Committee of the Regions (CoR)

• Green Capital/Green Leaf Network

• ICLEI – Local Governments for Sustainability

• URBACT – Driving Change for Better Cities

• Urban Agenda for the EU

Of course, this list is not exhaustive as many other more local, regional as well as thematic networks play an equally important role in knowledge sharing.

As regards networking, quality is more important than quantity

Interviewees acknowledged that it can sometimes be a challenge to manage participation in the large number of networks that have proliferated in the urban sustainability space in recent years. To ensure these partnerships are managed effectively, Lisbon has set up a special department that deals exclusively with EU collaborations and partnerships and makes sure they enhance the city's learning and knowledge exchange. Not all cities have this level of resourcing, so the importance of prioritising participation in networks that add the most value is key.

The smaller Green Leaf cities reported comparatively less engagement with big international and pan-European city networks, but instead stressed the importance of regional and national networks of cities (e.g. Cornellà de Llobregat, Gabrovo, Mikkeli). This may also be due in part to language barriers, which mean it may be more productive to engage with local city networks and organisations.

Cities are using city networks in many different ways. They are clearly not just seen as platforms that enable the sharing of knowledge and best practice but are also recognised as a way to amplify their voice and political bargaining power and to advocate common interests. In this context, the European Commission emerges as an important broker, and initiatives such as Climate-KIC were repeatedly highlighted as important positive drivers promoting greater collaboration and multi-stakeholder solutions to urban sustainability (e.g. Leuven, Lisbon).

Level of awareness and lack of communication can undermine sustainability efforts

Many cities highlighted how vital it is to raise the level of awareness of environmental sustainability, both in the general population but also among politicians and civil servants. While overall awareness of and interest in environmental issues has been increasing across all sectors of the population, knowledge gaps between stakeholders can still undermine progress sometimes. Developing targeted campaigns to ensure that everyone has a shared knowledge base regarding the main environmental challenges and what can be done about them was seen as critical to overcoming this barrier.

Communication (both within local government and between levels of government) was identified most frequently in the survey as inhibiting sustainability efforts. The level of shared understanding of environmental sustainability issues in local government, and knowledge management and dissemination were also identified as potential barriers by some cities. This was very much echoed by the interviews where cities frequently highlighted the importance of greater communication with other departments and other levels of government (e.g. Cornellà de Llobregat, Gabrovo, Lisbon, Mikkeli). Having an integrated strategic vision for the whole city that ensures that sustainability issues are not dealt with in a siloed way but instead become a shared responsibility was seen as a crucial way of overcoming this barrier. Cornellà de Llobregat also stressed how important close collaboration between the planning department and the environment department has been to mainstreaming sustainability issues across all government departments.

Box 3.10   How COVID-19 may be impacting knowledge drivers and barriers

In light of the coronavirus crisis, many of the city networks mentioned above have played a vital role in supporting information sharing between cities, helping them to identify policies that have worked well in other cities and learning from each other's mistakes. Initiatives such as the 'Cities for Global Health' Initiative led by UCLG, Metropolis and UN-Habitat also became important in this context, providing a safe space for cities to talk about the many challenges created by the pandemic.

A number of the existing city networks have developed new initiatives specifically focused on the recovery from coronavirus. For example, the C40 Global Mayors COVID-19 Recovery Task Force, has published an 'Agenda for a Green and Just Recovery', outlining key steps to delivering an equitable and sustainable recovery from the COVID-19 pandemic. In Europe, cities want to play an active role in the post-pandemic recovery, as is reflected, for example, in Eurocities' joint declaration 'EU recovery powered by cities' (Eurocities, 2020).

The coronavirus crisis is putting greater emphasis on the importance of good knowledge management and dissemination. More attention is being given to how 'scientific' data is or should be presented to wider audiences. In this sense, COVID-19 might be an opportunity for cities and other governments to learn how to communicate relevant information to the public and foster positive behavioural (but also institutional, legislative, etc.) change in relation to other urgent systemic challenges such as climate change and other environmental issues.

3.4   Culture

The SOER 2020 highlights that social practices and lifestyles are inextricably connected to the sustainability challenges facing cities. Our current use of resources and resulting pollution are tied in complex and historical ways to behaviours and ways of living. Culture is thus an essential component of sustainability transitions (EEA, 2019). It has a strong role to play in supporting the process of change and adaptation necessary for sustainable urban development, as evidenced by the emphasis on cultural and natural heritage among the targets of the UN Sustainable Development Goal 11 on Sustainable Cities and Communities (UN, 2015). The EU Urban Agenda partnership on culture and cultural heritage also recognises culture as an important driver of more sustainable cities. A recent white paper emphasises that by providing 'a context in which creative people from different backgrounds, lifestyles, knowledge and disciplines can meet, culture and cultural heritage fulfil the preconditions for innovation towards a more sustainable future. As a store of collective memory, cultural heritage can also provide contemporary societies with answers from the past on how to tackle adversity and remain resilient, both in terms of conceptualisation of problems and of offering practical solutions' (ICLEI and Eurocities, 2019).

For the purposes of this report, culture refers to the shared characteristics (e.g. language, religion, cuisine, etc.), patterns of behaviour (e.g. social habits, etc.) and understanding/attitude towards an issue (e.g. urban environmental sustainability and willingness to adopt new behaviour) of a particular group of people (in urban areas) that are learned through socialisation [3].

As the survey also highlighted (see Section 2.3), it is only in recent years that sustainability has become such a pressing issue for cities, reflecting broader shifts in environmental awareness that began to emerge following the 1992 UN Conference on Environment and Development in Rio de Janeiro and the development of the Local Agenda 21 (LA21) [4]. Cities are increasingly confronting the impacts of climate change and dealing with systemic environmental and social challenges that arise in urban agglomerations.

While a growing number of urban citizens are concerned about the state of the environment, firmly established cultural values and habits can often lead to contradictions between these new-found aspirations and lived realities. Thus, transitions to sustainability require cultural shifts in behaviour.

This requirement can generate anxieties and suspicion within local communities, for example, when new living and transport arrangements drastically change how

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[3]   This definition draws from the Center for Advanced Research on Language Acquisition, available at: http://carla.umn.edu/culture/definitions.html
[4]   Local Agenda 21 is conceptualised in Chapter 28 of Agenda 21, which was adopted by 178 governments at the 1992 Rio Conference. Local Agenda 21 (LA21) is a voluntary process of local community consultation with the aim of creating local policies and programmes that work towards achieving sustainable development. LA21 encompasses awareness-raising, capacity-building, community participation and the formation of partnerships.

people experience urban life. *Public engagement* is a key mechanism for bridging the gap between the community and sustainability issues. Through the involvement of local communities, complaints can be raised, doubts put to rest and attitudes even changed. Having local communities on-board becomes even more significant for sustainability transitions when we consider the power that people hold to campaign and put pressure on authorities to do more. In the light of recent global environmental movements, this fact — of local communities enabling sustainability transitions — has never been clearer.

Empowering and educating civil society creates feedback loops that push municipalities into action

The empowerment and training of civil society has been identified as one of the primary drivers for action on adaptation in the face of climate change (Bulkeley et al., 2009). The power of the public to further urban sustainability transitions was echoed in the survey results and the interviews conducted with cities. According to the results, the main cultural factors that enable urban sustainability transitions are *values and attitudes to environmental sustainability by the general public, willingness by local government to adopt new behaviours and practices,* and the *level of public engagement* (Figure 3.5).

In the interviews with cities, discussion largely focused on *values and attitudes to environmental sustainability by the general public,* and the *level of public engagement.*

Engaging the public is essential to co-create sustainable cities

The interviews revealed that *public engagement* was a powerful driver of sustainability transitions. Participatory processes that engage the public can raise environmental awareness and encourage citizens to rethink their behaviours and make changes to their consumption patterns to reduce negative environmental impacts — for example, by switching to more sustainable transport options, reducing single-use plastic or making more environmentally friendly food choices.

All cities expressed commitment to working with and listening to stakeholders in the community. For instance, Mikkeli and Leuven recognised the need to harness the power of individual actions to co-create a sustainable city. Recognising the importance of involving the public, the cities interviewed expressed a willingness to adopt participatory mechanisms and processes to ensure the public's voice was heard and captured (see also Section 3.3).

Figure 3.5 **Responses to survey question *'Have the following factors related to culture supported or inhibited the environmental sustainability transition in your city?'***
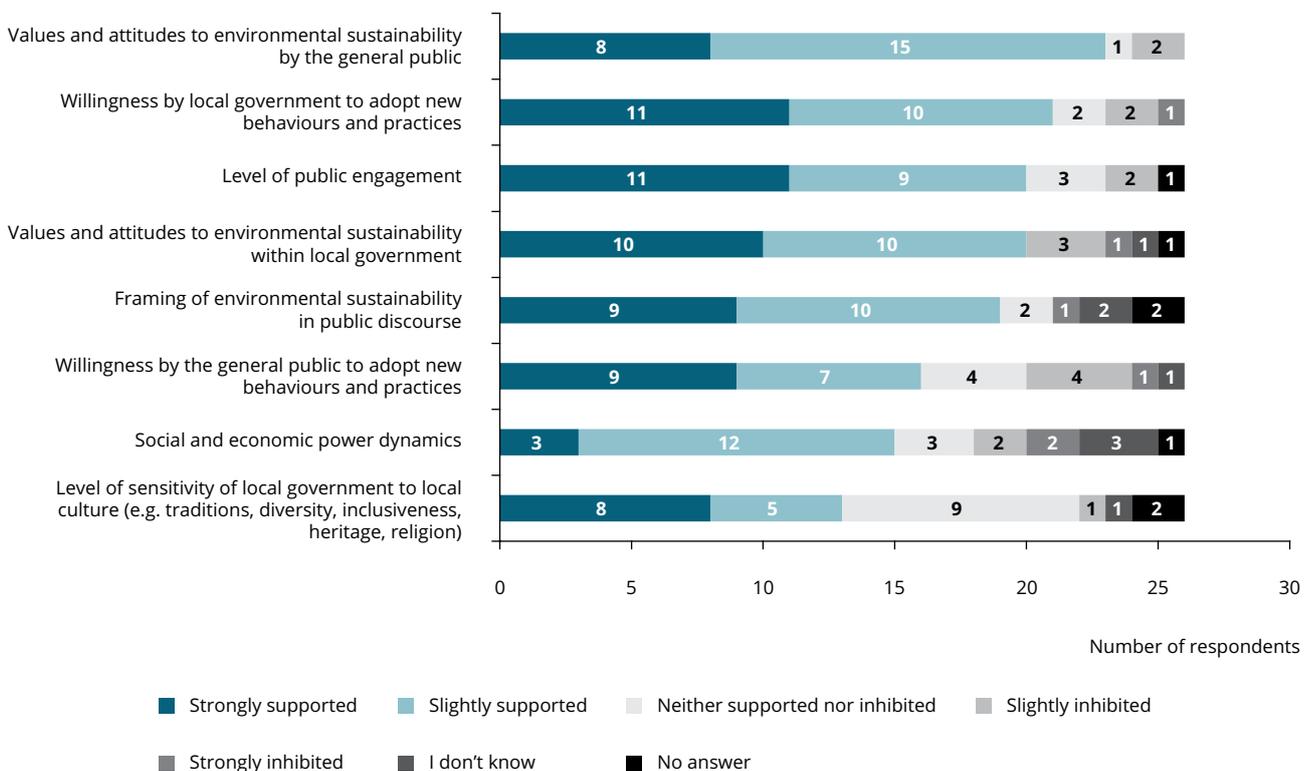
Educated and empowered citizens can drive action on sustainability

In addition, and perhaps most importantly, raising environmental awareness in the community means that the public becomes empowered to make demands on the authorities. Educating and empowering the public is crucial because it creates a positive feedback loop, which enables sustainability transitions. Awareness-raising campaigns and activities educate local people and enhance their understanding of the key sustainability issues. This heightens common awareness of environmental issues and, in turn, encourages local people to become more actively involved in putting pressure on municipalities to achieve their sustainability goals.

The initial difficulties involved in reaching out to get local people involved were noted in interviews. Cities that have successfully built and sustained a network of relations within their local communities praised this positive influence on sustainability transitions, even when it put pressure on themselves to deliver (see Box 3.11). This relates to the factor, *willingness by local government to adopt new behaviours and practices*, illustrating how local government attempts to integrate participatory mechanisms into their decision-making processes.

Younger generations are more flexible when it comes to adopting new behaviours

Broader cultural transitions are taking place across cities, with younger generations in particular forging their own understanding of what it means to live well within the limits of our planet. A generational divide in cultural attitudes was referred to by several interviewees. In this sense, younger people are generally considered more open-minded to the environmental sustainability agenda and more able to adopt greater flexibility in relation to the introduction of new technologies and initiatives that further sustainability transitions (see Box 3.12).

