EEA Report | No 06/2021

Urban sustainability in Europe

Avenues for change

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Foreword

Tallinn, the capital of Estonia, recently won the 2023 European Green Capital Award, joining the ranks of previous winners such as Hamburg, Stockholm, Copenhagen, Lisbon, Lahti and Grenoble. Similarly, the Green Leaf Award 2022 — for cities of 20 000 to 100 000 inhabitants — was awarded to the Portuguese city, Valongo and Winterswijk in the Netherlands. I had the privilege of taking part in jury deliberations for both competitions. It was extremely inspiring and enriching to see the magnitude of the actions Europe's cities are taking as they move towards sustainability and prepare for the challenges ahead. Yet, the path to urban sustainability is not an easy one.

Cities are home to about three out of four Europeans. Cities are complex systems, uniting businesses, communities and the environment in a living, continuously evolving setting. They are social, cultural and economic centres, embedded in the regions surrounding them. Despite these commonalities, each city and town in Europe is unique, with its own features developed throughout history and shaped by its geography, its inhabitants and its socio-political systems. Consequently, the challenges faced by cities can vary significantly. Some cities face ageing or shrinking populations, whereas others might be growing. Decline in an economic sector, such as tourism or fisheries, can severely affect some cities' economies, while others can act as economic innovation magnets, attracting young talent from across the EU. Similarly, the environmental impacts of different cities might differ considerably.

Most European cities have been continuously inhabited for centuries and their streets, neighbourhoods and buildings reflect this heritage. Historical urban patterns and landscapes, as well as transport networks, influence how easily cities can become sustainable as a result of, for example, replacing building stock or retrofitting existing buildings or transport options. At the same time, despite their unique features and challenges, all cities need to take measures to prepare for the climate impacts they might face. Every city must contribute to climate neutrality, the circular economy and biodiversity objectives, while ensuring a cleaner and healthier environment and providing better social and economic opportunities for its inhabitants.

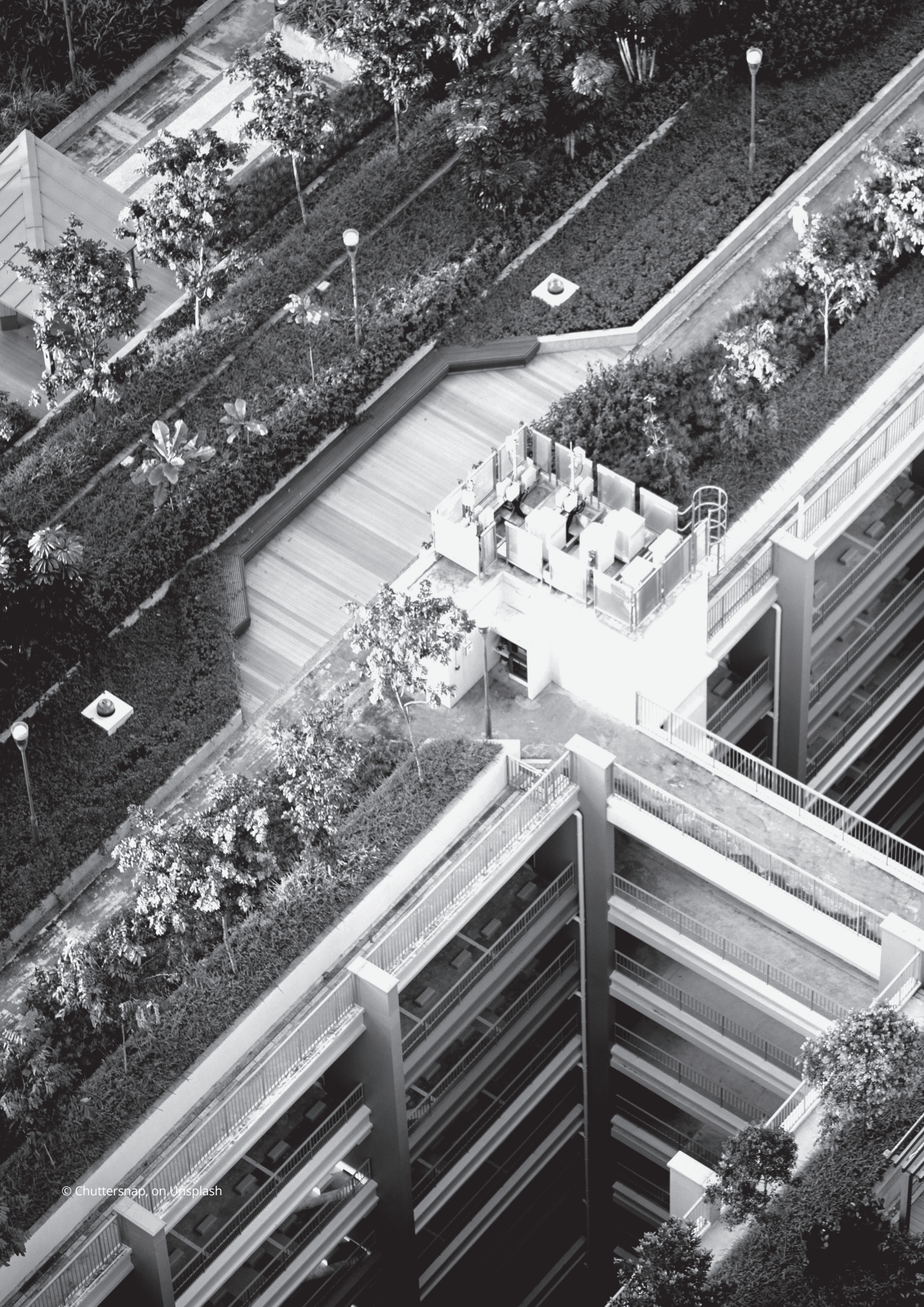
The end goal might be the same but the path towards sustainability for each city will need to cater for their unique set of characteristics and challenges. We, at the European Environment Agency, have been bringing stakeholders together — including many winners and finalists of the European Green Capital and Green Leaf Awards — to develop a common understanding of the role of cities in environment and sustainability transitions.

Based on a co-created conceptual framework, this common understanding is at the core of our recent urban sustainability publications, as well as this report and upcoming assessments on the issue. The framework aims to help city authorities and policy makers design their own sustainability transition by looking at urban sustainability as a whole through six different lenses: circular city, resilient city, low-carbon city, green city, inclusive city and healthy city. It also analyses how some key enablers of sustainability — governance, knowledge, culture, technology, finance and data and information — can drive or hinder urban transitions towards sustainability. Finally, it introduces the concept of an urban nexus and exemplifies its use in a city context via a preliminary assessment of eight priority nexus, highlighting the need for policy integration.

Many of our online tools, such as the European Air Quality Index, the European City Air Quality viewer and various thematic assessments and indicators show that different towns and cities will be impacted differently by climate change. Coastal cities, especially on the Northwest Atlantic coast, for example, will face greater storm surge risks, while others in the south will face water shortages. Our studies also show that some communities and groups within a given city could be even more vulnerable as they might be affected by multiple environmental hazards, such as air pollution or noise pollution.

From creating green and blue areas within the city centre to integrating public transport with active mobility systems like cycling and walking, or more effective recycling systems, there are many areas in which cities can take action in their transition towards urban sustainability. Wider uptake of technological developments such as electric vehicles or remote working can speed up the process. It is also clear from European Green Capitals like Copenhagen that a long-term and coherent vision supported by relevant governance structures can truly transform a city in just a couple of decades.

Hans Bruyninckx
EEA Executive Director



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Acknowledgements

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Other contributors

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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 and the development of the EEA's approach to urban environmental sustainability was largely finalised before the coronavirus emerged in Europe.

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.

The pandemic is highlighting the importance of addressing the nexus objectives presented in this report. For example, because of the pandemic and its cascading effects across systems (e.g. mobility, food) many cities have had to reconsider their resilience to large shocks, including to climate change (see the Climate resilience nexus). Many policies that have been implemented primarily to deal with the health emergency will also have long-term benefits for other nexus objectives (e.g. environmental, quality of life, resilience), as highlighted in the summary of the nexus analysis.

The research summarised in this report on the drivers of and barriers to cities transitioning towards more environmental sustainability, including the survey and interviews with city representatives, were finalised just as the coronavirus emerged in Europe. Therefore, 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 that 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 the light of this new reality.

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.

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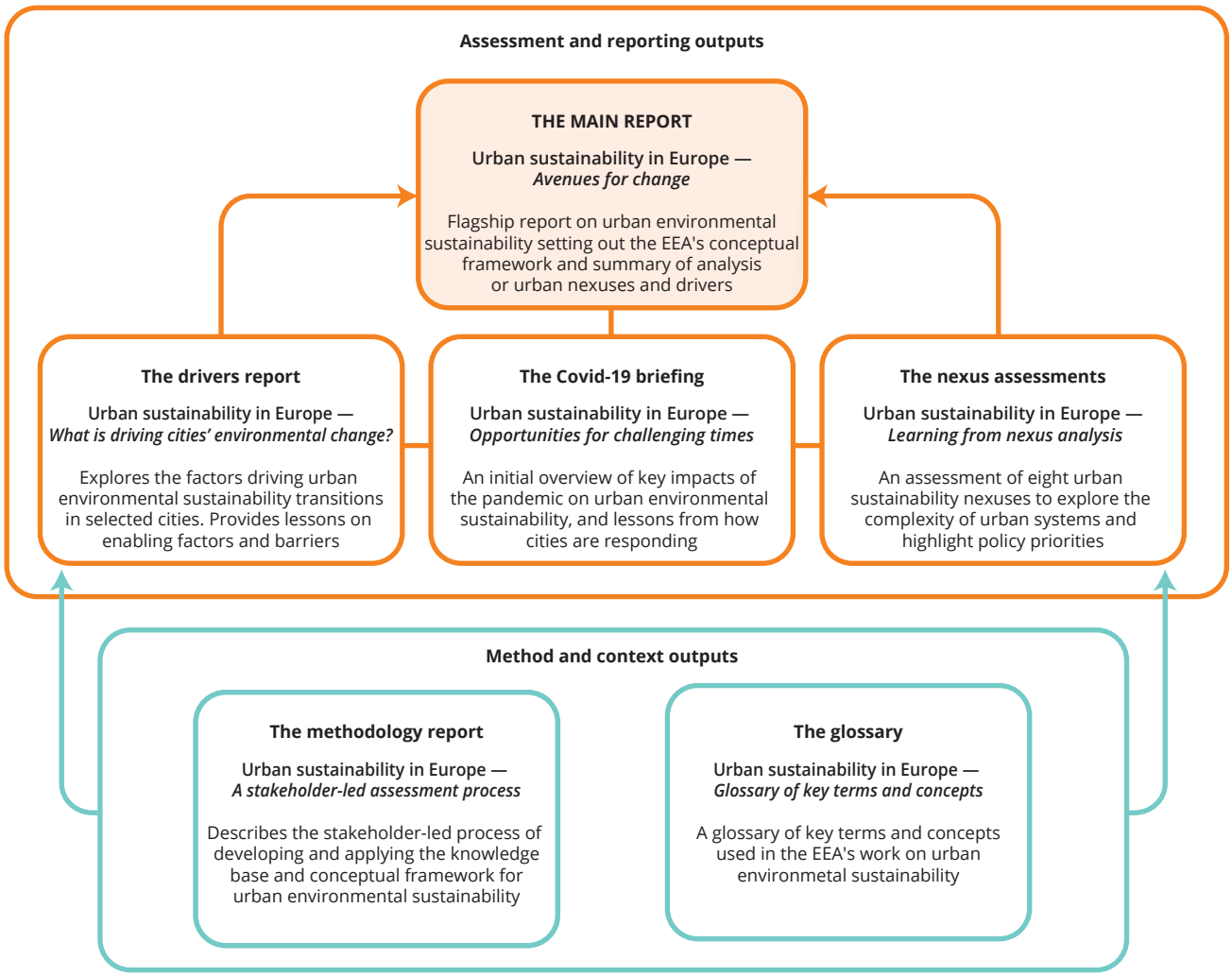
Executive summary