Box 3.11   Gabrovo: 'The more we do, the more people expect'

Participatory information campaigns across Gabrovo have facilitated the introduction of a retrofitting programme for multi-occupancy buildings. Gabrovo is a partner in the National Programme for Energy Efficiency of Multi-Family Housing, which aims to reduce energy consumption by 40 % by implementing energy-efficiency measures (Gabrovo Municipality, 2016).

Despite initial suspicion from residents, the municipality found that the information campaign not only helped address residents' concerns but also opened up a debate on the topic of sustainability more generally. It provided a space for the process of retrofitting to be discussed and for residents to understand the wider benefits to them, their families and the environment. These participatory initiatives raised environmental awareness and moulded public opinion on issues of sustainability. The more government officials in Gabrovo enacted sustainable policies and plans, the more people became engaged. Today, citizens are increasingly making demands on the authorities for further sustainability actions.

Box 3.12   Beyond the car — a major cultural shift is taking place in Lisbon

The end of car-centricity in Lisbon requires not just new infrastructural investments but, importantly, cultural shifts in social habits and lifestyles, too. Following decades of car-centric planning, Lisbon is trying to reduce car use and create a pedestrian and cyclist-friendly city. Steps that have been taken include fewer parking spaces and investments in active travel and public transport, including shared mobility options. Over the last 2 years, the Lisbon Plaza Programme has renovated 21 squares and Pavimentar 2020 is restoring over 100 streets (Lisbon Municipality, 2019).

Cultural shifts amenable to this transition are already occurring within younger generations who value high-density urban living and the car-free accessibility it provides. Younger generations are increasingly rejecting traditional cultural values centred on car ownership and larger suburban houses, cultivating an openness to change that is accelerating the sustainability transition and enabling a more radical rethink of what quality of life means.

In Mikkeli, for example, traditional values around ownership are fading away, with younger people increasingly recognising the value of the sharing economy. Having a vibrant young population may make it easier for cities to enact sustainability transitions through radical policies that reshape lifestyles and demand adherence to new ways of living and getting around the city. Despite this demographic divide being generally acknowledged across all cities, Stockholm felt that attitudes were improving across all age groups and that greater education and awareness-raising campaigns could help overcome entrenched behavioural patterns or prejudices.

This highlights an important dimension of the factor, *values and attitudes to environmental sustainability by the general public,* by explicitly showing that the general public is a diverse rather than a homogenous group. Despite generational differences in opinions on sustainability that were noted in interviews, *values and attitudes to environmental sustainability by the general public* is the top supporting factor identified in the survey. This implies that sustainability transitions can occur even when there are differences in values and attitudes among the public. In fact, by engaging with people's doubts and suspicions, sustainability transitions can be furthered.

It is clear that European citizens are increasingly voicing their frustration with the shortfalls in environment and climate governance (EEA, 2019) and placing demands on authorities to take meaningful action. This indicates that they are willing to both engage with authorities and to adapt to the new social habits and behaviours that are required to further urban sustainability transitions.

3.5   Technology

The 'Fourth Industrial Revolution' is rapidly changing the world around us (OECD, 2017; EEA, 2020). Widespread digitalisation of economies and societies is accelerating technological innovation worldwide, fundamentally changing production and consumption processes, and the way we live, work and interact with each other. These changes are most evident in large global cities where the high density and diversity of human settlements tend to lead to accelerated technological innovation (World Economic Forum, 2020).

The EU strongly recognises the importance of technological development for environmental sustainability. The European Green Deal states the 'Commission will support work to unlock the full benefits of the digital transformation to support the ecological transition' (EC, 2019a). The aim of the recently adopted new Industrial Strategy for Europe (EC, 2020b) is to support Europe's industry in leading the twin transition towards climate neutrality of the continent by 2050 and global digital leadership.

For the purpose of this report, technology refers to the different types of products and processes used to facilitate or support changes in practices, processes and behaviours in different forms and areas of technological development**,** including education, construction, transportation, energy, information and communication, among others.

Box 3.13   How COVID-19 may be impacting cultural drivers and barriers

The lockdown and related measures implemented by many European countries to stop the spread of COVID-19 have led to a sudden decline in economic activities, including a drop in road transport in many cities. This has resulted in an associated drop in air and noise pollution, with many people reporting increased awareness of the connection between human activities and their impacts on the natural world (Rousseau and Deschacht, 2020).

It remains to be seen whether this new awareness will lead to long-term changes in culture and behaviour. However, the clear data and evidence provided by the Copernicus Atmospheric Monitoring Service about the immediate improvements in air quality are likely to pave the way for emission reduction objectives that may have previously been seen as too ambitious or even counterproductive. Combined with other efforts, for example, through the European Green Deal initiative, this could lead to considerable changes towards greater environmental sustainability (Neill, 2020).

Figure 3.6 Responses to survey question '*Have the following factors related to technology supported or inhibited the environmental sustainability transition in your city?*'

	Strongly supported	Slightly supported	Neither supported nor inhibited	Slightly inhibited
■ Strongly supported	■ Slightly supported	☐ Neither supported nor inhibited	▨ Slightly inhibited

■ Strongly inhibited   ■ I don't know   ■ No answer
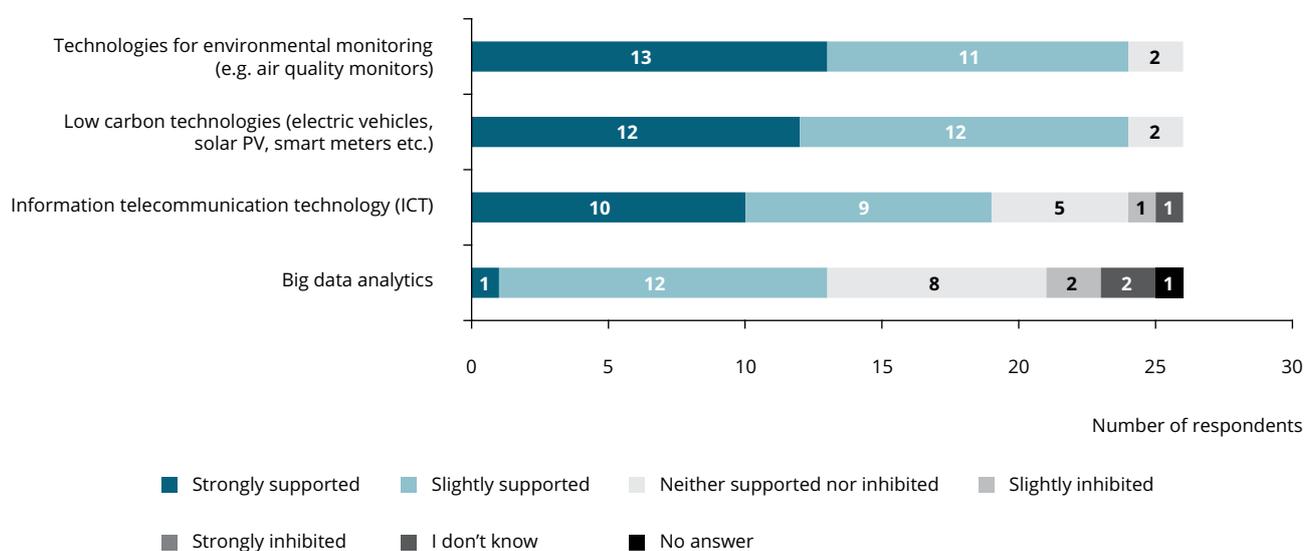
Technological developments can support sustainability transitions in cities

According to the survey results, all factors related to technology are considered as mainly supporting sustainability transitions by a significant majority of cities (at least half of the respondents) (see Figure 3.6). *Technologies for environmental monitoring (e.g. air quality monitors)* and *low-carbon technologies (e.g. electric vehicles, solar photovoltaic)* are recognised as supporting by almost all cities (about half of the respondents consider these factors strongly supporting). While considered as mainly supporting (by at least half of the respondents), *big data analytics* and *information communication technologies (ICT)* were also seen as either slightly inhibiting sustainability transitions or as not relevant (neither supporting nor inhibiting by a fairly high number of respondents). This may be because some cities may not be making use of big data or because there is a lack of government capacity to integrate big data analytics and other forms of ICT into existing decision-making processes. Another challenge might be the management of security and privacy requirements and concerns related to the use of these technologies.

All interviewees recognised that technological development in general terms supports and is important for sustainability transitions in their cities. A few interviewees mentioned that industrial or abandoned landfill sites on the city outskirts are being redeveloped into technological or green economy centres, attracting start-ups, corporations, and innovative companies, which are often in the forefront of green innovations. For example, EcoSairila is a new centre for blue and green economy built on an abandoned landfill site on the outskirts of Mikkeli,

attracting private eco-businesses developing new solutions for future challenges (see Box 19).

A creative atmosphere furthers the innovation momentum in cities

Leuven, Stockholm and Tallinn pointed out the importance of a creative atmosphere for global tech and start-up hubs that foster the momentum for technological innovations in these cities. Since the 1970s, Stockholm has been a global innovation leader in ICT, clean tech and life science technologies, while also being one of the leading European cities in urban environmental sustainability. Thriving technological innovations support Stockholm's sustainability efforts; these include the smart city agenda, implementation of NBS, more sustainable modes of transport (e.g. electric vehicles, bikes) and energy-efficient housing.

Tallinn, which happens to share important historical ties with Stockholm, is known for being the city with the highest number of start-ups per person among EU countries (Rooney, 2012). It is home to a number of high-tech companies, such as Skype and TransferWise, as well as the European Agency for the Operational Management of Large-Scale IT systems in the Area of Freedom, Security and Justice (eu-LISA) and the NATO Cooperative Cyber Defence Centre of Excellence. The interviewee also noted that new ICT, low-carbon and energy-efficiency technologies are strongly supported by the Estonian government and are considered crucial for Tallinn's successful sustainability transition.

By implementing and testing new innovations (e.g. driverless buses, solar roof tiles, virtual power stations), Tallinn is hoping to become an example for

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Box 3.14   Tallinn is banking on technological innovation to achieve its sustainability efforts

Tallinn has recently won the Netexplo Smart Cities 2020 Prize for digital transformation. The city provides over 80 fully digital services. Initially 'smart' for the city meant using the latest technology, enabling access to Wi-Fi anywhere, and providing opened data access and high-quality e-services. Examples include a web application for public transport, a web map of Tallinn, applying for licences and permits, application for traffic cameras, supporting entrepreneurial initiatives, etc. This has moved on towards involving people in planning practices with the launch of the digital participation tool AvaLinn, enabling residents to co-create and share feedback and ideas on the city's developments and spatial planning. The city recognises that being 'smart' does not only mean providing digital services as it is no less important that the citizens are willing and able to use them.

Tallinn City Transport operates a public transport system including four trolleybus lines, 75 bus lines, train and ferry services. In December 2019, it decided to replace all older diesel-powered buses with gas-powered models within the next 5 years. The buses will use a mixture of compressed natural gas and compressed biomethane. Produced from biodegradable waste, biomethane is a renewable natural gas. The trolleybuses run on renewable electricity, which is bought from WePower, an energy-trading platform (WePower, 2020).

In Estonia, WePower enables businesses and individuals to buy green energy directly from the energy generators (i.e. solar and wind energy producers). Trying to make Estonia's energy market more efficient, the platform is using blockchain technology, which is simply defined as a 'decentralised, distributed ledger that records the provenance of a digital asset'. Due to the country's 100 % smart meter coverage, in 2017, Estonia became a testing ground for the WePower platform and the location of the first nationwide energy trade tokenisation pilot globally (Invest in Estonia, 2018).

other European cities, demonstrating the importance of technological development for green growth (see Box 3.14).

ICT technologies supporting city governance and sustainable decentralised energy production

In relation to ICT technologies, Cornellà de Llobregat, for example, highlighted the importance of e-governance in giving residents the opportunity to report on environmental issues in the city. An interviewee from Gabrovo suggested their advanced geographic information system (GIS) is a key tool enabling spatial planners to adopt more sustainable solutions (e.g. green infrastructure, transport, housing).

A few cities spoke about the importance of ICT technology in relation to the new forms of sustainable energy production and distribution within cities. For example, Lisbon is exploring opportunities to develop an energy platform and implement a city-wide smart grid to reduce energy losses and make renewable energy more affordable for residents. Furthermore, the city is looking into the prospect of creating partnerships with companies and other institutions, such as hospitals, schools and public buildings, which might have the capacity to produce energy (e.g. via rooftop photovoltaic power stations).

Box 3.15   How COVID-19 may be impacting technological drivers and barriers

Technology, and in particular ICT, is proving to be crucial in easing the unprecedented economic and social implications of the COVID-19 pandemic (e.g. by enabling online education, working from home, and home delivery of essential and other goods). Technological development is generally seen as an important driver of sustainability transitions, and important EU policy frameworks like the European Green Deal are rightly placing significant emphasis on the digital agenda. However, it is important to keep in mind that technology is not a panacea and needs to be carefully integrated into wider decision-making to mitigate unintended consequences.