The urban dimension to Europe's sustainability challenge

This report is the EEA's flagship report on urban environmental sustainability. It sets out the EEA's conceptual framework for urban environmental sustainability and brings together recent analysis of urban nexuses and research to understand drivers of and barriers to urban environmental sustainability transitions. Figure ES.1 presents how this report relates to the EEA's work in this area.

The *European environment — state and outlook 2020* report emphasises that cities have a key role 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, 2019a). Cities concentrate people, jobs and economic activity. However, this also means that they are disproportionately affected by social challenges such as segregation, poverty and inequality (EC, 2016a).

Figure ES.1 **The EEA's reports and outputs on urban environmental sustainability transitions being published in 2020 and 2021**



Vulnerabilities from climate change and other environmental stresses will also be felt most acutely in urban areas because of the higher densities of people and infrastructure and because of cities' dependence on their hinterlands for food, water, energy and other resources (EEA, 2019a). The EEA's in-depth analysis of drivers of change of relevance for Europe's environment and sustainability (EEA, 2020a) emphasised that cities have a primary role in pushing forward societal change by promoting 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 them. Sharing concrete examples of the many different expressions of urban sustainability can help to inspire city governments, irrespective of their context, to recognise that there is a transition pathway that is right for them.

Urban environmental sustainability: a framework

Although there is no single agreed definition of urban sustainability, or what a sustainable city might look like, there is broad agreement on what contributes to urban sustainability. This includes the need to address economic, social and environmental issues in an integrated way and to ensure that cities are inclusive, safe, resilient and sustainable. For the EEA, urban environmental sustainability means encouraging revitalisation and transitions of urban areas and cities to improve liveability, promote innovation and reduce environmental impacts while maximising economic and social co-benefits.

Urban systems are inherently complex, as is the concept of urban environmental sustainability. To help understand the range of factors that will influence the transition towards urban environmental sustainability, a conceptual framework for urban environmental sustainability has been developed. The framework is designed to help support assessment and analysis.

The conceptual framework is based on four main components (see Figure ES.2). These are:

- **Lenses** — a range of perspectives on urban environmental sustainability that represent priority issues or 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 that create and shape the setting in which a specific city exists, develops and functions. Each city's context has a considerable influence on the transition to urban environmental sustainability.
- **Enabling factors** — relatively high-level forces that, based on their level of availability, 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 the inputs required to transition towards urban environmental sustainability.

The conceptual framework is intended to be applied in different ways to support the analysis of cities from the perspective of environmental sustainability. It has been used to develop and inform the analysis of urban nexuses and research into drivers of and barriers to sustainability in cities that are summarised in this report.

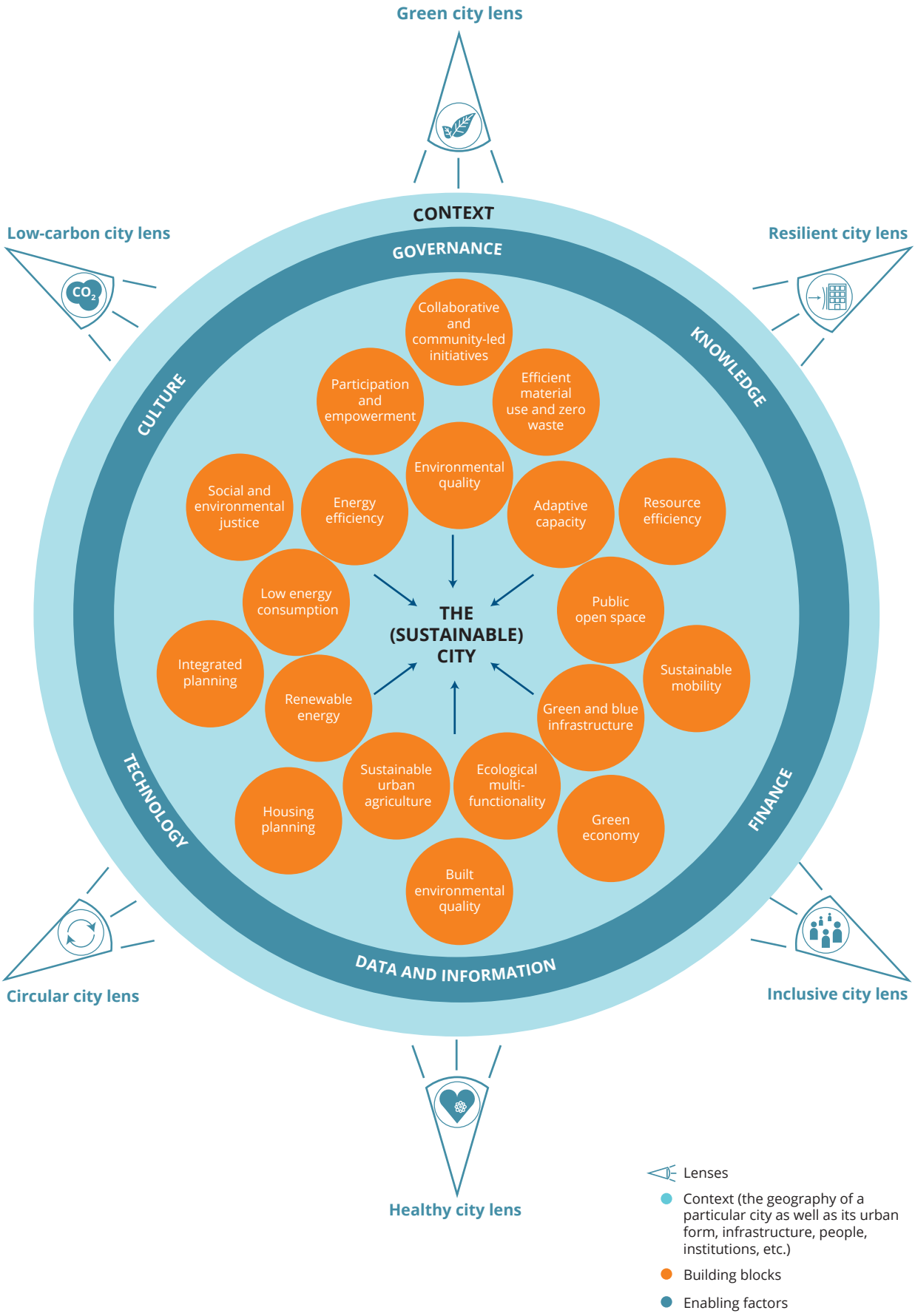
The urban nexus approach: towards integrated, cost-effective actions

To address systemic environmental challenges and accommodate a greater number of people in the coming decades while improving the quality of life of their residents, European cities must urgently shift towards a more integrated approach to policy and action. There is a need for cross-cutting strategies to address key systems (e.g. energy, mobility) and support the transformation to a low-carbon and circular economy. Nexus analysis provides a way of helping to understand complex systems and identify better coordinated polices and actions to support urban environmental sustainability.

Drawing on the conceptual framework, literature review and stakeholder input, eight example nexuses were selected for assessment:

- Climate resilience nexus
- Quality of life nexus
- Urban accessibility nexus
- Environment and health nexus
- Food security nexus
- Closing the loop nexus
- Clean energy nexus
- Sustainable buildings nexus.

Figure ES.2 **Conceptual framework for urban environmental sustainability**



Source: EEA.

The urban nexus approach can help to identify opportunities to coordinate policymaking and action. Policymaking and action are often developed in silos, addressing specific sectors or issues, with sometimes competing objectives. The urban nexus approach, through which two or more urban policy areas are considered together, can help identify synergies, co-benefits and trade-offs. In this way opportunities can be prioritised to achieve better coordinated and cost-effective policymaking and action.

To achieve sustainability transitions, policy needs to be integrated vertically as well as horizontally. Cities often have a degree of autonomy in their governance and so they can, to some extent, influence change independently. However, cities also have interrelationships and interdependencies at different scales, including at the EU and national scales, as well as with neighbourhoods and communities. The nexus approach focuses on the horizontal integration of policy within a city; however, it is also important to consider vertical integration of policy between a city and other scales.

The priority urban nexuses analysed illustrate how interconnected and complex urban systems are. They operate at different levels and interact in many ways. For example, meeting the nexus objective of urban climate resilience relates to other nexus objectives, in particular quality of life, urban accessibility, environment and health, and food security. However, assessing the nexuses individually helps break down the challenges into more manageable issues while also still considering their interconnectedness.

Looking across the lessons emerging from the nexus analysis some overall policy and governance implications are identified;

- Cities are complex systems, and a wide range of different types of actions are seen across the nexuses and can be linked to high-level policy agendas (e.g. at the EU scale). However, the nexus analysis shows that in practice **a relatively small number of policy agendas can be identified that may be key to achieving urban environmental sustainability**. A total of 18 policy agendas were identified, for example building adaptive capacity and reducing vulnerability to climate change; improving the quality of and access to public open space, and creating or improving green infrastructure and urban ecology; using digital technology; and promoting participation and empowerment of stakeholders and citizens.

- **The COVID-19 pandemic is likely to remain intertwined with policymaking and actions across sectors and affect the transition to urban environmental sustainability** in the immediate future and longer term. Although the overall implications of COVID-19 on progress towards the nexus objectives is unclear, many of the actions envisaged will be influenced by the response to and need to recover from the pandemic. Cities may have an opportunity to take advantage of the moment to implement a green recovery.

- **A lack of coordinated and integrated policy and action can result in trade-offs.** The analysis showed that nexuses interact through thematic and hierarchical links, as well as through specific actions and interventions. An action intended to help achieve one nexus objective can lead directly to trade-offs in the achievement of other nexus objectives.

- **Some actions provide opportunities to deliver co-benefits simultaneously across various urban sustainability objectives in a cost-effective way.** For example, developing and improving green infrastructure in cities can help to reduce flood risk and urban overheating (Climate resilience nexus), reduce air and noise pollution and encourage active travel (Environment and health nexus), and improve people's satisfaction with their surroundings (Quality of life nexus).

- **Cities are well-placed to be leaders in delivering the transition to a low-carbon sustainable economy and have a pivotal role in achieving related EU policy objectives.** For most of the policy areas across the nexuses, cities can design, resource and implement sector-specific policy and actions without necessarily requiring the reform of the policymaking process at national and/or EU scales. However, EU and national governments also have an important role in ensuring complementarity between policy at different scales and in helping cities to overcome challenges to achieving the nexus objectives.

- **Achieving urban sustainability will require new governance approaches.** Such approaches could include systematic identification of conflicts and barriers across policy sectors, horizontal and vertical integration and coordination of measures, empowerment of all residents and enabling them to have a greater say in urban decision-making.

- **Citizens and communities are fundamental to help move cities towards reaching their urban sustainability objectives.** People are a fundamental part of the various systems (food, energy, transport, etc.); thus to be truly effective, equitable action and collaboration must be central to any policy responses.

- **The nexus analysis could make use of composite indicators.** The nexus analysis shows that there is a limited number of such indicators available that could support nexus assessment. This contrasts with the abundance of quantitative contextual indicators focusing on a single topic.

- **The nexus analysis is a useful approach to improve urban policy integration.** Applying this approach encourages communication and coordination and can help decision-makers to identify key actions to meet the selected urban sustainability objectives. Potential blind spots in decision-making processes can also be uncovered by highlighting potential trade-offs.

- **The EEA conceptual framework for urban environmental sustainability is useful for decision-makers** in identifying key actions in the context of meeting the selected urban sustainability objectives. The lenses and building blocks that are embedded in the framework can help to identify the focus of analysis and provide a set of relevant actions to contribute to urban environmental sustainability.

Pioneering cities: learning from their experience

A meta-analysis was undertaken aiming to improve the understanding of the drivers of change that can either enable or hinder urban environmental sustainability transitions in European cities. Given the EEA's remit and interests, the focus of this research was on urban environmental sustainability transitions.

The analysis was based on a mixed methods approach that combined a literature review, a survey of European cities (with 26 responding) and semi-structured interviews with seven case study cities that helped to deepen and contextualise the survey results. The survey focused on 'frontrunner' cities that have either won or been selected as finalists in the European Green Capital Awards or the European Green Leaf Awards. The survey was structured around a series of potential drivers and barriers — actions that are 'supporting or inhibiting' transitions to urban environmental sustainability.

A number of lessons emerge from the research:

- **Cities are heterogeneous** and transition pathways need to be tailored to local contexts. Drivers and barriers can differ greatly between cities, and their diverse needs and capacities need to be taken into account and supported by EU, national and regional governance and policy.

- Some **contextual factors** are fixed and hard to change (such as climate or geography), but others are dynamic and evolving (such as infrastructure and demographics). Understanding their natures and interrelationships within an urban context can help prioritise policy and action.

- 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.

- **EU laws and policy frameworks** have a key role to play in accelerating sustainability changes in cities. City governments are strongly incentivised, supported and even inspired by EU laws, standards, regulations and funding opportunities.

- **National and supranational governments** can facilitate, as well as inhibit, systemic change towards urban sustainability transitions in cities. 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.

- **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.

- 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, as well as engage the private sector and communities.

- Updated and accessible **data and information** are needed to monitor progress. This leads to better environmental management and makes it easier to demonstrate how a city is advancing towards specific goals.

- Accessing **EU, national and private funding** plays a critical role in supporting cities' sustainability transitions. Governments can accelerate systemic change by reorienting financial flows towards sustainable investments and by developing relevant knowledge systems and skills to support them.

Future research opportunities

A number of research needs and opportunities are identified, including applying the nexus approach at different levels, such as within cities, and at national and European levels; expanding research on and analysis of drivers of urban sustainability to include more cities and explore specific topics in more detail; using cities to test and experiment with solutions to complex transition challenges, for example through EU and national research agendas; and developing new measures of progress towards urban sustainability, including composite indicators and measures combining quantitative and qualitative evidence.

Another key opportunity is to localise the EEA-Eionet strategy 2021-2030 (EEA, 2021) through activities focused on urban sustainability and in collaboration with urban stakeholders. This could valuably include co-creation with cities and their networks; integration with different levels of decision-making; ensuring that research findings are available in time to inform policymaking; innovation by connecting with citizen and industry data; equality and a focus on understanding winners and losers; and equipping cities with the capacity and skills they need to develop and work with data and evidence.

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1 Introduction: from EU sustainability challenges to cities as actors

Key Messages

- **The EU sustainability perspective — overarching challenges and outlooks —** *The European environment — state and outlook 2020* highlights the scale and urgency of the challenges that Europe faces and the need for coordinated action, including the crucial role of cities in transitions. The United Nations affirms the role of cities with its new urban agenda (Habitat III) and through Sustainable Development Goal 11. Major strategic EU policy stems from the European Green Deal and the Eighth Environment Action Programme — covering the period 2021-2030 — contemplates EU action on the urban environment and needs to be articulated with the EU Urban Agenda.

- **The rise of the urban dimension —** the past century and a half has seen a succession of competing or overlapping urban paradigms. Most recently, the EU is pursuing the European Green Deal roadmap and launched the 'New European Bauhaus' in January 2021. The European Urban Initiative is an instrument to provide coherent support for cities, a highly fragmented governance landscape while stakeholders rich. The responses to the COVID-19 pandemic will have widespread impacts on people and economies across Europe, and the city level will be key to a successful recovery.

- **The importance of focusing on cities —** cities are at the centre of key environmental challenges, and there is an urgent need for European cities to shift towards a more integrated approach to addressing persistent, systemic environmental challenges, including developing resilience to a changing climate and improving the quality of life of city residents.

- **Cities and the COVID-19 pandemic —** cities across Europe have been at the forefront of the impacts of and actions in response to the COVID-19 pandemic, and the response will be deeply intertwined with efforts to transition towards environmental sustainability for years to come.

- **The EEA's interest in the urban environment in Europe —** the role of cities in delivering on EU policymaking has been increasingly recognised and this, along with the environmental challenges cities face, has led the EEA to work on understanding and assessing transitions to urban environmental sustainability drawing on a broad range of stakeholders.

- **The available knowledge base relevant to urban environmental sustainability —** from a review of various sources, it is evident that there is an abundance of data on certain urban-related topics, while on others the data are more limited. The research highlights some of the challenges that relate to the information that is likely to be available for assessing urban sustainability.

1.1 The EU sustainability perspective: overarching challenges and outlooks

The European environment — state and outlook 2020 report (SOER 2020) (EEA, 2019a) stated that Europe faces environmental challenges of unprecedented scale and urgency. This 5-yearly state of the environment report is positive in that EU environment and climate policies have delivered substantial benefits over recent decades. Still, it highlights that Europe faces persistent problems in areas such as biodiversity loss, resource use, climate change impacts and environmental risks to health and well-being.

Global megatrends — global, long-term trends that are likely to affect the future of the world over the next 10-15 years — such as a growing, urbanising and migrating global population, are driving change and intensifying many environmental challenges and bringing new risks and uncertainties. Diversifying values, lifestyles and governance approaches, worldwide climate change and environmental degradation, increasing scarcity of and global competition for resources, and power shifts in the global economy and the geopolitical landscape, coupled with accelerating technological change and convergence, add to the EEA's selected megatrends ([1]) that are driving change and already having measurable impacts (Figure 1.1).

Some European trends, specific to the continent, are in contrast to global trends, as is the case of the almost stagnating trend in the European urban population, while the evolution of production and consumption patterns will lead to emerging trends that may evolve into bigger continental or global trends.

Although the EU has committed to a range of long-term sustainability goals with the overall aim of 'living well, within the limits of our planet' (Seventh Environment Action Programme to 2020 ([2])), the SOER 2020 states that achieving these goals will not be possible without a rapid and fundamental shift in the character and ambition of Europe's responses. It also states that the coming decade will be decisive in shaping the 21st century.

Europe needs to rethink not only technological approaches and production processes but also consumption patterns and ways of living. Environment and climate pressures and health impacts require immediate and concerted action, engaging a diversity of policy areas and a broad spectrum of actors across governance scales.

All the environmental and sustainability challenges that Europe faces today are rooted in interconnected global developments stretching back over decades. During this period, a 'Great Acceleration' of social and economic activity has transformed humanity's relationship with the environment (see Figure 1.2). This period is associated with increasing prosperity, poverty alleviation and major positive trends in health indicators in many parts of the world, including Europe. Yet these positive trends were paralleled with consistent damage to ecosystems and erosion of biodiversity. The impact of COVID-19 on these trends is yet to be assessed.