There are still important inequities when it comes to digital access and individuals with poor computer literacy or limited access to high-speed internet or ICT devices may face barriers. As a growing number of public services, employment opportunities, public discourse and social engagement are moving 'online', some social groups are at risk of not only being excluded from spheres of community participation and involvement but also of having reduced access to essential public services. This is an important reminder that we have to digitalise in a way that does not undermine social inclusion objectives.

3.6 Data and information

Although data collection methods to measure the quality of environmental components like air, water or soil are scientifically sound and well developed, measuring cities' sustainability achievements can be challenging. Arising from the potential of cities to reduce their impact on the environment is the need to establish reliable data and information to identify these impacts, their origins and to understand how they vary across urban areas (Yetano Roche et al., 2014).

For the purpose of this report, data refers to raw, unorganised facts in various forms (e.g. big data, open data, etc.) on relevant issues, whereas information is processed, organised and/or structured data so as to make it useful to develop knowledge on a subject, issue, event or process relevant to achieving sustainability transition ([5]).

Cities are making efforts to improve data collection and communication practices

The survey results show that most factors related to data and information are recognised by most cities as (either strongly or slightly) supporting sustainability

transitions (see Figure 3.7). Most interviewees mentioned the significance of data and information to monitor and present a city's progress, set relevant objectives and prioritise areas and actions needed to achieve sustainability targets. The factors that stand out in the survey and were often discussed by the interviewees are *data and information collection practices* and *presentation and communication of data and information* (both considered as supporting by more than two thirds of respondents).

A few cities mentioned that EGCA, EU Directives and membership of EU networks highlighted the need for, as well as led to, significant improvements in *data and information collection practices*. For example, Stockholm started observing environmental indicators more closely when the idea of the EGCA was founded in 2006. The award was launched in 2008 with Stockholm becoming the first city to win it in 2010. The EGCA guided and inspired Lisbon to develop and monitor data across 12 environmental indicators, as required by the award. This was further encouraged when Lisbon's Sustainable Energy Action Plan (SEAP) was drafted in 2010 as part of the city's commitments to the Covenant of Mayors.

Figure 3.7   **Responses to survey question '*Have the following factors related to data and information supported or inhibited the urban environmental sustainability transition in your city?*'**

Number of respondents

■ Strongly supported   ■ Slightly supported   ▢ Neither supported nor inhibited   ▤ Slightly inhibited

▨ Strongly inhibited   ▨ I don't know   ■ No answer
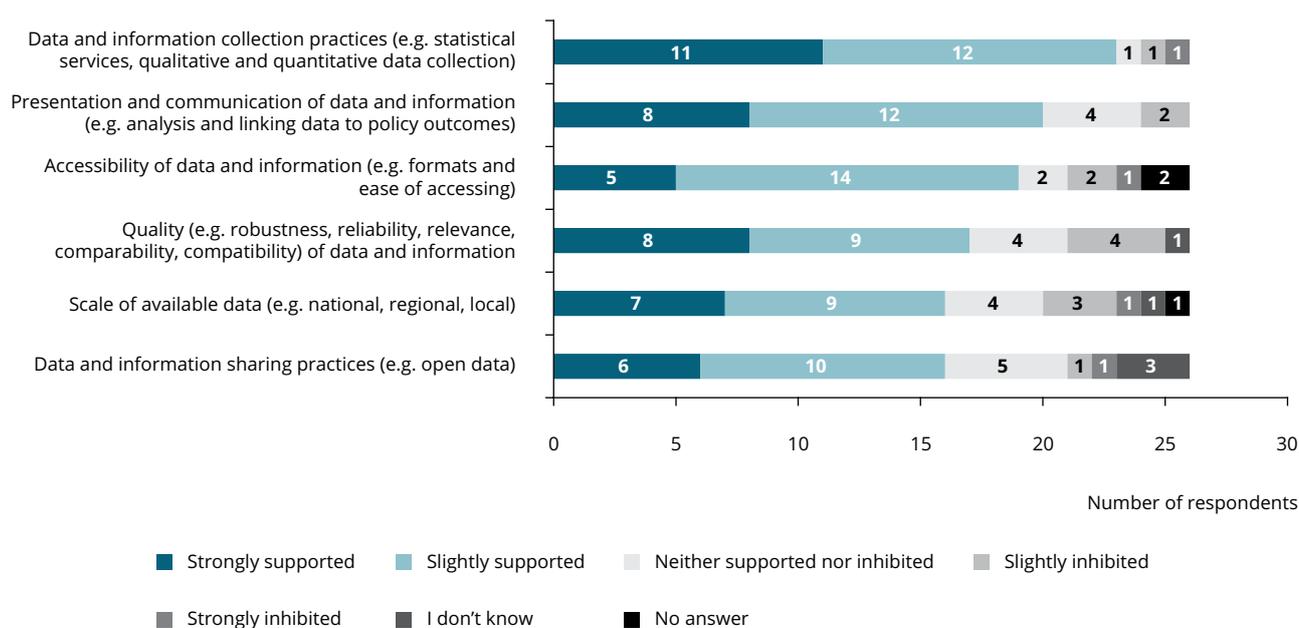
([5])   This definition draws from SMILE by Imperial College, Loughborough University and the University of Worcester in the UK.
Available at: https://www.gcu.ac.uk/library/smile/searching/whydoweneedinformation/whatisinformation

Interviewees also highlighted *presentation and communication of data and information* as important for sustainability transitions, especially when it comes to communicating environmental and sustainability objectives and achievements to its residents. Clear, simple and specific green/sustainability objectives — the green programme (e.g. removing cars from the city, improving air quality, using green infrastructure as the basis for spatial development, providing four times more solar power, etc.) — were considered crucial for winning the 2009 local government elections in Lisbon against the 'business as usual' scenario advocated by the opponents. After winning the election, the green programme became the new government's action plan and the basis for the new Lisbon Municipal Master Plan. Centred on green infrastructure and the ethos of green spatial planning and development, this Plan became the flagship of Lisbon's sustainability transition. Commitments to the green programme have won the local government four consecutive elections to date.

An interviewee from Leuven emphasised the importance of storytelling to facilitate sustainability transition in its city (see Box 3.16).

Measuring sustainability can be challenging

While considered as supporting by two thirds of the survey respondents, *accessibility of data and information* is also seen by a few cities as (either strongly or slightly) inhibiting sustainability transitions. Other inhibiting factors identified by a few survey respondents included *quality of data and information* and *scale of available data*.

Interviewees also reflected on these issues, indicating that the most pressing concern is that relevant data

(e.g. biodiversity, energy efficiency, emissions) is mostly generated at the national *scale* and is thus less useful when measuring cities' sustainability efforts. To overcome this challenge, cities usually use whatever data are available from national statistics offices and often use various proxies to adjust the data to their needs. As highlighted by the interviewees, this means that the outcomes of the monitoring come with some degree of uncertainty, which apart from making the efforts less believable sometimes instils distrust and communication difficulties among various groups of stakeholders (e.g. general public, opposing party, businesses, etc.). Other challenges mentioned include timeliness (i.e. data are often too old to be useful), accessibility (e.g. format and ease of accessing) and quality (e.g. robustness, reliability, relevance, comparability, compatibility) of data and information.

While trying to be as accurate as possible, to some extent cities also gather and produce data and information themselves. Most have their own monitoring systems for water and air quality and often measure various indicators as part of specific projects. The issue some cities raised in relation to projects is that when specific project funding comes to an end, monitoring of indicators often stops, too.

To enhance collection practices, quality, and availability of data and information, the cities interviewed cooperate with national statistics offices to improve the understanding on what data are needed at national, regional, municipal or even city level to monitor and support their sustainability transitions. Some cities, such as Tallinn, are putting data collection strategies in place. Working closely with a national data agency, Statistics Estonia, Tallinn is developing a data pool for future analysis of its

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Box 3.16   Importance of storytelling to support Leuven's sustainability transition

Leuven 2030, an NGO leading the city's urban sustainability transition, has been relying on professional guidance on how to tell its stories to build credibility and broaden its reach. Underestimating storytelling in the past, it has now recognised its power to communicate often complex issues and processes in a simple way to facilitate the city's sustainability transition.

The NGO hired a professional storytelling agency, which resulted in the complete rebranding of Leuven 2030. Apart from changing the logo, it stopped being the only messenger and moved from very scientific and informative to more emotional communication. It invited people with whom the residents of Leuven could identify (e.g. owners of small businesses, shops, etc.), to tell their story, to explain how the 'greener' choices they had made had helped them and their businesses. In this way, the NGO has encouraged peer-to-peer inspiration, which has made a big difference to how people engage with the city's environmental and sustainability initiatives.

For example, in 2016, it ran a campaign called 'LeuvenSwitch' to encourage people to switch to green energy. It was carried out by 21 ambassadors, among them a famous football player and singer, people with a different fan base who added their face to what turned out to be a very successful campaign.

As they say in Leuven 2030, 'not everything you do has to be about climate emissions and reductions. You don't have to use those words to make a change.'

sustainability progress. Leuven has instigated a knowledge and monitoring sharing programme, in line with the Aarhus Convention's focus on providing access to environmental information.

Box 3.17   How COVID-19 may be impacting data and information drivers and barriers

As also reflected in the knowledge section of this report (Section 3.3), COVID-19 might further emphasise the importance of clear presentation and communication of data and information, in particular scientific data to the public in order to encourage behavioural change. This might be an opportunity for cities and other governments to improve public communication practices when addressing other systemic challenges, including climate and environmental issues.

Cities were the 'hot spots' during the initial coronavirus outbreak in Europe and globally, and larger cities in particular usually continue to have a higher concentration of cases compared to less urbanised areas. This might lead to better accessibility, quality and availability of data and information at scales more relevant to cities (e.g. city region, district, municipality). Greater interest in what influences the health and well-being of city dwellers (e.g. lifestyle choices, habits, socio-economic conditions, education, etc.) might also lead to better availability of data that could potentially be relevant to an analysis of urban sustainability transitions.

3.7   Finance

Finance, funding and budgetary allocations are some of the most significant ways governments can shape sustainability outcomes in cities. As highlighted in SOER 2020, finance has a key role to play in either enabling or hindering sustainability transitions (EEA, 2019).

For the purposes of this report, finance refers to the provision and management of public/government money and the process of acquiring funds through traditional (e.g. taxes, public-private partnerships) and innovative (e.g. micro-contributions/crowdfunding, land value capture) financial mechanisms to support green investments and the transition towards urban environmental sustainability. Note that financing typically refers to how upfront costs of building infrastructure, etc. are met, while funding refers to how it is paid for it over its life cycle (Institute for Governance, 2018).

The survey highlighted that most factors related to finance listed in the questionnaire are considered as (either strongly or slightly) supporting by more than two thirds of respondents (Figure 3.8).

Factors that stand out as being particularly supportive include *level of own-source revenues, level of national/ state government public funding for environmental sustainability* and *access to multilateral funds such as EU funds*. The factors considered a barrier by the highest number of cities in the survey include *level of fiscal decentralisation* and *level of funding for public service operations and maintenance*. The *level of bilateral funding* was largely considered as neither supporting nor inhibiting. This is not surprising given that few European cities receive any bilateral funding from individual donor countries but rely much more on multilateral funding through EU institutions (e.g. European Structural and Investment Funds and funding programmes such as Horizon 2020, LIFE, etc.).

Wealth matters — but it is not the only thing driving sustainability

Urban sustainability transitions will require investments across multiple sectors (e.g. transport systems, housing retrofits and electricity systems), many of which have to be supported by new business and financing models. Investments in green infrastructure will need to be complemented by increased spending on research and development and financial support for new processes and policies that can change behaviour. When looking at international sustainability indices, many seem to suggest a correlation between wealth and sustainability. For example, the Siemens Green City Index points out that the best-ranked cities in its European Index have one thing in common — they are all wealthy — with Copenhagen, Stockholm, Amsterdam, Vienna and Oslo topping the list (Shields et al., 2009). The interviews confirmed this to an extent, with some of the wealthier cities such as Stockholm and Leuven indicating that strong economic growth had enabled a lot of the more expensive investments the city has undertaken in recent years and provided the momentum for them to push their green agenda further. On the other hand, Lisbon made major progress in its sustainability transitions in the midst of the financial recession, demonstrating that political will and vision is at least as important as a big budget. High-impact initiatives and changes do not always have to be expensive, and relatively low-cost interventions, such public awareness campaigns or increasing community engagement, can still make a major difference.