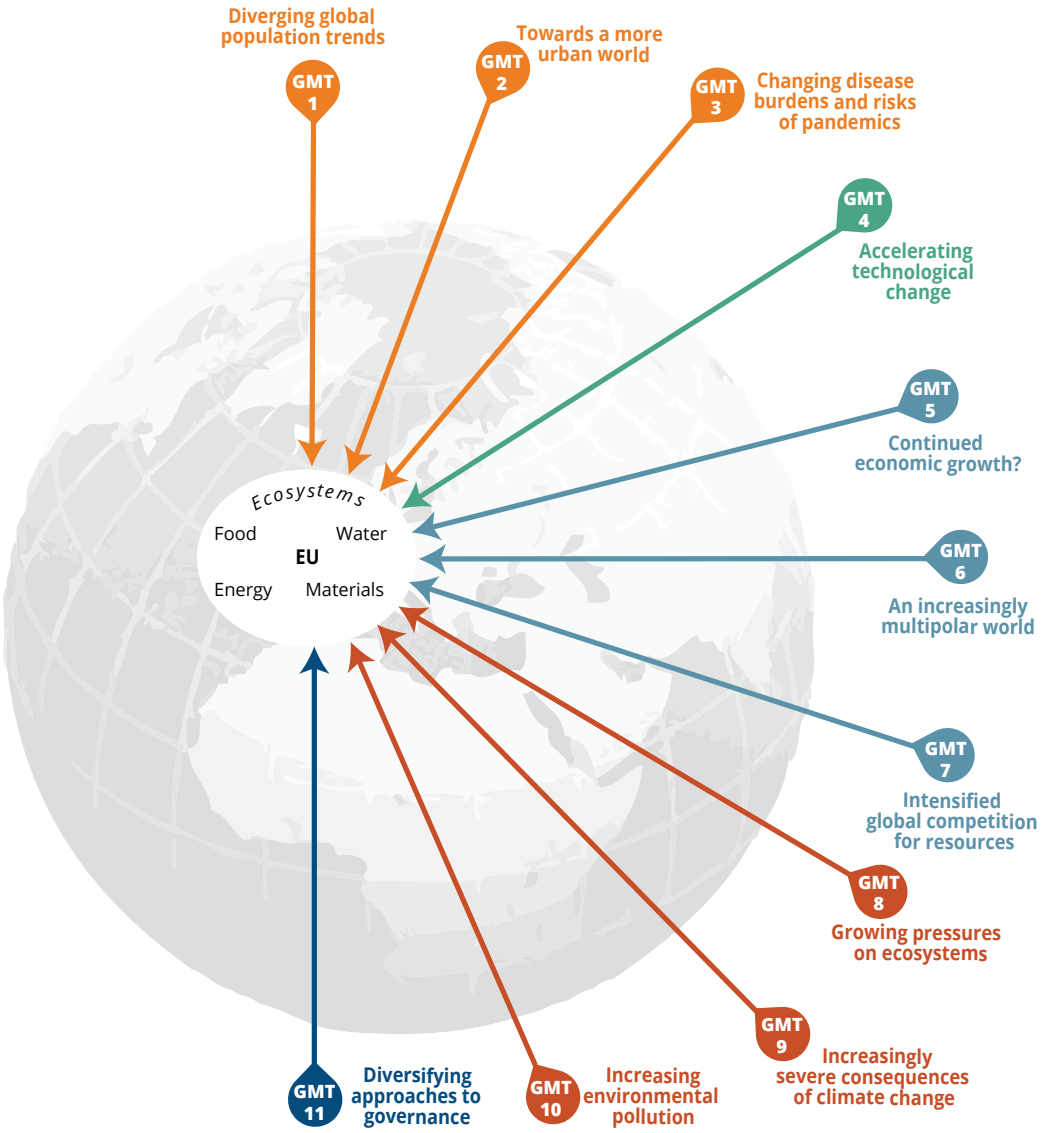
As a pioneer of industrialisation and urbanisation, Europe played a pivotal role in shaping global changes. To meet its high consumption levels, Europe depends on resources extracted or used in other parts of the world, such as water, land, biomass and other materials.

These realities pose a profound challenge for Europe, as the current trajectories of social and economic development are destroying the ecosystems that ultimately sustain life and humanity. Shifting onto truly sustainable pathways will require rapid and large-scale transitions implying reductions in environmental pressures, much beyond what has been achieved so far.

Considering Europe's long-term vision ([3]) and corresponding policy targets, it is clear that Europe is not making enough progress in addressing environmental challenges. The messages from the SOER 2020 assessment of recent trends and outlooks is clear ([4]): policies have been more effective in reducing environmental pressures than in protecting biodiversity and ecosystems or human health and well-being. Despite the successes of European environmental governance, persistent problems remain, and the outlook for Europe's environment in the coming decades is disheartening (Figure 1.3).

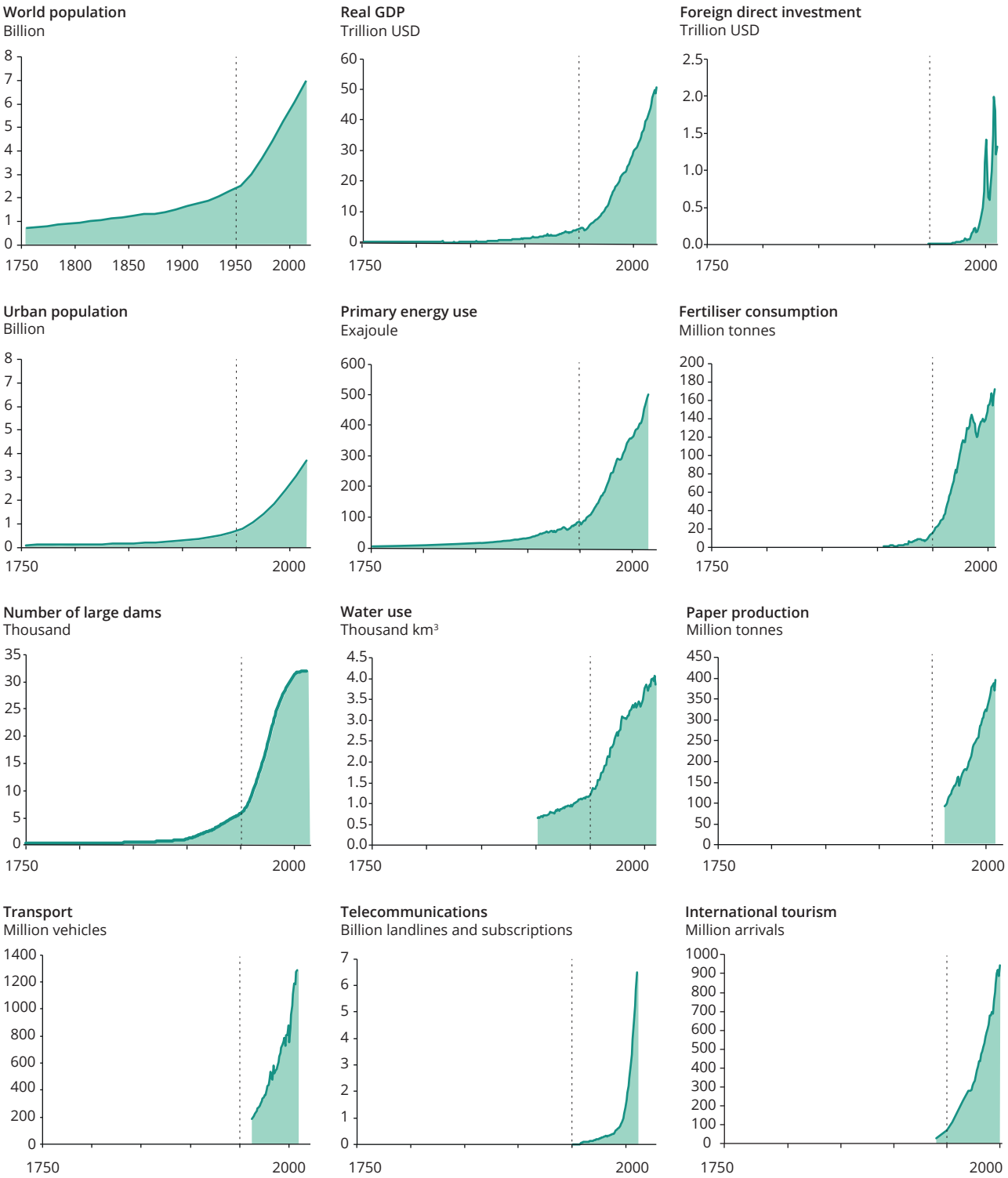
([1]) https://www.eea.europa.eu/themes/sustainability-transitions/drivers-of-change
([2]) https://ec.europa.eu/environment/action-programme
([3]) https://ec.europa.eu/environment/action-programme
([4]) https://www.eea.europa.eu/soer/2020

Figure 1.1 **Impacts of global megatrends on European resource systems**



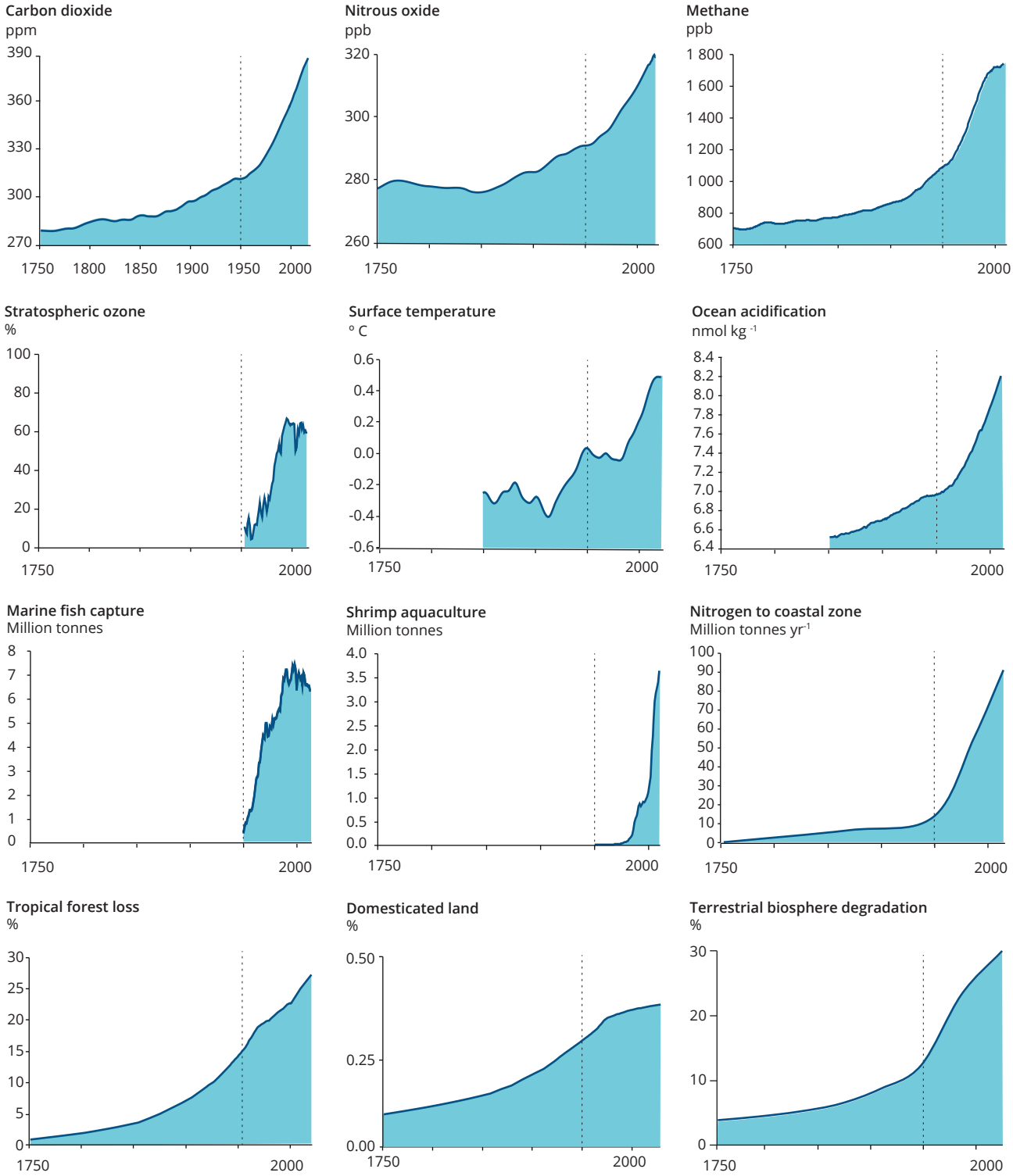
Source: EEA.

Figure 1.2 **Indicators of global socio-economic development and the structure and functioning of the Earth system**



Source: SOER 2020 (EEA, 2019a, pp. 36-37).

Figure 1.2 **Indicators of global socio-economic development and the structure and functioning of the Earth system (cont.)**



Source: SOER 2020 (EEA, 2019a, pp. 36-37).

Figure 1.3 **Summary of past trends in, outlooks for and prospects of meeting policy objectives/targets**

Theme	Past trends and outlook		Prospects of meeting policy objectives/targets		
	Past trends (10-15 years)	Outlook to 2030	2020	2030	2050
Protecting, conserving and enhancing natural capital					
Terrestrial protected areas			☑		
Marine protected areas			☑		
EU protected species and habitats			☒		
Common species (birds and butterflies)			☒		
Ecosystem condition and services			☒		
Water ecosystems and wetlands			☒		
Hydromorphological pressures			☒		
State of marine ecosystems and biodiversity			☒		
Pressures and impacts on marine ecosystems			☒		
Urbanisation and land use by agriculture and forestry					☒
Soil condition			☒		
Air pollution and impacts on ecosystems			☐	☐	
Chemical pollution and impacts on ecosystems			☒		
Climate change and impacts on ecosystems			☒		
Resource-efficient, circular and low-carbon economy					
Material resource efficiency			☑		
Circular use of materials				☐	
Waste generation			☐		
Waste management			☐		
Greenhouse gas emissions and mitigation efforts			☑	☒	☒
Energy efficiency			☐	☒	☒
Renewable energy sources			☑	☒	☒
Emissions of air pollutants			☑	☐	
Pollutant emissions from industry			☐		
Clean industrial technologies and processes			☐		
Emissions of chemicals			☒		
Water abstraction and its pressures on surface and groundwater			☒		
Sustainable use of the seas			☐		
Safeguarding from environmental risks to health and well-being					
Concentrations of air pollutants			☒	☑	
Air pollution impacts on human health and well-being				☑	
Population exposure to environmental noise and impacts on human health			☒		
Preservation of quiet areas			☒		
Pollution pressures on water and links to human health			☒		
Chemical pollution and risks to human health and well-being			☒		
Climate change risks to society			☐		
Climate change adaptation strategies and plans			☐		

Indicative assessment of past trends (10-15 years) and outlook to 2030		Indicative assessment of prospects of meeting selected policy objectives/targets	
Improving trends/developments dominate	Year	☑	Largely on track
Trends/developments show a mixed picture	Year	☐	Partially on track
Deteriorating trends/developments dominate	Year	☒	Largely not on track

Notes: The year for the objectives/targets does not indicate the exact target year but the time frame of the objectives/targets.

Source: SOER 2020 (EEA, 2019a, p. 12).

The most important factor underlying Europe's persistent environmental and sustainability challenges is that they are inextricably linked to economic activities and lifestyles, in particular those that provide Europeans with necessities such as shelter, food, energy and mobility.

Achieving the goals of the United Nations (UN) 2030 agenda for sustainable development and the Paris Agreement will require urgent action in each of these areas during the next 10 years. Sustainability needs to become the guiding principle for ambitious and coherent policies and actions across society. For this to happen, sustainability principles have to be culturally, politically and institutionally ingrained at all scales of governance.

Society is currently experiencing limits to its growth because it is locked into defining growth in terms of economic activities and material consumption. As emphasised by Commission Vice-President Frans Timmermans (EUdebates Team, 2021), however, the need for transformative change, amplified and accentuated by the COVID-19 pandemic, calls for a profound rethinking of our activities in the light of sustainability.

Acting to collectively change these realities is a major challenge for Europe and other world regions. SOER 2020 points to key enablers of change: cities, finance and knowledge. Of these three cross-cutting enablers that stand out as having particular importance in bringing about change, cities are mentioned as crucial for transitions.

As almost 75 % of the EU's population lives in cities, supporting the potential of cities and city networks is an imperative. Much of the production-consumption dynamic in Europe occurs in urban areas. The UN affirms the role of cities with its new urban agenda (Habitat III) ([5]) and through Sustainable Development Goal (SDG) 11 ([6]) — 'Make cities inclusive, safe, resilient and sustainable'. In Europe, the EU's 2016 Pact of Amsterdam (EC, 2016a) established the EU urban agenda.

Cities and towns are also the administrative level closest to people, providing good settings for the engagement and participation of citizens, businesses and local governance in social innovation, cocreation, experimentation and learning. They have the capacity to implement systemic change at local scales and to share ideas through city networks. Since the Aalborg Charter of 1994 ([7]), inspired by the Rio Earth Summit's local agenda 21, cities have collaborated voluntarily, paving the way to the myriad of cities' networks, schemes and movements of today.

SOER 2020 recognises the role of networks of cities and mentions some of the most prominent: the C40 ([8]) Climate Leadership Group, a network of global megacities and global actors on climate change; the International Council for Local Environmental Initiatives (ICLEI) ([9]), also known as Local Governments for Sustainability, which is increasingly engaged with systemic local sustainability transformations; and the global Covenant of Mayors for Climate & Energy ([10]), which facilitates monitoring and sharing of best practices among more than 7 000 cities worldwide (albeit primarily European) that commit to reducing carbon dioxide (CO_2) emissions by at least 40 % by 2030. Others such as EuroCities ([11]) or the Council of European Municipalities and Regions (CEMR) ([12]) have played a distinct role in Europe by providing a platform for 190 major cities in 39 European countries or by being the oldest association of local and regional governments in Europe since 1951, respectively.

EU cities and towns vary in their intrinsic capacities and have for decades required competent skill sets and resources to pursue transformational approaches. European and national authorities already have a long tradition of supporting urban experimentation and fostering change through the Urbact ([13]) programme since 1989, aiming to achieve sustainable urban development through capacity building, policy design and implementation and knowledge building. Urbact is an instrument of the cohesion policy, is co-financed by the European Regional Development Fund and includes EU Members States, Norway and Switzerland.

In late 2019, the current European Commission (2019-2024) presented the European Green Deal (EGD) (EC, 2019a), a political commitment setting out the main directions of future Commission action (Figure 1.4). For the first time the Commission put sustainability, environment and climate at the forefront of all European policies as a means of economic and social transition.

Understanding the EGD is important. Some call it visionary, others revolutionary, as it proposes measures to run a modern economy on net-zero greenhouse gas emissions by 2050. But it is at the same time very familiar, as it will be put into practice through a very long list of recognisable goals from existing and well-settled EU policies.

([5]) https://habitat3.org/the-new-urban-agenda
([6]) https://sdgs.un.org/goals/goal11
([7]) https://sustainablecities.eu/the-aalborg-charter
([8]) https://www.c40.org
([9]) https://iclei.org
([10]) https://www.covenantofmayors.eu/en
([11]) https://eurocities.eu
([12]) https://www.ccre.org
([13]) https://urbact.eu/urbact-glance

Box 1.1 Key areas for bold action from the 2020 state of the environment report

- Enable transformative change across Europe — by harnessing the ambition, creativity and power of citizens, businesses and communities to shift towards sustainable production and consumption patterns and lifestyles that are socially fair.
- Embrace the Sustainable Development Goals as an overarching framework for policymaking and implementation, at all scales, and complement them with additional measures if the goals could be more ambitious, for example on air pollution and impacts on health.
- Realise the unfulfilled potential of existing environmental policies — by achieving full implementation across Europe through increased funding, capacity building, stakeholder engagement and better coordination of local, regional and national authorities.
- Develop systemic policy frameworks with binding targets — to mobilise and guide actions across society (starting with the food system and an integrated framework for environment and health). Engage stakeholders and use resource nexus and ecosystem-based management approaches.
- Reorient public budgets, private investments and financial markets towards promoting sustainability transitions — by making full use of public resources to invest in innovations and nature-based solutions, procure sustainably and support sectors and regions negatively affected by the transition.
- Develop knowledge and skills fit for the 21st century — by focusing on understanding the key systems driving sustainability challenges and opportunities for change. Build capacity to navigate a rapidly changing world by investing in education, life-long learning and research and development programmes focused on sustainability, and harness the sustainability potential of new digital technologies.

Figure 1.4 The elements of the European Green Deal

Source: The European Green Deal (EC, 2019a).

The EGD is also framed as an industrial strategy, whose aim 'will be to stimulate the development of lead markets for climate neutral and circular products, in the EU and beyond', based on green jobs.

The EGD is also a holistic approach to climate action that is so often absent from technology-driven decarbonisation strategies. In most adopted approaches a combination of low-carbon energy sources and reducing emissions is advocated. The EGD couples this with encouragement to adopt 'nature-based solutions' and to reduce resource consumption and waste. It proposes to reconceptualise how the future economy might look. Such framing and ambition is probably what sets the EGD apart in terms of policymaking, and its success (or not) will affect Europe and the rest of the world in the future.