Figure 3.8 **Responses to survey question** *'Have the following factors related to finance supported or inhibited the environmental sustainability transition in your city?'*

Level of own-source revenues (e.g. local taxes, fees, charges) — 10, 12, 3, 1

Level of national/state government public funding for environmental sustainability — 10, 12, 2, 1, 1

Level of regional/local funding for environmental sustainability — 10, 11, 4, 1

Access to multilateral funds (e.g. European Regional Development Fund ; UN- Multilateral Fund) — 14, 6, 3, 2, 1

Level of funding for infrastructure projects (both private and public sources) — 10, 10, 3, 1, 1, 1

Level of public investment in research and development — 7, 12, 4, 1, 2

Level of private investment in research and development — 3, 14, 5, 1, 2, 1

Level of private sector funding for environmental sustainability — 1, 16, 4, 1, 1, 2, 1

Level of funding for public service operations and maintenance (both private and public sources) — 5, 11, 4, 1, 1, 3, 1

Level of fiscal decentralisation — 4, 8, 4, 2, 2, 5, 1

Level of bilateral funding (e.g. from donor countries) — 1, 1, 18, 1, 5

Number of respondents

- Strongly supported
- Slightly supported
- Neither supported nor inhibited
- Slightly inhibited
- Strongly inhibited
- I don't know
- No answer

Insufficient fiscal decentralisation continues to be a barrier

Several cities highlighted that small municipal budgets can be a challenge when it comes to implementing more ambitious sustainability projects (e.g. Gabrovo, Lisbon, Tallinn). Across the EU, there has been a push towards greater fiscal decentralisation, increasing the ability of local governments to collect their own revenues while also giving them greater autonomy when spending the funds they receive from national government (see Section 3.2). Despite this, differences remain when it comes to the powers that cities in different EU countries have over their spending (see Box 3.18). While in some countries, local governments receive a high share of tax revenue and have relatively high autonomy over how to spend it (e.g. Finland, Belgium, Finland, Germany, Spain, Sweden) in others, local tax revenue is a lot lower and cities have more limited decision-making power when it comes to spending (e.g. Bulgaria, Estonia, Greece, Ireland, Slovenia) (Alexandru et al., 2011).

Access to multilateral funding through the EU is fundamental

Many of the substantial investments required to develop more sustainable infrastructure exceed what cities can finance through their own budgets and will therefore rely on support from national and supranational governments as well as public-private partnerships. Even for cities that have higher own-source revenues than Gabrovo, the vitally important role of multilateral funding, in particular diverse sources of EU funding, was repeatedly highlighted in this context. The European Commission was seen as essential in facilitating access to critical investments that support more sustainable infrastructure and operations, with all cities highlighting how important this had been to their progress. Support from the European Investment Bank (EIB) was mentioned as an important driver by Leuven and Lisbon. In both cities, the EIB played a crucial role in financing essential green investments, including into new water infrastructure, transport, waste management and energy-efficient buildings. The European Regional Development Fund has been an important source of support for Gabrovo, Mikkeli and Tallinn.

> **Box 3.18   EU funding allows Gabrovo to overcome limited municipal budget**
>
> Low levels of fiscal decentralisation in Bulgaria mean that Gabrovo only has a very limited operating budget. This funding challenge is amplified given the costs the city faces in providing quality services, such as water and sanitation, that meet strict EU standards across a highly dispersed hinterland of disconnected villages.
>
> But this has not prevented the administration from thinking in innovative ways about its funding constraints. Today, Gabrovo receives more financial support from the EU than any other city in Bulgaria, with EU funding making up 85 % of its operational programmes and the remaining 15 % covered by the national government. For years, Gabrovo has held a leading position when it comes to applying for and accessing EU funding. This includes European Regional Development funding for energy-efficiency improvements, improved green spaces and better urban infrastructure. In 2018, the city was recognised by MEPs as a role model for funding it received via the EU Cohesion Fund to upgrade its water infrastructure.
>
> Given that many of these funds are distributed on a competitive basis, the significant number of successful EU-funded projects in Gabrovo are testament to the administration's hard work to ensure that the city can advance its sustainability agenda with the help of EU funding.

Lack of alignment with national government can undermine funding goals

Political alignment between the national government and the city can ensure that national spending supports the sustainability objectives. In Lisbon, support from the national government for new transport projects is considered essential. The fact that the prime minister used to be the mayor of Lisbon makes it easier for the central government to understand why certain investments should be prioritised. In Cornellà de Llobregat, spending by the regional government is playing a vital role in supporting new sustainability projects in the city, including the flagship Cornellà Natura project. There is a very strong consensus across the key administrative levels when it comes to priority projects and a shared sense of urgency around environmental sustainability challenges (see also Box 3.5).

By contrast, Tallinn mentioned that cooperation issues with the national government have at times created a serious barrier to progress. One clear example is the national government's unwillingness to consider introducing car taxes, which would support Tallinn's efforts to reduce car use and would also generate tax income that could then be invested in the public transport system. The city has been trying to introduce its own tax on combustion engine vehicles, but this has yet to prove successful because Estonian municipalities do not have powers to raise taxes locally. The introduction of a tourist tax that could be used to cross-subsidise important sustainability projects has not come to fruition for the same reason, leading to tensions between the municipality and the national government.

Private-sector funding is essential and can lead to win-win outcomes

Working closely with the private sector to increase investment in sustainable infrastructure was mentioned by most of the cities as an important driver. This includes developing public-private partnerships for the delivery and operation of new wastewater treatment, energy-efficiency measures and transport improvements (e.g. Cornellà de Llobregat, Gabrovo and Lisbon). Collaboration with the private sector can accelerate progress towards core policy objectives while, at the same time, providing significant benefits for local businesses (see Box 3.19). Gabrovo, Leuven,

> **Box 3.19   Mikkeli aims to attract private investors with new blue green innovation centre**
>
> In an effort to attract private-sector investment while simultaneously driving innovation in the circular economy, Mikkeli is redeveloping an old landfill site and transforming it into EcoSairila — a new Centre for the Blue and Green Economy, which the city hopes will act as a development platform for new circular economy ideas. To date, over EUR 100 million have been invested in the research and infrastructure of water technology, material cycles and renewable energy. A state-of-the-art water-treatment plant with research and pilot facilities and a biorefinery producing biogas and organic nutrients are under construction.
>
> The aim of EcoSairila is to bring together a diverse group of companies specialising in the circular economy, as well as research and development organisations studying new technologies and business models. The ecosystem of companies is boosted through the collaboration of the private and public sectors: EcoSairila is opening up the public infrastructure to welcome private businesses to bring growth and strengthen the region (Miksei Mikkeli, 2019).

Stockholm, Tallinn all highlighted the co-benefits for innovative local businesses, which can take advantage of the new green economy that is emerging in their cities.

One challenge referred to by Lisbon was that the quest for private-sector investment and the associated jobs can create competition, which, at times, risks undermining certain sustainability objectives. For instance, municipalities in the Lisbon metropolitan area are all vying to attract large companies, but if these large companies are then located in new business parks without an adequate transport infrastructure this could perpetuate car dependency and urban sprawl.

Green public procurement allows cities to use their purchasing power for the common good

Many cities mentioned the importance of improving their procurement processes and embracing green procurement as a vital part of their sustainability transitions. Gabrovo highlighted that green public procurements provide additional economic and ecological added value to the process of public spending. Lisbon is becoming involved with the European EcoProcura conference series to accelerate

its own capacity for green procurement. Mikkeli mentioned the importance of EU procurement policy as an important way of accessing additional funding for sustainable transport initiatives.

Unsustainable spending behaviour continues to undermine progress

Although ensuring that both public and private investments support sustainability objectives in cities is essential, it is still not happening in a consistent way. As the United Nations Environment Programme notes, 'clearly, some capital is flowing to the new economy that we need. But far more is continuing to support the old economy' (UNEP, 2018). For example, Leuven suggested that it needs to invest about EUR 350 million a year between now and 2050 to achieve carbon neutrality. About 75 % of that money is already there and circulating in the local economy — but it needs to be spent in different ways to support sustainability transitions rather than continuing to promote unsustainable consumption patterns (e.g. flying, driving, meat consumption). Finding ways to promote more environmentally sustainable consumer spending is clearly an important part of the wider efforts to fund urban sustainability transitions.

Box 3.20   How COVID-19 may be impacting finance drivers and barriers

The financial repercussions of the coronavirus crisis are being felt across all sectors of society in Europe, and across all levels of government, and are also affecting their environment and climate agendas. Local governments are at the forefront of this struggle, with unexpected expenses to address the social and economic fallout exacerbated by a drastic collapse in revenues (e.g. due to reduced local taxes, fees and charges). While greater fiscal autonomy and own-source revenues are generally seen as desirable, during the pandemic, cities that rely heavily on municipal income sources for their budget may actually struggle the most.

Cities will require commitments by EU and national governments to maintain or increase funding to address local shortfalls and enable cities to continue to deliver vital public services, while at the same time making progress towards their environmental targets. Without this support, there is a real risk that cities will not be able to advance important green initiatives, which could have catastrophic consequences for Europe's wider sustainability transitions. Fortunately, there is clear evidence that just and green economic recovery measures (such as investing in energy-efficiency retrofits) can help municipal governments to maximise short-term benefits for employment, while catalysing wider transformations and securing the longer-term socio-economic rewards associated with ambitious climate action (C40, 2020).

The European Green Deal provides an important framework to guide how recovery funds should be spent, although it will still be up to individual cities to identify opportunities that move them away from 'business as usual' spending decisions.

4 Summary of findings

Local governments across Europe are proactively leading the way towards a more sustainable, resilient and just urban future. Based on the surveys and interviews with individual city officials, this report has provided some evidence about how progress towards this goal might be accelerated by identifying common drivers of change that can either enable or hinder urban environmental sustainability transitions. A summary of the main findings from this analysis is presented below.

Of course, cities differ enormously in the challenges they face and the tools they have available to address them. Sharing concrete examples of the many different expressions of urban sustainability can help to inspire cities, irrespective of their context, and help them develop a transition pathway that is right for them. To make this work more useful and robust, this first piece of research will need to be complemented with a more in-depth analysis to better understand individual factors and their interactions, both across and within individual cities.

4.1 About the cities that participated in the research

The geographic spread of the 26 cities that responded to the survey broadly reflects the distribution of all 40 winners and finalists of the EGCA and EGLA. Eastern cities are the least represented, followed by southern, northern and western cities. Most of the representatives of cities who completed the survey work in environment and climate change departments.

Interviews were held with a range of cities, both in terms of their size and their geographic distribution. The interviews covered two eastern European cities (Gabrovo and Tallinn), two southern European cities (Cornellà de Llobregat and Lisbon), two northern European cities (Mikkeli and Stockholm) and one western European city (Leuven).

The cities face a wide range of environmental challenges with those most commonly identified including severe storms and flooding, air pollution, storm water management, decline of native species/

natural habitats and heatwaves. This was confirmed by interviews with cities where storms, flooding, air pollution, water scarcity, heatwaves and the lack of green space were identified as major challenges.

Most cities in the survey have been considering environmental sustainability objectives as an important part of their political agenda since the period between 1992 (the Rio Conference) and 2000. This means they have around 25 years of experience mainstreaming environmental sustainability into their policy-making processes and can be considered as having a fairly well-established track record in this area. In the interviews, some cities felt that sustainability has only really emerged as a core aspect of their political agenda in the past 10 years or so (e.g. Tallinn), while some cities said that sustainability had been an important priority for several decades (e.g. Stockholm).

According to the survey, public opinion/awareness of sustainability issues was seen as the most significant trigger driving greater action around environmental sustainability in cities. This was followed by changes in political leadership, a specific environmental crisis and pressure from stakeholders. The interviews supported this to a large extent, highlighting the importance of public opinion, leadership change and pressure from diverse stakeholders.

4.2 Key drivers of and barriers to urban environmental sustainability transitions

This section summarises the key drivers of and barriers to urban environmental transitions identified through this research. A review of all the enabling factors identified in this study highlights particular factors that stood out from the survey results and subsequent interviews. While some factors certainly featured in a general consensus from the cities participating in this research regarding their importance, this did not apply universally. Factors identified as extremely important to sustainability transitions by some cities were highlighted either as a barrier or considered less relevant by other cities (e.g. sub-national taxes, subsidies or other economic instruments; sub-national

laws, standards and regulations; social and economic power dynamics; and the framing of environmental sustainability in public discourse). This indicates that what drives sustainability transitions, at least to some extent, varies across cities and there is no 'one-size-fits-all' solution to achieving sustainability transitions. Of course, the relatively small sample size also makes it more difficult to discern very clear patterns and repeating the survey with a larger number of European cities might yield more definitive results about the leading drivers and barriers. Nevertheless, despite this heterogeneity of opinions, some important findings in relation to the key drivers and barriers of urban sustainability transitions have emerged from this exploratory work. In future research, these should be investigated further to test their robustness in different urban contexts.

4.2.1 Key drivers supporting environmental sustainability transitions in cities

Contextual drivers

- The most significant contextual factors identified in the survey as supporting sustainability transitions in cities are: existing infrastructure; air/water/soil quality; city size; climatic conditions; and GDP per capita.