The EGD presents a roadmap of actions to be rolled out in 2020/21 containing a number of specific strategies and laws that will implement it based on pre-existing policies and the best available knowledge (Figure 1.5). Through the EGD, the EU reaffirms its commitments to the 2030 agenda for sustainable development. In fact, the SDGs are an intrinsic part of Ursula von der Leyen's political agenda both internally and externally and across all sectors.

The COVID-19 wild card — a wild card ([14]) being a development that may seem unlikely at present but could occur in the future and, if it does, is likely to bring about disruptive changes — that hit the world early in 2020 has exposed the fragility of a hyper-connected world. The knock-on effects are real, the damage to economies and societies being considerable. The stock markets were affected, a low-demand oil market emerged, large sectors — aviation, tourism destinations, conference centres and major events — suffered, schools closed, and many businesses started operating from home. A global recession is inevitable.

In the face of the health crisis and ensuing economic and social emergency (when most countries re-opened after an initial period of lockdown), in mid-2020 the Commission presented a new recovery instrument — NextGenerationEU ([15]) — embedded in a long-term EU budget, agreed at the end of 2020. This temporary instrument, based on a recovery and resilience facility, will constitute the largest and most ambitious stimulus package ever financed through the EU budget.

The EGD played an important role in allocating priorities and financing major policies. These include the fight against climate change, halting and reversing the decline in biodiversity, research and innovation and digital transformation. It also contemplates the modernising of the 'big two' traditional policies — cohesion and agriculture policies.

To benefit from the recovery and resilience facility's support, Member States were to prepare by April 2021 national recovery and resilience plans indicating the investments to be financed.

Figure 1.5 European Green Deal roadmap

Source: EC (2021a).

([14]) https://www.eea.europa.eu/themes/sustainability-transitions/drivers-of-change
([15]) https://ec.europa.eu/info/strategy/recovery-plan-europe_en#nextgenerationeu

The European Commission encouraged Member States to involve local and regional authorities in their preparation. The European Committee of the Regions (CoR) and the CEMR ([16]), bringing together thousands of European local and regional authorities, considers this involvement extremely important, but a jointly conducted and targeted consultation of national associations of local and regional governments and authorities shows that this was not the case.

The CoR — supported by the European city umbrella organisations — advocates strongly for the 'Green Deal Going Local' ([17]), placing cities and regions at the core of the EGD and ensuring that direct funding for cities and regions contributes to territorial cohesion, the EU's sustainable growth strategy and the COVID-19 recovery.

In October 2020 a major strategic policy stemming from the European Green Deal roadmap was presented by the Commission — the Eighth Environment Action Programme (8th EAP) ([18]) — covering the period 2021-2030. The proposal 'will complement the European Green Deal and will include a new monitoring mechanism to ensure that Europe remains on track to meet its environmental objectives', while it reiterates the commitment expressed in the 7th EAP's 2050 vision: ensure well-being for all while staying within the planetary boundaries.

The 8th EAP proposal calls for active engagement of all stakeholders at all levels of governance. It is expected to be adopted in 2021. The 8th EAP contemplates EU action on the urban environment through the European Green Capital Awards (EGCA) ([19]) and Green Leaf Awards (EGLA) and the Green City Accord ([20]).

1.2 The rise of the urban dimension

The past century and a half has seen a succession of competing or overlapping urban paradigms — from the garden city of Ebenezer Howard to the views of Le Corbusier and the Athens Charter and on to Christaller's theory of central places and polycentricity and Ian McHarg's precursor work on ecological design. All of these concepts revolved around shifting design models or geographical theories. All these and other models were important in making the cities of today's Europe.

Local agenda 21, adopted in 1992 at the UN Rio Conference, brought to the fore two other important elements of urban development: community participation and the formation of partnerships among local governments to pursue sustainable development, integrating environmental, social and economic concerns.

Cities and the urban dimension entered European policy agendas (still informally and voluntarily) with the Aalborg Charter (1994) ([21]), a follow up to the global local agenda 21 movement. This charter triggered the Sustainable Cities Campaign, a precursor of informal and voluntary city networks. The 5th EAP — Towards sustainability (1993) ([22]) — addressed the urban environment theme for the first time within an EU environment policy context.

The 6th EAP, adopted on 22 July 2002 as the framework for EU environmental policymaking for the period 2002-2012, identifies four priority areas of concern: climate change, nature and biodiversity, environment and health, and natural resources and waste. The 6th EAP intended to achieve full integration of environmental protection requirements in all Community policies while building bridges between environmental objectives and European objectives for growth, competitiveness and employment.

The 6th EAP calls for the development of seven thematic strategies as a framework for action in the fields of soil and the marine environment (in the priority area of biodiversity), air, pesticides and the urban environment (in the priority area of environment, health and quality of life) and natural resources and waste recycling (in the priority area of natural resources and waste). The 6th EAP is of strategic relevance, as it defined some integrated and cross-cutting approaches to meeting environmental goals and set objectives and priority actions on international issues. The strategic approaches include the development of Community legislation and its effective implementation and enforcement; the integration of environmental protection requirements in other Community policies; and the promotion of sustainable production and consumption patterns, improving collaboration with enterprises. Over a 10-year timeframe, rapid developments in climate change quickly overtook the 6th EAP's objectives (Homeyer, 2011a).

Nonetheless, a multitude of urban initiatives and programmes under various EU directorates and presidencies emerged during the period of the 6th EAP, to name a few: the thematic strategy on the urban environment (EC, 2006); the urban dimension in the cohesion policy (Atkinson, 2014); the EU territorial agenda (EC, 2007a); and the Leipzig Charter (EC, 2007b). They run in parallel, are rarely coordinated, and seldom build on one another. Despite the existence of integration initiatives such as the Commission communication 'Sustainable urban development in the European Union: a framework for action' (EC, 1998), the situation, apart from a greater general awareness, has hardly changed for more than a decade.

([16]) https://cor.europa.eu/en/news/Pages/post-COVID-recovery-plans-.aspx
([17]) https://cor.europa.eu/en/engage/Pages/green-deal.aspx
([18]) https://ec.europa.eu/environment/strategy/environment-action-programme-2030_en#ecl-inpage-249
([19]) https://ec.europa.eu/environment/europeangreencapital
([20]) https://ec.europa.eu/environment/topics/urban-environment/green-city-accord_en
([21]) https://sustainablecities.eu/the-aalborg-charter
([22]) https://ec.europa.eu/environment/archives/action-programme/env-act5/pdf/5eap.pdf

Decisions taken in many other non-urban and non-environmental EU policy areas also have major impacts on the situation in cities and towns and may even be contradictory; the same goes for the national and regional levels. For example, the development of the Trans-European Transport Network (TEN-T) and the promotion of rural development through the common agricultural policy could — if they do not carefully consider possible negative side effects — result in urban sprawl at the local level (see EEA, 2009, pp. 24-25; EEA, 2010). Despite the need for integration, cities have to fight hard to participate in European policymaking. For example, local actors had to initiate the Local Government Climate roadmap in the run up to the 2009 UN Climate Change Conference (COP 15) to draw attention to the role cities can play in mitigating climate change (EEA, 2019a).

The 7th EAP — a general EU environment action programme to 2020 —explicitly addresses urban aspects and their relevance. Horizontal objective 8 on sustainable cities is 'Working together for common solutions'. It addresses the following specific aspects: help cities become more sustainable; promote and expand initiatives that support innovation and sharing best practice in cities; and ensure that, by 2020, most cities in the EU are implementing policies for sustainable urban planning and design, and are using the EU funding available for this purpose.

Evaluating the progress of the 7th EAP in the next steps towards an 8th EAP, the European Environmental Bureau (EEB, 2018) concluded that environmental policies need to involve more local and regional stakeholders in policymaking at the EU level as a means of implementing the science-policy-stakeholder interface. It also advises that the CoR and cities' associations, as well as non-governmental organisations (NGOs), should be consistently involved so that their challenges are heard and addressed in a more systemic manner. Some priority actions at city level were highlighted: mobility systems, promotion of green spaces, resource efficiency and the circular economy, and accessibility to funds for local authorities and citizens' associations.

The same EEB evaluation recalls the need to ensure that the achievement of the 2030 agenda for sustainable development and the SDGs are fully integrated into the EU's internal and external policies ensuring policy coherence for sustainable development. While the EGD addresses this aspect Eurostat ([23]) reports yearly on Europe's progress towards achieving the objectives of the 2030 agenda and its 17 SDGs, adopted by the UN General Assembly in September 2015. Using an indicator set comprising around 100 indicators — and short-term and long-term trends — the report is structured along the 17 SDGs, focusing on the aspects that are relevant from an EU perspective. This includes SDG 11 ([24]) and its 10 specific targets, including:

- by 2030, reduce the adverse per capita environmental impact of cities (air quality and waste);
- by 2030, provide universal access to safe, inclusive and accessible green and public spaces;
- support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning;
- by 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation of and adaptation to climate change, and resilience to disasters.

SDG 11 can also be considered as an integrator of all the other sustainable development goals by virtue of expressing a different scale of action rather than a specific thematic concern (Figure 1.6). It embeds the importance of local contexts in pursuing urban transitions within diverse thematic areas (Kabisch et al., 2019). This perspective was adopted by the Pact of Amsterdam (EC, 2016a) — agreed on 30 May 2016 — that sets the basis for an urban agenda for the EU with the objective of involving urban authorities in achieving better regulation, better funding and better knowledge.

The Pact of Amsterdam (EC, 2016a) arguably marked the start of 'a new role-redefining phase for cities: one in which cities are no longer only the object of EU policy-making, but now also become part of policy-making itself. Since then, cities got a "seat at the table' of EU governance".' (Potjer and Hajer, 2017). The EU urban agenda (2016-2020) organised 'partnerships' on various themes, in which cities, Member States, the European Commission and other stakeholders worked together to discuss how EU policy can contribute to urban sustainability and governance. The innovative framework that emerged from the Pact of Amsterdam used an open method of coordination (European Parliament, 2014) — an EU policymaking process, formally initiated by the Lisbon European Council in 2000 as a method of soft governance that aims to spread best practice and achieve convergence towards EU goals in specific policy areas while not resulting in EU legislation.