- Although the survey identified existing grey infrastructure as the most important supporting factor, interviews highlighted that it can also be a barrier by creating path dependencies and behavioural lock-in (e.g. car-centric road use, urban sprawl, outdated/energy-inefficient infrastructure). Since this is one of the more dynamic contextual factors, it can be adapted to align with new sustainability objectives (e.g. removing parking to make space for cycle lanes, retrofitting buildings).

- Close proximity to natural assets and accessibility to green spaces and natural areas were identified in the interviews as important contextual factors that can encourage people to care about environmental sustainability, thus becoming important drivers for more action.

Governance drivers

- Among factors related to national and supranational governance, international treaties and EU laws, standards and regulations stand out as the most strongly supporting factors. Interviewees mentioned the European Green Deal and emphasised the importance of EU Directives such as the Water Framework Directive (WFD), the Energy Efficiency Directive (EED) and the Energy Performance of Buildings Directive (EPBD) for implementing environmental legislation and driving environmental technological innovations. These are followed by national laws, standards and regulations, and the distribution of state powers and level of political decentralisation.

- While all the factors related to local governance are considered as mainly supportive, local governments' overall vision and plans were seen as the most important local governance factor. The evidence gathered shows that local governance is crucial in influencing sustainability transitions in cities. However, all levels of governance, including European, national, and regional, play an important role in this process.

- Effective multi-level governance across sectors and governance scales, as well as better collaboration with non-governmental stakeholders, such as civil society, the private sector and academia, were also highlighted in the interviews as important drivers.

Knowledge drivers

- All factors related to knowledge were mainly seen to support sustainability transitions. The top factors identified through the survey include: networks of cities and peer-to-peer learning (selected as supporting by every city in the survey); research and innovation; and the level of awareness of environmental sustainability.

- These findings were confirmed in interviews where the role of city networks and the learning and innovation this enables were emphasised as an important positive driver in all cities, with the EGCA and EGLA standing out as particularly important.

- Research and innovation, particularly if carried out in a collaborative and inclusive way across public, private and third sectors, and raising environmental sustainability awareness were also highlighted repeatedly.

Cultural drivers

- Cultural factors seen as the most important in supporting sustainability transitions include: the general public's values and attitudes to environmental sustainability; willingness by local government to adopt new behaviours and practices; the level of public engagement; and values and attitudes to environmental sustainability within local government.

- The importance of engaging local citizens early and consistently in sustainability transitions was highlighted in the interviews as the best way to change values and attitudes to environmental sustainability and ensure that people feel included in the transition process.

Technological drivers

- As indicated by the survey and interviews, technological development is generally seen as an important enabler of sustainability transitions in cities. Nevertheless, the increasing digitalisation of economies and societies raises social inclusion and equity concerns as some social groups with poor computer literacy or limited access to ICT devices (e.g. elderly, low-income families) are at risk of not only being excluded from spheres of community participation and involvement but also of experiencing reduced access to vital public services.

- While all the factors related to technology were seen as largely supporting sustainability transitions, technologies for environmental monitoring (e.g. air-quality monitors) and low-carbon technologies (e.g. electric vehicles, solar photovoltaic) stand out as being the most supportive.

- The interviews further confirmed that cities are implementing and relying on ICT and big data analytics, as well as developments in low-carbon technologies and environmental monitoring technologies, to further their green efforts in various sectors, including housing, transport, energy, governance, water and waste management.

Data and information drivers

- The survey highlighted that most factors related to data and information are recognised as supporting sustainability transitions. Factors that stand out in the survey and were also frequently mentioned by interviewees are: data and information collection practices; and presentation and communication of data and information (both considered as supporting by more than two thirds of respondents).

- Most interviewees mentioned the significance of data and information to monitor and present a city's progress, set relevant objectives and prioritise policies and actions needed to achieve sustainability targets.

- Several cities stated that they are working on enhancing their information collection and communication practices, and there is growing

recognition of the important role these factors play in successful sustainability transitions, helping cities with evidence-based decision-making and *ex-post* analysis of specific interventions, including policies.

Financial drivers

- The main financial factors identified in the survey as supporting sustainability transitions are: own-source revenues (e.g. local taxes, fees); level of national/ state funding for environmental sustainability; and access to multilateral funds (e.g. European Regional Development Fund).

- The importance of multilateral funding, and in particular EU funding, was seen as absolutely essential by all cities interviewed, providing support for a wide range of sustainability investments from energy efficiency to transport improvements and upgrades to water and sanitation infrastructure.

- Green public procurement was also seen as an important driver, with the role of EU procurement policies highlighted as particularly valuable in supporting cities to improve their procurement processes and embracing green procurement as a vital part of their sustainability transitions.

4.2.2 Key barriers to environmental sustainability transitions in cities

Contextual barriers

- The key barriers identified in the survey as hindering transitions are: gentrification; demographics; existing urban form; and structure of the economy.

- The interviews highlighted that urbanisation and population pressures (e.g. population growth, urban sprawl, gentrification), especially in the context of the climate crisis, intensify existing environmental challenges and can make it harder to advance towards greater environmental sustainability.

- Demographics can be a barrier in different ways, with growing populations adding more pressure to existing services, but sparse populations making certain services, such as public transport, more challenging to deliver. An ageing population and 'brain drain' caused by the migration of young people were also seen as major challenges.

Governance barriers

- Barriers were identified in relation to sub-national laws, standards and regulations and, importantly, sub-national taxes, subsidies or other economic instruments. Some cities have less legislative and fiscal autonomy, which might hinder their ability to pursue environmental ambitions. For example, they may be unable to collect emissions tax which might adversely affect efforts to decarbonise urban economies and encourage more sustainable travel patterns.

- Factors related to local governance that significantly hinder transitions in a small selection of cities include: election cycle/term times and related continuity of local government and administration; planning culture and practices; and trade-offs of environmental sustainability with other objectives.

Knowledge barriers

- The following factors were identified as barriers by a small number of cities (suggesting that all such factors were not sufficiently well developed/lacking in their city): level of awareness of environmental sustainability; level of shared understanding of sustainability issues in local government; communication within local government as well as between different levels of government; and knowledge management and dissemination.

- The interviews further highlighted that a lack of shared understanding of sustainability priorities and insufficient communication across government departments can sometimes be an important barrier when it comes to knowledge creation and dissemination.

Cultural barriers

- Although this was also one of the main supporting factors, the general public's willingness to adopt new behaviours and practices emerged as the main barrier from the factors tested via the survey.

- This was supported by some of the interviews, which highlighted that it can be a challenge to get citizens involved in participatory processes and decision-making and to ensure that a diversity of voices is represented in consultation processes.

Technological barriers

- While the majority of survey respondents still identified these as supporting, big data analytics and ICT were seen as a barrier by some cities and to neither support nor inhibit sustainability transitions by others.

- These different views and experiences may be the result of cities not making use of big data or because there is a lack of government capacity to integrate big data analytics and other forms of ICT into existing decision-making processes. This issue was not touched upon much in the interviews and would require further investigation to confirm specific barriers.

Data and information barriers

- As regards measuring sustainability progress, cities face barriers surrounding the following factors: timeliness (e.g. data are often too old to be useful), accessibility (e.g. format and ease of access) and quality (e.g. robustness, reliability, relevance, comparability, compatibility) of data and information, which can all inhibit their sustainably efforts.

- Another barrier mentioned in the interviews was the lack of data available at the city level, with national or regional-level data having to be used as a proxy in some instances, thereby preventing more locally targeted responses.

Financial barriers

- In terms of factors that were identified by some cities in the survey as inhibiting sustainability transitions, the level of fiscal decentralisation stands out as the most important barrier.

- This aligns with findings from the interviews, where limited municipal budgets (arising from insufficient fiscal decentralisation) were repeatedly highlighted as a barrier.

- Another related challenge was the limited ability of some cities to raise their own taxes, which is exacerbated when there is a lack of political alignment between the city and higher tiers of government regarding environmental policy priorities.

4.3 General reflections on the research approach

This relatively small-scale study was intended as a prototype — a way to test the approach of using literature reviews, surveys and interviews with city authorities to identify potential drivers and barriers to urban environmental sustainability transitions. This work is largely based on the personal perception of respondents and would need to be supplemented by additional more quantitative analysis of the drivers and barriers that cities experience. Based on this first experience, the approach can be replicated and revised in the future. The methodologies would allow for an easy scaling-up to include a larger sample of cities, which would enable more reliable insights into the diverse drivers and barriers to urban environmental transitions in different types of cities. It would also allow for an in-depth examination of specific enabling factors (e.g. understanding the specific governance drivers in more detail for a particular subset of cities). Another interesting approach may be to explore what supporting factors are absent in cities; this is a slightly different analysis and involves more than merely looking at concrete barriers.

Context, alongside each of the six enabling factors in the conceptual framework on urban environmental sustainability (i.e. governance, knowledge, culture, technology, data and information, finance) were generally seen by cities to support their sustainability transitions. This is not surprising since these factors were identified via an in-depth literature review and consultation with stakeholders, although the survey provided further empirical evidence of their relevance as important enablers of environmental sustainability. This is not to suggest that the list of enabling factors is exhaustive and it may well be worth exploring if other enabling factors (or sub-categories of factors) were missed in the initial literature review and stakeholder consultation. It should be noted that cities had the opportunity to mention specific additional factors in free-form fields in the survey but none of the respondents added any entirely new categories.

Overall, few of the factors in the survey were identified as presenting serious barriers to environmental sustainability in cities. Even where some cities identified a factor as a barrier, in all cases, some others suggested that the same factor supported their sustainability transitions. This may be partly due to the fact that all cities targeted by the survey are already 'sustainability leaders' and, as such, may have overcome many of the barriers that could still be preventing other cities from taking more decisive action in this area.

Expanding the survey to include cities that may not yet be as advanced in their sustainability transitions would be an interesting area for future research, given that it would probably highlight additional barriers. In addition, the format of the survey did not provide the cities with an opportunity to explicitly list barriers they felt were most inhibiting their sustainability transitions. In contrast, interviews asked cities to reflect specifically on the barriers they currently face or have faced in the past.

Of all the elements of the conceptual framework tested via the survey, contextual factors were the most polarising, with context identified as both strongly supporting or strongly inhibiting sustainability transitions. This is not surprising given the heterogeneity of the cities participating in the survey as well as the nature of the contextual factors, which can be both a positive driver or a barrier depending on the specific environmental sustainability objective (e.g. urban form, geographic location).

The interviews provided a lot more detail than the survey and, in most cases, acted as an important complement to the survey results, confirming many of the general trends that emerged from the survey in terms of the most important drivers of change. However, there were some areas where the survey results and the findings from interviews diverged in terms of the factors seen as most significant. Given that the interviews were only around an hour long, this could mean that not all enabling factors and barriers were covered.

5 Lessons and next steps

Based on the findings summarised in the previous section, a number of specific lessons emerge from this research. These lessons may be helpful to policymakers across all levels of decision-making when identifying important levers of change that can help to accelerate urban environmental sustainability transitions across European cities. They also provide important insights that may be relevant to other urban stakeholders, including local citizens, NGOs and the research community. Looking ahead, several continuations of this research could be explored to build on this initial study and strengthen the understanding of how specific factors either enable or hinder progress. These will be discussed briefly at the end of this concluding chapter.

5.1 Lessons emerging from this research

A number of early lessons that may give more insight into the drivers and barriers of sustainability transitions in European cities have emerged from this research. These lessons were shaped by the results from the survey and interviews, as well as by the EEA/Eionet consultation. Bearing in mind that this study is relatively limited in scope, these lessons would have to be tested further, with a wider sample of cities, to confirm their robustness and to develop concrete policy recommendations that emerge from these observations.

Cities are heterogenous and transition pathways need to be tailored to local contexts

There are significant variations between cities as regards the most important drivers and barriers shaping their sustainability transitions. This highlights the extreme heterogeneity of European cities and the diverse urban sustainability pathways that exist. This is also relevant when it comes to EU legislation and policy frameworks that must leave enough flexibility to enable cities to implement initiatives in ways that are most relevant and effective for them, respecting the unique local drivers and barriers they face on their sustainability journey. It also suggests that cities will have very different policy priorities and divergent abilities to influence specific sectors that are relevant to their sustainability transitions. Thus, identifying the

most relevant policy nexuses where sectoral challenges can be tackled in an integrated manner is also likely to vary between cities.