([23]) https://ec.europa.eu/eurostat/documents/3217494/11011074/KS-02-20-202-EN-N.pdf/334a8cfe-636a-bb8a-294a-73a052882f7f?t=1592994779000
([24]) https://sdgs.un.org/goals/goal11

Figure 1.6 **SDG 11 as the entry point to the SDGs, showing some of the connections between the SDGs**

Source: Kabisch et al. (2019).

The urban agenda aims to improve the accessibility, coordination and simplification of the existing funding possibilities. According to the Pact of Amsterdam, voluntary partnerships are the key delivery mechanism within the urban agenda for the EU. These integrated urban authorities (cities), the European Commission, EU organisations (European Investment Bank, European Economic and Social Committee, CoR), Member States, partner states, experts, umbrella organisations (e.g. EuroCities, CEMR), knowledge organisations (e.g. Urbact, ESPON — the European Spatial Planning Observation Network) and other stakeholders (NGOs, business, etc.).

The 12 priority themes defined in the Pact of Amsterdam correspond to partnerships that delivered action plans. The 12 initial partnerships — all dedicated to improving the knowledge base and the exchange of good practice — covered inclusion of migrants and refugees; urban poverty, air quality; housing; circular economy; digital transition; urban mobility and jobs and skills in the local economy; energy transition; climate adaptation; innovative and responsible public procurement; and sustainable use of land and nature-based solutions. Further to these 12 initial partnerships two others were proposed at the Directors-General Meeting on Urban Matters in November 2018: safety in public spaces; and culture and cultural heritage.

The Commission also reinforced its policy coordination on urban matters to ensure better coherence through a common framework for urban policy initiatives. This includes the European Innovation Partnership on Smart Cities and Communities ([25]), the Joint Programming Initiative Urban Europe ([26]); Horizon 2020 missions ([27]) — followed by Horizon Europe Innovation Cities ([28]); the Covenant of Mayors ([29]); and the Urban Innovative Actions ([30]).

([25]) https://ec.europa.eu/info/eu-regional-and-urban-development/topics/cities-and-urban-development/city-initiatives/smart-cities_en
([26]) https://www.era-learn.eu/network-information/networks/urban-europe
([27]) https://ec.europa.eu/info/horizon-europe/missions-horizon-europe_en
([28]) https://ec.europa.eu/info/research-and-innovation/research-area/environment/urban-development/innovating-cities_en
([29]) https://www.covenantofmayors.eu/en
([30]) https://uia-initiative.eu/en/about-us/what-urban-innovative-actions

To facilitate the exchange of experiences on funding urban projects, the Directorate-General for Regional and Urban Policy (DG REGIO) also established the Urban Development Network ([31]). At the same time existing sources also need to be better tailored to cities' needs and challenges by making use of other existing networks. To address this, the European Investment Bank created the Urban Investment and Advisory Platform (URBIS) ([32]), which provides financial and technical advisory services for cities. To improve access to data, the Commission (DG REGIO and the Joint Research Centre) established the Urban Data Platform ([33]), bringing together for the first time the data available at EU level on key urban challenges (e.g. housing, key pollutants or traffic) and providing key indicators, not only at city level but also for functional urban areas and metropolitan regions. This platform is a key element of the EU Knowledge Centre for Territorial Policies.

The European Urban Knowledge Network ([34]) report *Ten years after the Leipzig Charter* (EUKN, 2017) concludes that more than ever the urban dimension of EU policies is relevant in the light of European structural policy after 2020. The adoption, under the German Presidency of the Council of the European Union, of the 'New Leipzig Charter' ([35]) by EU ministers in November 2020 defines common principles for achieving the vision of green, just and productive cities in the EU. Its implementing document considers the urban agenda of the EU as the vehicle for the implementation of the charter.

The strong sustainable urban development dimension of cohesion policy has been strengthened for the period 2021-2027. Cohesion policy is at the heart of responding to urban sustainability challenges in the EU — in terms of both funding and fostering place-based, strategic, integrated, participatory and inclusive approach to addressing the sustainability challenges and transitions of cities. In the period 2014-2020, around EUR 115 billion was spent in cities, of which EUR 17 billion was managed locally by urban authorities through more than 950 integrated and sustainable urban development strategies. For the 2021-2027 period, the European Commission proposes a stronger urban and territorial dimension by introducing a new policy objective, 'Europe closer to citizens', supporting a place-based approach and engaging local authorities, civil society and citizens in delivering on local challenges. Furthermore, the Commission proposes the launch of a new European urban initiative ([36]) to support cities with capacity building, innovative solutions, knowledge, policy development and communication. The funds earmarked for sustainable urban development are also being increased to 8 % of the total European Regional Development Fund in each EU Member State.

A century ago, the Bauhaus (literally 'Building House') school brought together artists and architects who challenged orthodoxy and developed a modernist thinking about housing at the city and state levels while pursuing interesting avenues in environmental thinking, such as passive solar energy and ecological gardening. Pursuing the EGD roadmap, in January 2021 the European Commission in launched the 'New European Bauhaus' — the Bauhaus reference interpreted as a metaphor for innovative thinking and of design taking on everyday problems — linked to the earlier 'Renovation wave', which was born out of a need to renovate and construct more energy-efficient buildings. As building operations and construction together account for 39 % of global greenhouse gas emissions (WGBC, 2017), the proposal for energy retrofits is part of the climate change mitigation actions at the core of the EU's coronavirus recovery plan. The renovation wave will support the goal of making Europe the world's first climate-neutral continent by 2050.

The original Bauhaus was neither a movement nor a style but a school, a house of ideas and experimentation rather than a policy influencer. Research, technology, nature and the involvement of the right actors — the cities — will be paramount in the New European Bauhaus. To be fully successful, any renovation wave will need to take into account the local ecosystem, both social and natural.

The responses to the COVID-19 pandemic will have widespread impacts on people and economies across Europe. The impetus for rapidly re-establishing economic growth and stability will need to realise synergies and manage trade-offs between climate change mitigation and wider well-being. Although aligning policies over multiple different areas, such as biodiversity, climate change and resource use, will be challenging, involving all possible actors, including those at the city level, will be key to a successful recovery.

1.3 Why focus on cities?

1.3.1 The European context

Europe is a highly urbanised continent: it is estimated that the share of the EU population living in urban areas is currently 74 % and that this is predicted to rise to 80 % by 2050 (EEA, 2019a). Historically, the urban population in Europe has been growing over the last half-century. Much of this growth has been in towns and suburbs, especially in newly developed residential areas surrounding existing cities (Nabielek et al., 2016).

([31]) https://ec.europa.eu/regional_policy/en/policy/themes/urban-development/network
([32]) https://eiah.eib.org/about/initiative-urbis
([33]) https://urban.jrc.ec.europa.eu/#/en
([34]) https://www.eukn.eu
([35]) https://ec.europa.eu/regional_policy/en/newsroom/news/2020/12/12-08-2020-new-leipzig-charter-the-transformative-power-of-cities-for-the-common-good
([36]) https://ec.europa.eu/regional_policy/sources/docgener/brochure/explanatory_memo_eui_post_2020_en.pdf

However, since 2000 an increasing number of cities in European countries (e.g. Austria, Belgium, Denmark, Finland, Germany, Hungary, the Netherlands and Sweden) have had higher annual population growth in their urban cores than in their commuting zones (OECD, 2018; Salvati et al., 2019).

The urban landscape of Europe is characterised by a diversity of small, medium and large cities (Nabielek et al., 2016). There are just over 800 cities in the EU with more than 50 000 inhabitants (Heinelt, 2017). The majority of these, almost 700, are small and medium-sized cities (between 50 000 and 250 000 inhabitants) (Nabielek et al., 2016). At the other end of the scale, there are 26 cities in the EU with a population of more than one million. One in eight Europeans live in these largest cities (EC, 2012). Of these cities, only Paris and London can be considered megacities — high-density metropolises of more than 10 million inhabitants (EC and UN-Habitat, 2016).

Europe's varying urban structure is a product of many underlying factors, including the historical development of settlements, their location and geographical characteristics, their function, and various political, demographic and economic developments. However, while overall Europe is highly urbanised there is both a high degree of heterogeneity among its cities and also varying levels of urbanisation from country to country. Many urban regions have many towns and cities in close proximity — a polycentric structure — while others are characterised by a single large city, often the capital city, dominating its surroundings — a monocentric structure. There are also some examples of a more linear urban pattern, for example along the Mediterranean and Adriatic coasts (Nabielek et al., 2016).

In general, western and northern Europe are more urbanised than the rest of Europe. The most urbanised region of Europe is an area forming a pentagon with its apexes in London, Paris, Milan, Munich and Hamburg. In countries such as Belgium, Germany, the Netherlands and the United Kingdom, more than three quarters of the population lives in urban areas. In contrast, other countries, such as Poland, Romania, Slovakia and Slovenia, are less urbanised, with more than 40 % of the population living in rural areas (Nabielek et al., 2016).

The urban environmental challenge

Europeans have adopted an urban lifestyle partly to benefit from the amenities that cities provide, such as cultural, educational and health services, as well as the economic opportunities cities offer as the engines of Europe's economy. However, cities do not operate in isolation: they rely on the regions outside the city to meet their demand for resources, such as energy, water and food, and to dispose of and disperse waste and emissions (EEA, 2017a).

This context poses a significant challenge: how to accommodate even greater numbers of people in urban areas while reducing the impact on the environment and being resilient to a changing climate, and at the same time improving the quality of life of city residents. Meeting this challenge and achieving the objective of urban sustainability — i.e. efficient and smartly planned, designed, renovated, managed and governed cities — is likely to require a radical transformation of the current model of urban development and a more people-oriented approach (EEA, 2017a).

Some of the main environmental challenges facing European cities include the emissions they produce, levels of air and noise pollution, increasing energy use and the consumption of water and materials, land take and habitat fragmentation (see Table 1.1 which includes examples of the challenges cities face). Urban areas are major consumers of energy and account for 60-80 % of global energy consumption (UN-Habitat, 2019). The consumption of water varies considerably across European cities, from an average consumption in Madrid of 263 litres per person per day and 164 litres per day in London to 100 litres per day in Copenhagen (Carranza and Bueno, 2018; Greater London Authority, 2020; IWA, 2020). On average, households across European cities use nearly three times the amount of water (144 litres per person per day) than the minimum required for basic human needs (50 litres per person per day) (EEA, 2018a).