Some contextual factors are fixed and hard to change, but many are dynamic and evolving

Understanding the complex relationships between the existing urban context and sustainability efforts can help cities prioritise those environmental policies that are the most appropriate for their individual circumstances. Although a contextual factor that acts as a major barrier in one city may be largely irrelevant in another, what emerges clearly from the research is that a good understanding of a city's context, and its constantly evolving nature, are essential prerequisites to successful sustainability planning. Some contextual factors cannot easily be changed (either because they are fixed, e.g. geographical context) or they occur at a larger scale (e.g. climate change). Fixed contextual factors form part of a city's distinctiveness and, wherever possible, they should be embraced as they can enable unique ways of addressing sustainability transitions. At the same time, many aspects of a city's context are changeable (either by targeted policy intervention or through more large-scale external forces) — an important reminder that cities are living systems. They are constantly evolving and urban policymaking must remain agile to respond to emerging challenges and new realities. Also, the contextual factors the city can change or influence are very often shaped in some way by external actors and dynamics that can either support or undermine local efforts (e.g. GDP, demographics).

City government's sustainability vision and strategic plan are vital as foundations for further action

Having an overall sustainability vision and associated strategic plan at the city level is an essential precondition for advancing towards ambitious environmental goals. All cities highlighted the importance of having well-thought-out plans that provide a clear trajectory and can act as a baseline for their sustainability transitions, as well as committed leadership to drive progress towards that vision. Despite this, it is important to note that a vision on its own will not lead

to change, and having clear and measurable targets in key sectors, as well as a system of accountability related to the achievement of these targets, is essential. Another potential issue relates to the priorities that may be included in a city's strategic plan, which are often conditioned by the issues and sectors a city can meaningfully influence but are also influenced by political preferences and ideologies. This is why it is so essential for urban sustainability plans to align with and respond to wider programmes and plans set at the national and EU level.

EU laws and policy frameworks have a key role to play in accelerating sustainability changes in cities

EU laws, standards and regulations, and access to EU funding play a major role in shaping local sustainability ambitions and actions. Cities are strongly incentivised, supported and even inspired by EU legislation and strategies, such as the Green Deal, the EU Urban Agenda and various EU Directives (e.g. WFD, EED, EPBD). Compared to international initiatives (e.g. UN Sustainable Development Goals, UN Urban Agenda), European regulations and initiatives are considered significantly more relevant to cities. This may be because EU regulations are legally binding and are linked very clearly to other EU incentive mechanisms (e.g. funds, networks, awards). With the emergence of COVID-19, it is likely that leadership on key sustainability issues from the EU and associated funding will play an even bigger role in accelerating change in European cities.

National and supranational governments can facilitate, as well as inhibit, systemic change

National and supranational governments can accelerate systemic change by facilitating knowledge exchange and supporting strong networks that enable peer-to-peer learning. Initiatives such as the EGCA and EGLA, and many other EU initiatives are crucial for sharing knowledge and best practice. This is also true for collaborative European research initiatives that provide the framework for cities to learn from each other and find innovative solutions to shared challenges. At the same time, some cities did highlight that a lack of alignment between local, national and supranational priorities and objectives can undermine progress, underscoring why it is so essential that urban leaders are consulted in wider decision-making processes related to the sustainability transition.

Cities benefit from greater decision-making powers and fiscal autonomy

Although higher levels of government (EU, national, regional) clearly have an essential role to play in supporting urban sustainability transitions, it tends to be beneficial for cities to have a greater degree of decision-making power and fiscal autonomy. The importance of both fiscal and political decentralisation emerged repeatedly through this research, with cities stating it was essential for them to have a substantial level of independence when it comes to policy sectors that most acutely influence local sustainability outcomes. A lack of fiscal autonomy was repeatedly highlighted as a barrier that constrains cities in accelerating their sustainability transition, particularly when it comes to big investments, such as new transport infrastructure, that often exceed their capacity to finance independently. COVID-19 has already had a significant impact on local government budgets, so finding innovative ways to access local sources of revenue will have to be complemented by financial support from other tiers of government and the private sector.

City networks and focused partnerships can add value

All cities identified the vital role of sharing knowledge and experiences with other cities, often facilitated through regional or thematic networks that enable them to co-create solutions to shared sustainability challenges. City networks work best when they encourage collaboration rather than competition and when their value added for individual member cities is very clear. Having a safe space to share both successes and failures was highlighted as an important aspect of such networks. Cities must take care not to overcommit to too many initiatives and rather to focus on the networks and partnerships that provide them with concrete inputs and support to help them to advance towards specific goals. COVID-19 has also shown how city networks can be essential not just for information sharing but also by enabling cities to speak with a unified voice, raising their collective profile in important policy conversations. Recent examples of this include the C40 Global Mayors COVID-19 Recovery Task Force and explicit calls by the Global Covenant of Mayors and Eurocities for a green recovery and cross-border solidarity.

Local research and experimentation can accelerate innovation

Urban sustainability transitions are inherently complex and often have to respond to 'wicked problems' that can be difficult to solve or have unintended spillover effects. Research and experimentation are critical to identifying locally appropriate solutions. Using the city as a test bed can accelerate innovation because it ensures new approaches and technologies are appropriate for the local context. It also allows cities to think about the different sustainability nexuses that they want to address and to find solutions that can lead

to co-benefits across different critical policy sectors. At the same time, a supportive research agenda at the EU and national levels is also needed to support and reinforce efforts by individual cities, while also providing important insights into issues that are shared by a wide range of cities. Having an integrated strategic vision for the whole city that ensures that sustainability issues are not dealt with in a siloed way but instead become a shared responsibility can help to create a common understanding of sustainability issues across all sectors of government.

Involving various stakeholders and supporting effective public engagement in decision-making processes leads to better outcomes

Including a broad range of stakeholders from various sectors and across all levels of government and society in decision-making (e.g. drafting the city's strategic vison), and processes of knowledge production and innovation tends to lead to better outcomes in terms of urban environmental sustainability transitions. The sense of ownership and shared responsibility to deal with environmental challenges can help to create a common understanding of sustainability issues across various sectors of society and government. Achieving sustainability transitions also requires public engagement in defining a city's visions and pathways — without this buy-in and participation it is very difficult to achieve positive change. Public engagement positively influences attitudes on sustainability and sets the scene for the generation of feedback loops that further urban sustainability transitions at a later stage. Educating civil society through informative campaigns on sustainable policies and plans equips citizens to place demands on municipalities to act, while also empowering individuals to take meaningful action within their own communities. Having an engaged and empowered population that is open to new innovative technologies and willing to change behaviours and habits, and embrace more sustainable lifestyles, can facilitate the implementation of more transformational changes.

New technologies can play an important role but need to be inclusive and fit for purpose

Innovation cannot be embraced for its own sake but rather must respond to genuine needs — first and foremost the need for more liveable and sustainable cities. While new technologies are not a panacea to all environmental challenges, care must be taken to ensure technologies do not have unintended consequences or side effects (e.g. social exclusion and inequality in access to goods and services) — technological developments play an important role in accelerating sustainability transitions in cities. As a result, some cities are placing technological innovation

at the centre of their sustainability transitions. Fostering a culture of innovation and an atmosphere of creativity can help cities attract global technology firms while also providing the right environment for local start-ups to thrive and facilitate new technology development and implementation on the ground. Often new technologies will be more impactful if they are linked to participatory and bottom-up approaches, for example, by enabling the involvement of local residents through citizen science to help collect scientific data, monitor local biodiversity, identify pollution hot spots or even to map vulnerabilities to disasters.

Updated and accessible data and information is needed to monitor progress

Better data and information generally lead to better environmental management, making it easier to demonstrate progress towards specific goals. Initiatives such as the EGCA and EGLA, EU Directives, and membership of other EU networks help cities to identify areas where they may be lagging behind and incentivises them to improve their data- and information-collection processes. To enhance data-collection practices, data quality and availability at the local level, it can be helpful for cities to collaborate with national statistics offices to understand what data should be collected at more granular levels, as well as the types of indicators that should be monitored. Again, new technologies can play an important role in both data collection and analysis, but a proliferation of data is only as useful as a city's capacity to analyse it and integrate it into its decision-making processes. This is why it is essential for cities to acquire the skills to work with large datasets that can help them to identify patterns and track the impact of specific policy interventions. This is also an important reminder that the provision of timely, relevant and accessible European-level data and information on environmental issues is essential for cities and should remain a priority for agencies such as the EEA.

Communicating information effectively and innovatively is an important part of engaging the public

Thinking in innovative ways about how data and information can be presented to highlight challenges or new initiatives can ensure that the public is clear about what the city is aiming to achieve and how they can be part of the sustainability transition. Innovative communication includes more qualitative storytelling, and accessible and attractive ways of data visualisation and presentation, as well as better availability of relevant open data (e.g. appropriate scale, thematic). All this can improve the accessibility and understanding of relevant information for the public and various other stakeholders and can support urban environmental

sustainability transitions. Cities also mentioned other ideas, such as having high-profile 'champions' to promote more sustainable behaviours, involving the public and private sector through competitions and events where the public can try out new technologies, and regular town-hall meetings and other ways of engaging that enable dialogue with citizens and the development of shared sustainability objectives.

Accessing EU, national and private funding plays a critical role

Governments can accelerate systemic change by reorienting financial flows towards sustainable investments and developing relevant knowledge systems and skills to support these. Wealthier cities may find it easier to independently invest in important sustainability initiatives and upgrade urban infrastructure. However, particularly for cities with less own-source revenues, knowing how to access other sources of funding at EU and national levels can play a critical role in overcoming this barrier. These sources of funding are likely to become even more essential in the aftermath of COVID-19, when municipal budgets are likely to be considerably constrained. Even though EU funding may be available, applying for such funds can be time-consuming and require a particular skillset that not all local authorities necessarily possess. This means that access to EU funds is not equally distributed across Europe and may not always reach the cities that need it most. Public-private partnerships are another way cities can increase investment in sustainable infrastructure. Successful collaboration with the private sector can accelerate progress towards core policy objectives while, at the same time, providing significant benefits for local businesses.

Green procurement processes and sustainable consumption are important drivers of change

Green procurement practices provide an opportunity for cities to align public spending with core environmental objectives. Simplifying and supporting green procurement processes is therefore an important potential driver of change. The EU is already supporting cities in this process through initiatives such as the EcoProcura conference series, which enables cities to exchange best practices when it comes to more sustainable procurement processes. While cities are making progress on changing the environmental footprint of consumption, at times, decisions controlled directly by the local authority, private consumer spending decisions and investments are still undermining sustainability outcomes. Ensuring that individuals use their purchasing power correctly can be challenging for cities to influence. However, this was

mentioned several times as an important area where more progress is required.

5.2 Future research opportunities

This report has provided an overview of some of the drivers and barriers identified as being significant in shaping environmental sustainability transitions in a relatively small subset of European cities. The findings and emerging lessons should only be seen as an entry point into a wider conversation about the drivers of urban sustainability transitions. Further research would be needed to develop a more definitive overview of the multitude of complex and interrelated factors that shape sustainability outcomes in European cities.

Looking ahead, a number of important pieces of follow-on work emerge from this initial analysis, which the EEA and other interested parties may want to explore:

Expanding the survey to include more cities

• The first and most obvious opportunity would be to roll out the survey to a wider selection of European cities. Ensuring that a higher percentage of winners and finalists of the EGCA and EGLA respond to the survey would be one potential avenue.

• At the same time, this sample of cities is clearly already leading when it comes to environmental sustainability initiatives. It may therefore be of interest to widen the survey to include all cities that have so far applied to the EGCA and EGLA, or even those that have yet to apply. This would provide more interesting insights into the experiences of cities that are perhaps at an earlier stage of their sustainability journey. It would also shed some light on the barriers they face and allow for an exploration as to how these might best be overcome.

• Moving beyond EGCA and EGLA as a 'filter' to identify cities, another avenue could be to use the extensive city networks the EEA has access to through partners such as Eurocities and ICLEI (both members of the external stakeholder group). This would allow the survey to be shared with a potentially much wider pool of cities, ensuring a more representative cross-section of survey respondents.

• A further benefit from expanding the survey in this way would be that the larger sample size would allow for more sophisticated analyses of the results.

The current study worked with a sample size below 30, which makes it difficult to generalise some of the results and also means that any analysis of differences on the basis of geography, city size or any other typology were not appropriate.

- It would be very interesting to see if a larger sample size could begin to highlight any particular patterns in how the drivers and barriers manifest across different types of cities, thereby enabling more nuanced recommendations and a more comparative approach. This would also allow some cities to be clustered by themes in order to start to discern whether there are very clear differences.

Interviewing a wider range of cities or using interviews for in-depth examinations of specific topics

- As with the survey, the interviews only covered a relatively small number of cities (7), which limits the extent to which the findings can be generalised and drawn on for broader conclusions for EU policy-making. Engaging further with the same set of cities that filled out the survey would also create a sense of continuity and co-creation whereby they feel they are active participants in the research.

- It would be valuable to expand the number of cities interviewed, either to other cities that have already filled out the survey or even to those that are not part of the EGCA and EGLA process. This would help to understand the perspectives of cities that may either be at a much earlier stage in their sustainability journey or are perhaps struggling with particular barriers.

- Another option for further interviews might be to use them for in-depth investigations to better understand the specifics of a particular driver or barrier in relation to different topics. For example, interviews might focus only on the role of financing/technology/data and how this specific factor is helping or hindering individual urban sustainability transitions.

Linking the findings to major new EU policy initiatives as well as the coronavirus pandemic

- The research was completed ahead of the publication of a number of important EU initiatives, including the EEA's SOER 2020 report, the EU Biodiversity Strategy for 2030, the revised Leipzig Charter and the European Green Deal. It would be useful to analyse to what extent the key findings from this piece of work align with the priorities set out in these new policy documents and to use

this to identify important gaps where the efforts of cities to transition might be better supported through existing EU initiatives and legislation.

- The survey and interviews were completed before the coronavirus pandemic swept across Europe. In the aftermath, cities, nations and the EU will have to find a way to recover from the human and economic toll of the pandemic, while ensuring that the inevitable economic challenges do not undermine urgent agendas related to climate change and ecological restoration. Research into the types of recovery packages that will allow us to 'build back better', while also accelerating progress towards environmental sustainability in Europe's cities, will be of critical importance and this report could provide an entry point into these discussions. Of course, the emergence of COVID-19 has also fundamentally changed priorities across European cities — thus, repeating this research and comparing how drivers and barriers may have changed over the past year would also be a valuable approach.

Exploring wider themes and subject areas that may be driving the sustainability transition

- Some themes did not emerge as clearly from this research as might have been expected. These includes the importance of urban and territorial planning, especially how differences in planning and urban development contexts among different cities may shape their sustainability transitions. In light of current updates to the EU Territorial Agenda (EC, 2020c) and the imminent publication of a revised Leipzig Charter (URBACT, 2020), integrated urban development may be an important aspect to explore in follow-up research, ensuring that these important conversations and emerging policy priorities are more adequately reflected in this analysis and that the link between urban planning and environmental sustainability is explored in more depth.

- Another important theme that did not emerge from the research was governance for transformation, including discussions of how cities are creating a climate for innovation within the municipality, where new approaches can be tested without the fear of failure and where failure is seen as a means of learning and growth. Understanding to what extent such openness for experimentation embedded in local government culture can accelerate progress towards greater environmental sustainability may be a relevant focus for future research. Related to this, work to

better understand the difference between more top-down leadership on sustainability versus more bottom-up drivers emerging from civil society and the public might also be of value. Furthermore, it might be beneficial to collect views at national and regional governance levels on factors relevant for urban environmental sustainability transitions.

- While this work was very explicitly focused on understanding the drivers of environmental sustainability transitions, it is also important to understand what the social and economic drivers of sustainability in cities might be. Therefore, further research may seek to broaden the scope to include a wider selection of drivers and barriers. Similarly, understanding interlinkages between these different drivers and barriers could be explored further. Topics such as mobility in cities, noise, green spaces and land-use change are all connected. To a certain extent, this will be

explored in the forthcoming EEA work on nexus analysis, although it may be useful to take this more integrated approach as a starting point for future primary research with specific cities.

- Finally, it would be valuable to explore the role of lock-ins and path dependencies in greater detail. This would help us to understand how cities might be supported to move from incremental improvements and fairly linear progress to more transformative action and accelerated change. The COVID-19 crisis is adding to the urgency of this type of research, given that cities are currently facing unprecedented pressures to respond to deeply interlinked health, social, economic and environmental challenges. There is a real risk that the gains made in recent years in urban environmental sustainability transitions may either slow down or even be reversed unless cities are supported in their efforts to build back better.

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Appendix A Urban environmental sustainability transitions survey

About the survey

This survey is part of a project conducted by the European Environment Agency (EEA) that aims to provide a clearer understanding of specific factors, drivers and barriers that enable or hinder the achievement of environmental sustainability in European cities. The responses to this survey and the associated analysis will directly inform the EEA's work on urban sustainability, notably the *Urban Sustainability in Europe – Avenues for change* report (EEA, forthcoming). It also aims to provide important lessons about the way in which cities and national governments can foster more sustainable urban growth that protects the environment and creates thriving, low-carbon and climate-resilient communities that promote economic vitality, health, wellbeing and social inclusion.

Your city has been contacted because you are either a winner or finalist in the prestigious European Green Capital or European Green Leaf Awards, which were chosen as the most appropriate benchmark for urban sustainability leadership across Europe. Responses across a wide range of different cities are critical to the success of the survey, and your participation is greatly appreciated. By participating, you can directly support the EEA's assessments and consequently inform policy debate and formulation at the EU level and beyond. We also hope you find it a useful process of reflection on its own and that it can propose or trigger new ideas and insights into urban policymaking as you take part.

Responding to this survey

Replies may be submitted in English language only. The survey should take about 20-30 minutes to complete. However, when responding to the questions you might wish to consult your colleagues, thus responding to the questionnaire might take longer. You may interrupt your session at any time and continue answering at a later stage. If you do so, **please remember to keep the link to your saved answers as this is the only way to access them**. Once you have submitted your answers online, you will be able to download a copy of the completed questionnaire.

The survey is being conducted by Collingwood Environmental Planning (CEP) and LSE Cities at the London School of Economics on behalf of the EEA. In addition to the results from this questionnaire, there will be follow-up interviews with a selection of cities that have responded to the survey.

Publication of contributions

This survey is conducted using the European Commission's platform EUSurvey. This platform conforms to the policy on the protection of personal data by the European institutions. Please note that the responses received will be used to form the basis of our report that will be published online. However, in the publication material only the name of the city will be mentioned, while all your personal data will be kept confidential. Your answers will therefore be anonymous. For further information please read the specific privacy statement referred to at the bottom of this webpage.

Please do not share this survey. You are of course welcome to consult with colleagues to help you complete the survey.

About you and your city

As there is a chance you might be contacted to participate in a follow-up interview based on your survey responses, please provide your name and email address. All contact information will be kept confidential.
If you are contacted to take part in the interview, your participation is optional.

Name:

Email Address:

1. What city do you represent?

- ☐ Amsterdam
- ☐ Barcelona
- ☐ Bristol
- ☐ Brussels
- ☐ Copenhagen
- ☐ Cornellà de Llobregat
- ☐ Essen
- ☐ Frankfurt
- ☐ Freiburg
- ☐ Gabrovo
- ☐ Galway
- ☐ Ghent
- ☐ Glasgow
- ☐ Hamburg
- ☐ Horst aan de Maas
- ☐ Joensuu
- ☐ Lappeenranta
- ☐ Lahti
- ☐ Leuven
- ☐ Limerick

- ☐ Lisbon
- ☐ Ljubljana
- ☐ Ludwigsburg
- ☐ Malmö
- ☐ Mechelen
- ☐ Mikkeli
- ☐ Mollet del Vallès
- ☐ Münster
- ☐ Nantes
- ☐ Nijmegen
- ☐ Nuremberg
- ☐ Oslo
- ☐ Reykjavík
- ☐ s'-Hertogenbosch
- ☐ Stockholm
- ☐ Tallinn
- ☐ Torres Vedras
- ☐ Umeå
- ☐ Växjö
- ☐ Vitoria-Gasteiz

2. Which of the following best describes the department/sector in which you work? If you (and your colleagues) work in more than one department or your department covers more than one area, please choose all that apply.

- ☐ Mayor's Office
- ☐ City Council Office
- ☐ Other elected office
- ☐ Education
- ☐ Environment
- ☐ Climate change
- ☐ Health and social services
- ☐ Public works
- ☐ Planning
- ☐ Technology/innovation

- ☐ Transport
- ☐ Finance
- ☐ Energy and utilities
- ☐ Public and international relations
- ☐ Culture
- ☐ Other

If other, please specify *(Word limit 20 words)*

Introduction

Understanding your city's environmental sustainability story.

3. How significant are the following environmental challenges for your city and its region?

	Very significant	Somewhat significant	Not significant	I don't know
Heatwaves	☐	☐	☐	☐
Sea level rise	☐	☐	☐	☐
Severe storms and flooding	☐	☐	☐	☐
Water shortages/droughts	☐	☐	☐	☐
Forest fires	☐	☐	☐	☐
Air Pollution	☐	☐	☐	☐
Water pollution	☐	☐	☐	☐
Ground contamination	☐	☐	☐	☐
Noise pollution	☐	☐	☐	☐
Light pollution	☐	☐	☐	☐
Energy shortages/scarcity	☐	☐	☐	☐
Clean drinking water	☐	☐	☐	☐
Timber, mineral and other natural resource shortages	☐	☐	☐	☐
Land/soil erosion	☐	☐	☐	☐
Food shortages/access to food	☐	☐	☐	☐
Solid waste processing	☐	☐	☐	☐
Solid waste disposal	☐	☐	☐	☐
Sewage treatment and disposal	☐	☐	☐	☐
Stormwater management	☐	☐	☐	☐
Decline of native species/natural habitats	☐	☐	☐	☐
Lack/loss of green space	☐	☐	☐	☐
Lack/loss of ecologically productive land	☐	☐	☐	☐
Other	☐	☐	☐	☐

If other, please specify *(Word limit 20 words)*

4. How significant are the following additional challenges for your city and its region?

	Very significant	Somewhat significant	Not significant	I don't know
Urban sprawl	☐	☐	☐	☐
Overcrowding	☐	☐	☐	☐
Inadequate or absent infrastructure	☐	☐	☐	☐
Community severance (a physical and psychological barrier created by e.g. roads or rail infrastructure)	☐	☐	☐	☐
Road congestion	☐	☐	☐	☐
Social exclusion	☐	☐	☐	☐
Unemployment rates	☐	☐	☐	☐
Lack of affordable housing	☐	☐	☐	☐
Insufficient public services	☐	☐	☐	☐
Non-communicable diseases (e.g. heart disease, cancer, asthma, diabetes)	☐	☐	☐	☐
Mental health	☐	☐	☐	☐
Demographic change	☐	☐	☐	☐
Other	☐	☐	☐	☐

If other, please specify *(Word limit 20 words)*

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5. How long have environmental sustainability objectives been an important part of your city's political agenda?

☐ Since before 1972 (the Stockholm UN Conference)

☐ Since the period between 1973 (the Oil Crisis) and 1992

☐ Since the period between 1992 (the Rio Conference) and 2000

☐ Only in the last decades (2001-2019)

☐ Environmental sustainability objectives are an important part of my city's political agenda, but I can't specify when they became important.

☐ Environmental sustainability objectives are NOT an important part of our city's political agenda.

6. Are there any policies your city has put in place (current or historic) that have significantly supported your city's achievement of environmental sustainability objectives? Please list up to three in order of significance.

(Word limit 60 words)

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7. Are there any policies your city has put in place (current or historic) that have significantly undermined your city's achievement of environmental sustainability objectives? Please list up to three in order of significance.

(Word limit 60 words)

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8. How important were/are the following triggers in making environmental sustainability objectives an important part of your city's political agenda?

	Very significant	**Somewhat significant**	**Not significant**	**I don't know**
A specific environmental crisis	☐	☐	☐	☐
Another particular crisis (not related to the environment)	☐	☐	☐	☐
A change in local political leadership	☐	☐	☐	☐
Pressure from national/supranational government	☐	☐	☐	☐
Pressure from stakeholders	☐	☐	☐	☐
Public opinion/awareness	☐	☐	☐	☐
Other	☐	☐	☐	☐

If other, please specify *(Word limit 20 words)*

Understanding the drivers of urban environmental sustainability

Context

Context is understood as the range of current and historic physical (e.g. geographical, environmental), cultural and institutional characteristics which create and shape the setting in which a specific city exists, develops and functions. These characteristics influence the ability of a city to transition to environmental sustainability.

9. Have the following contextual factors supported or inhibited the environmental sustainability transition in your city?

	Strongly supported	**Slightly supported**	**Neither supported nor inhibited**	**Slightly inhibited**	**Strongly inhibited**	**I don't know**
City size	☐	☐	☐	☐	☐	☐
Existing urban form (e.g. level of compactness)	☐	☐	☐	☐	☐	☐
Existing infrastructure (e.g. public transport network)	☐	☐	☐	☐	☐	☐
GDP per capita	☐	☐	☐	☐	☐	☐
Structure of the economy	☐	☐	☐	☐	☐	☐
Demographics	☐	☐	☐	☐	☐	☐
Level of Gentrification	☐	☐	☐	☐	☐	☐
Geographic location (e.g. coastal, mountainous)	☐	☐	☐	☐	☐	☐
Climatic conditions	☐	☐	☐	☐	☐	☐
Natural assets	☐	☐	☐	☐	☐	☐
Air/water/soil quality	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

If other, please specify *(Word limit 20 words)*

10. Please provide any additional comments on how context has either supported or inhibited the environmental sustainability transition in your city

(Word limit 100 words)

Governance

Governance is understood as the structures and processes as well as the norms, values and rules through which affairs are conducted by political, business or community leaders exercising their power of authority.

11. Have the following factors related to national governance supported or inhibited the environmental sustainability transition in your city?

	Strongly supported	Slightly supported	Neither supported nor inhibited	Slightly inhibited	Strongly inhibited	I don't know
Distribution of state powers and the level of political decentralisation	☐	☐	☐	☐	☐	☐
International treaties- and EU laws, standards and regulations	☐	☐	☐	☐	☐	☐
National laws, standards and regulations	☐	☐	☐	☐	☐	☐
Sub-national laws, standards and regulations	☐	☐	☐	☐	☐	☐
National taxes, subsidies or other economic instruments	☐	☐	☐	☐	☐	☐
Sub-national taxes, subsidies or other economic instruments	☐	☐	☐	☐	☐	☐
Actions and policy objectives of the national/state government	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

If other, please specify *(Word limit 20 words)*

12. Have the following factors related to local governance supported or inhibited the environmental sustainability transition in your city?

	Strongly supported	Slightly supported	Neither supported nor inhibited	Slightly inhibited	Strongly inhibited	I don't know
Local government overall vision and strategic plans	☐	☐	☐	☐	☐	☐
Individual political leadership	☐	☐	☐	☐	☐	☐
Election cycles/term times	☐	☐	☐	☐	☐	☐
Level of civic engagement and public participation	☐	☐	☐	☐	☐	☐
Implementation of local governance innovations	☐	☐	☐	☐	☐	☐
Measurable targets and monitoring of policy objectives	☐	☐	☐	☐	☐	☐
Level of coordination and integration of environmental sustainability objectives with other sectors	☐	☐	☐	☐	☐	☐
Trade-offs of environmental sustainability with other objectives	☐	☐	☐	☐	☐	☐
Planning culture and practices	☐	☐	☐	☐	☐	☐
Models of public service delivery (public, private, public–private partnership)	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

If other, please specify *(Word limit 20 words)*

13. Please provide any additional comments on how governance has either supported or inhibited the environmental sustainability transition in your city

(Word limit 100 words)

Knowledge

Knowledge is understood as key insights, skills and expertise related to urban environmental sustainability processes, their management and options for action held by individuals within a group or amongst groups (6).

14. Have the following factors related to knowledge supported or inhibited the environmental sustainability transition in your city?

	Strongly supported	Slightly supported	Neither supported nor inhibited	Slightly inhibited	Strongly inhibited	I don't know
Education system	☐	☐	☐	☐	☐	☐
Research and innovation	☐	☐	☐	☐	☐	☐
Skills in local government	☐	☐	☐	☐	☐	☐
Skills of local workforce	☐	☐	☐	☐	☐	☐
Communication and knowledge sharing between different levels of government	☐	☐	☐	☐	☐	☐
Communication and knowledge sharing within local government	☐	☐	☐	☐	☐	☐
Level of awareness of environmental sustainability	☐	☐	☐	☐	☐	☐
Level of shared understanding of sustainability issues in local government	☐	☐	☐	☐	☐	☐
Knowledge management and dissemination	☐	☐	☐	☐	☐	☐
Networks of cities and peer-to-peer learning	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

If other, please specify *(Word limit 20 words)*

15. Please provide any additional comments on how knowledge has either supported or inhibited the environmental sustainability transition in your city

(Word limit 100 words)

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(6)   This definition draws on the EEA MDIAK framework.

Culture

Culture is understood as shared characteristics (e.g. language, religion, cuisine etc.), patterns of behaviour (e.g. social habits etc.) and understanding/attitude towards an issue (e.g. urban environmental sustainability and willingness to adopt new behaviour) of a particular group of people (in urban areas) that are learned by socialisation ([7]).

16. Have the following factors related to culture supported or inhibited the environmental sustainability transition in your city?

	Strongly supported	Slightly supported	Neither supported nor inhibited	Slightly inhibited	Strongly inhibited	I don't know
Willingness by local government to adopt new behaviours and practices	☐	☐	☐	☐	☐	☐
Willingness by the general public to adopt new behaviours and practices	☐	☐	☐	☐	☐	☐
Values and attitudes to environmental sustainability within local government	☐	☐	☐	☐	☐	☐
Values and attitudes to environmental sustainability by the general public	☐	☐	☐	☐	☐	☐
Framing of environmental sustainability in public discourse	☐	☐	☐	☐	☐	☐
Level of sensitivity of local government to local culture (e.g. traditions, diversity, inclusiveness, heritage, religion)	☐	☐	☐	☐	☐	☐
Level of public engagement	☐	☐	☐	☐	☐	☐
Social and economic power dynamics	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

If other, please specify *(Word limit 20 words)*

17. Please provide any additional comments on how culture has either supported or inhibited the environmental sustainability transition in your city

(Word limit 100 words)

([7])   This definition draws from The Center for Advance Research on Language Acquisition.
Available at: http://carla.umn.edu/culture/definitions.html

Technology

Technology is understood as different types of products and processes used to facilitate or support changes in practices, processes and behaviours in different forms and areas of technological development including education, construction, transportation, energy, information and communication among others.

18. Have the following factors related to technology supported or inhibited the environmental sustainability transition in your city?

	Strongly supported	Slightly supported	Neither supported nor inhibited	Slightly inhibited	Strongly inhibited	I don't know
Information telecommunication technology (ICT)	☐	☐	☐	☐	☐	☐
Big data analytics	☐	☐	☐	☐	☐	☐
Low carbon technologies (electric vehicles, solar PV, smart meters etc.)	☐	☐	☐	☐	☐	☐
Technologies for environmental monitoring (e.g. air quality monitors)	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

If other, please specify *(Word limit 20 words)*

19. Has the level of technological development in the following sectors supported or inhibited the environmental sustainability transition in your city?

	Strongly supported	Slightly supported	Neither supported nor inhibited	Slightly inhibited	Strongly inhibited	I don't know
Government and administration	☐	☐	☐	☐	☐	☐
Transport	☐	☐	☐	☐	☐	☐
Energy generation, distribution and storage	☐	☐	☐	☐	☐	☐
Land management and planning	☐	☐	☐	☐	☐	☐
Building construction and retrofitting existing buildings to improve sustainability and energy efficiency	☐	☐	☐	☐	☐	☐
Water management	☐	☐	☐	☐	☐	☐
Waste management	☐	☐	☐	☐	☐	☐
Environment and nature protection and conservation	☐	☐	☐	☐	☐	☐
Agriculture	☐	☐	☐	☐	☐	☐
Forestry	☐	☐	☐	☐	☐	☐
Health	☐	☐	☐	☐	☐	☐
Education	☐	☐	☐	☐	☐	☐

20. Are there any specific technologies that have supported or inhibited the environmental sustainability transition in your city? If so, please name these technologies and the sectors for which they were most relevant.

(Word limit 100 words)

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21. Please provide any additional comments on how technology has either supported or inhibited the environmental sustainability transition in your city.

(Word limit 100 words)

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Data and information

Data are understood as raw, unorganised facts in various forms (e.g. Big data, Open data etc.) on relevant issues, whereas information is processed, organised and/or structured data so as to make it useful to form knowledge on a subject, issue, event or process relevant to achieve (urban environmental) sustainability transition[8].

22. Have the following factors related to data and information supported or inhibited the urban environmental sustainability transition in your city?

	Strongly supported	Slightly supported	Neither supported nor inhibited	Slightly inhibited	Strongly inhibited	I don't know
Data and information collection practices (e.g. statistical services, qualitative and quantitative data collection)	☐	☐	☐	☐	☐	☐
Data and information sharing practices (e.g. open data)	☐	☐	☐	☐	☐	☐
Accessibility of data and information (e.g. formats and ease of accessing)	☐	☐	☐	☐	☐	☐
Presentation and communication of data and information (e.g. analysis and linking data to policy outcomes)	☐	☐	☐	☐	☐	☐
Quality (e.g. robustness, reliability, relevance, comparability, compatibility) of data and information	☐	☐	☐	☐	☐	☐
Scale of available data (e.g. national, regional, local)	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

[8]   This definition draws from SMILE by Imperial College, Loughborough University and the University of Worcester.
     Available at: https://www.gcu.ac.uk/library/smile/searching/whydoweneedinformation/whatisinformation

If other, please specify *(Word limit 20 words)*

_____

23. Please provide any additional comments on how data and information has either supported or inhibited the sustainability transition in your city.

(Word limit 100 words)

_____

Finance

Finance is understood as the provision and management of public/government money and the process of acquiring funds through traditional (e.g. taxes, public–private partnerships) and innovative (e.g. micro-contributions/crowd-funding, land value capture) financial mechanisms to support green investments and the transition towards urban environmental sustainability.

24. Have the following factors related to finance supported or inhibited the environmental sustainability transition in your city?

	Strongly supported	Slightly supported	Neither supported nor inhibited	Slightly inhibited	Strongly inhibited	I don't know
Level of fiscal decentralisation	☐	☐	☐	☐	☐	☐
Level of own-source revenues (e.g. local taxes, fees, charges)	☐	☐	☐	☐	☐	☐
Level of multilateral funding (e.g. European Regional Development Fund; United Nations- Multilateral Fund)	☐	☐	☐	☐	☐	☐
Level of bilateral funding (e.g. from donor countries)	☐	☐	☐	☐	☐	☐
Level of national/state government public funding for environmental sustainability	☐	☐	☐	☐	☐	☐
Level of regional/local funding for environmental sustainability	☐	☐	☐	☐	☐	☐
Level of private sector funding for environmental sustainability	☐	☐	☐	☐	☐	☐
Level of public investment in research and development	☐	☐	☐	☐	☐	☐
Level of private investment in research and development	☐	☐	☐	☐	☐	☐
Level of funding for infrastructure projects (both private and public sources)	☐	☐	☐	☐	☐	☐
Level of funding for public service operations and maintenance (both private and public sources)	☐	☐	☐	☐	☐	☐
Other	☐	☐	☐	☐	☐	☐

If other, please specify *(Word limit 20 words)*

[   ]

25. Over the past 10 years, how has the proportion of your city's budget/expenditure on environmental sustainability measures changed?

☐ Increased significantly

☐ Increased slightly

☐ Stayed the same

☐ Decreased slightly

☐ Decreased significantly

☐ I don't know

27. What are the top three spending priorities to achieve your city's environmental sustainability objectives?

(Word limit 20 words)

[   ]

28. Please provide any additional comments on how finance has either supported or inhibited the sustainability transition in your city.

(Word limit 100 words)

[   ]

Responding to this survey

29. Did you consult any of your colleagues to help you respond to any questions in this survey?

☐ Yes

☐ No

Many thanks for taking the time to contribute to this survey. We really appreciate your time!

You will be kept informed on the development of this project.

Appendix B: Urban environmental sustainability transitions interview questions

Interview questions

1. What do you believe your city has achieved that has been of significant importance when it comes to delivering urban environmental sustainability?

2. What would you say have been the most significant drivers that have helped accelerate your cities environmental sustainability transition?

3. Are there any particular factors relevant to your city that you believe have contributed positively to your sustainability transition that make your city stand out from other cities (nationally or within the EU)?

4. What are the biggest challenges your city has faced/ is facing when it comes to achieving the transition towards greater environmental sustainability and are these challenges more political, contextual, technical, financial, cultural, etc.?

5. Can you elaborate on how significant these challenges have been in preventing your city from accomplishing a more profound shift towards environmental sustainability?

6. How have the challenges you mention been dealt with or even overcome to allow the transition towards greater environmental sustainability in your city? Can you provide any specific examples?

7. Can you describe in a bit more detail some of the systemic factors (e.g. large governance, economic and cultural shifts) that you believe have contributed the most to the sustainability success of your city? Were there any clear catalysts/events that really made a difference?

8. Can you describe how/if your city applies the long-term strategic planning and measurable targets to advance towards the sustainability goals? Have there been any particular successes or challenges with regard to the long-term planning and measurable objectives? For example, have you significantly changed the way you allocate your budget and other resources or made any other changes and what difference has that made to the city's progress towards sustainability transition?

9. How important has collaboration and coordination with other stakeholders been to your success (e.g. with other cities, municipalities and other governance levels, government and other institutions, private sector, etc.)?

10. How important has the interaction and integration between different policy areas/sectors (e.g. environment, education, economy, transport, energy etc.) been for the success of your city? Are there any particular areas where you feel you have successfully taken advantage of co-benefits between policy areas, broken down policy or institutional siloes and enhanced the effectiveness of your city's efforts towards environmental sustainability transition through greater integration?

11. Are there any particular policy sectors or issue areas where you have encountered particular obstacles/ challenges to the policy/sectoral integration that have prevented you from advancing towards your city's sustainability objectives? If so, what do you believe are the reasons for these challenges and are you taking any actions to address them?

12. What do you think are the biggest challenges and opportunities that your city faces in the coming 10 years and what is your city doing to ensure that it will be able to meet the most ambitious environmental objectives over this period?

13. What do you believe other cities can learn from the way your city has tackled complex environmental sustainability issues?

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