Although emissions of air pollutants have declined in recent years, almost 20 % of the EU's urban population lives in areas where air pollutant concentrations exceed at least one EU air quality standard (e.g. $PM_{2.5}$ (fine particulate matter), PM_{10} (particulate matter), O_3 (ozone), NO_2 (nitrogen dioxide)) (EEA, 2019a). Urban areas are also responsible for at least 70 % of global carbon emissions (EEA, 2019b).

As a result of land take, urban areas may severely hamper ecosystem functioning and the related delivery of ecosystem services (EEA, 2016a). The increase in land take for urban development is an ongoing process across Europe, with the total urban area expanding by approximately 6.7 % between 2000 and 2018 at the expense of agricultural and semi-natural areas. Urban areas consumed 0.6 % of all arable land and permanent crops, 0.5 % of all pastures and mosaic farmland, and 0.3 % of all grasslands. In the EU-27 and the UK, between 2000 and 2018 urban sprawl converted 0.5 % of all pastures and mosaic farmland and 0.3 % of all grasslands into artificial surfaces (EEA, 2016b).

Cities are at the centre of future environmental challenges, and therefore there is an urgent need for European cities to shift towards a more integrated approach to addressing persistent, systemic environmental challenges.

Table 1.1 Examples of potential challenges facing cities

Environmental challenges	Other challenges with environmental implications or that can increase vulnerability to environmental challenges
• Heat waves • Sea level rise • Severe storms and flooding • Water consumption and shortages/droughts • Forest fires • Air pollution • Water pollution • Ground contamination • Noise pollution • Light pollution • Energy consumption and shortages • Clean drinking water • Timber, mineral and other natural resource and material consumption and shortages • Land/soil erosion • Food shortages/access to food • Solid waste processing • Solid waste disposal • Sewage treatment and disposal • Stormwater management • Habitat fragmentation • Decline of native species/natural habitats • Land take • Lack/loss of green space • Lack/loss of ecologically productive land	• Urban sprawl • Overcrowding and population density • Inadequate or absent infrastructure • Community severance (a physical and psychological barrier created by, for example, roads or rail infrastructure) • Road congestion • Social exclusion and inequality • Unemployment rates • Lack of affordable housing • Insufficient public services • Non-communicable diseases (e.g. heart disease, cancer, asthma, diabetes) • Poor mental health • Demographic change • Health pandemics

Source: Authors' compilation.

The EU has a key role in promoting sustainable urban development; however, it is city administrations that are likely to be best placed to take local action to tackle and resolve many of these issues (EEA, 2017a). They are crucial in improving waste and water management, public transport and efficient use of land by implementing integrated urban planning (EEA, 2015). Furthermore, city networks and associations are becoming increasingly important in shaping global climate and sustainability agreements (EEA, 2020a).

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 a 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 stakeholders from science, business and society (EEA and Eionet, 2016).

European citizens are deeply concerned about climate change and the environment and believe that their actions towards environmental protection matter (EC, 2017a). 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, 2019a).

The role of cities

The influence of cities in EU policymaking has been increasingly recognised over the last few decades, including through the establishment of the European CoR in 1994 and the signing of the Leipzig Charter in 2007 and culminating in the urban agenda for the EU, established as the Pact of Amsterdam, in May 2016. In 2020 the EU ministers responsible for urban matters agreed on a new, refocused Leipzig Charter supplemented by an 'implementing document' to envisage and realise the recent European and global agreements on sustainability (e.g. EGD, urban agenda for the EU, Paris Agreement) at the urban scale. While cities do not have a formal role in decision-making at the EU level, municipal administrations can influence decisions, as they are a key source of expertise and offer legitimacy to the EU given their proximity to citizens. Once EU legislation is transposed into Member State law, cities often have a key role in its implementation, particularly as many individual countries in the EU have granted cities and regions constitutional powers of self-governance. Cities also often control significant budgets, and municipal administrations represent an important part of the 'state-at-work' in many EU Member States (Heinelt, 2017).

In parallel with this increasing recognition of the role of cities in Europe, and not unconnected, has been a trend towards strengthening urban governance. This has been coupled with an expansion of a range of networks, organisations and initiatives across European cities and their metropolitan areas (JRC, 2020), such as EuroCities and ICLEI Europe. There has also been an increasing commitment from European cities on the global stage working through large networks, such as United Cities and Local Governments, Metropolis, the C40 Cities Climate Leadership Group, and the Global Covenant of Mayors, and given an extra momentum and focus by the SDGs and their implementation — SDG 11 in particular. For example, many local governments in Europe have made a political commitment to climate change adaptation by joining international initiatives, with over a quarter of the population in the 38 EEA member and collaborating countries living in local authorities committed to adaptation under the Covenant of Mayors for Climate & Energy (EEA, 2020b). This is empowering cities, facilitating greater cooperation and knowledge exchange, and has accelerated the demand for the devolution of fiscal, political, and administrative powers and responsibilities to cities from central governments (JRC, 2020).

Taking the example of adaptation to climate change, by following the 2013 EU strategy Member States have recognised the importance of adaptation in the urban context and many identify local governments as the implementers of adaptation (EEA, 2020b). Local-level adaptation planning or climate change risk assessments are mandatory in some countries and several hundred cities have benefited so far from EU funding for adaptation-related research, knowledge exchange, and the planning and implementation of measures. Many cities have organised their own mutual support and knowledge sharing through networks at the international, national or regional level (EEA, 2020b).

1.3.2 COVID-19 and environmental sustainability in cities

Cities across Europe have been at the forefront of the COVID-19 pandemic from the very beginning of the health crisis, bearing some of the worst impacts. The pandemic has had many wide-ranging impacts on how cities operate and is likely to remain deeply intertwined with efforts to transition towards environmental sustainability for years to come. Cities have also become essential actors in proactively and innovatively addressing the public health emergency, as well as in dealing with the wider social and economic ramifications. At the same time, many innovative actions and policies intended to deal with the health emergency also have potential long-term environmental benefits, such as an improved active travel infrastructure. 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 EGD.

When it comes to cultural and behavioural shifts, uncertainties exist — while people may be more attuned to the importance of clean air and high-quality green spaces, whether this translates into more permanent pro-environmental behaviours and how we develop and plan our cities is still unclear. As such, it remains to be seen what the long-term impacts on the sustainability transition in cities will be. It is also clear that city, national and EU budgets will be under economic strain as a result of the pandemic, which may result in reduced budgets for core environmental initiatives in the years ahead.

As the pandemic is still ongoing and its duration is uncertain, the overall implications of the responses to it on the transition towards urban environmental sustainability and EU environmental sustainability goals are unclear. The way that the EU and European countries have responded to the COVID-19 pandemic has had impacts on all aspects of life. This includes implications in cities and for a range of urban systems, such as the mobility, food and energy systems. The wide range of impacts has meant that the pandemic has exacerbated some of the existing challenges that cities face, whereas others have proved environmentally beneficial, or have opened up debates about urban environmental and social issues and political space to explore positive change. For example, lockdowns in cities highlighted the value of having access to green space for physical and mental well-being, and the inequalities in this access, especially for those who do not have access to private green and outdoor spaces (e.g. gardens). The nature of the impacts also appears to vary over time, and for different types and sizes of cities.

1.3.3 The EEA's activities on the urban environment

The EEA regularly assesses the urban environment in Europe — for example, assessing the trends in land take

and consumption and environmental quality. SOER 2020, published at the end of 2019, creates a new mandate for the EEA to work at the urban level. While the main conclusions are targeted at the broader country and institutional level, they nonetheless express (directly or indirectly) the relevance of other scales of action such as cities. The report clearly presents the need for urgent action in several key areas and affirms the need for 'enabling transformative change (that) will require that all areas and levels of government work together and harness the ambition, creativity and power of citizens, businesses and communities'.

SOER 2020 builds on SOER 2015, which concluded that 'Living well within environmental limits will require fundamental transitions in core societal systems, including food, energy, mobility, urban, fiscal and finance systems. To achieve such purpose profound changes in dominant practices, policies and thinking are needed.' This will require fundamental transitions in core societal systems, including the urban system, and this will necessitate profound changes in dominant practices, policies and thinking.

In recent years the EEA has produced a range of outputs (e.g. reports, tools and online repositories) that provide indicators and case studies at the EU city level and at the national/regional level. These cover a range of urban environmental topics including climate, air and noise pollution, resource use, energy and transport. A summary of key recent EEA activities on urban environmental sustainability is presented in Table 1.2.

It is within this context, and in recognition of the fact that European cities need to be more sustainable, that over recent years the EEA has focused on gathering more knowledge in the field of urban sustainability. This has led to the development of a conceptual framework, in consultation with and using input from external stakeholders, to support the analysis of the EEA's future assessments. This framework, along with some initial assessments of urban environmental sustainability, is presented in Chapter 2 of this report.

Scope and focus

The EEA's work on urban sustainability is framed in terms of its core environmental sustainability remit. The work is therefore not trying to capture the breadth of all the economic, social and environmental dimensions of urban sustainability, but instead it concentrates on the EEA's environmental perspective on urban sustainability. However, the need to break out of separate 'economic', 'social' and 'environment' silos is reflected in EU policy initiatives such as the 7th EAP, EU biodiversity strategy for 2030 (EC, 2020a) and the EGD (EC, 2019a). The 7th EAP, for example, has an explicit focus on improving the environment, in order to benefit health and well-being, and creating a resource-efficient, green and competitive low-carbon economy (EU, 2013). The EGD emphasises the need for 'intense coordination to exploit the available synergies across all policy areas' to address the complex and interlinked social, environmental and economic challenges (EC, 2019a). The EEA is therefore interested in questions that touch on the breadth of sustainability, but from a clear environmental perspective — for example, will air pollution be a more serious issue for a larger elderly urban population? And what impact will climate change have on the key infrastructure and assets upon which the economies of cities depend?

Stakeholder input

Recognising the transversal and complex nature of urban sustainability research and practice, in 2017 the EEA launched a work stream on understanding and assessing urban environmental sustainability. The EEA's urban environmental sustainability work has incorporated a broad stakeholder-led process involving both internal and external experts, including:

Table 1.2 Overview of the EEA's activities on urban environmental sustainability

Selected key reports and sources	Summary of data/indicators/examples available
Urban adaptation in Europe: How cities and towns respond to climate change (EEA, 2020b)	• Provides an up-to-date evidence base on adaptation planning and actions in the local and urban contexts. • Summarises the scientific evidence on climate- and weather-related hazards facing European cities and their impacts. • Includes many case studies of urban adaptation in Europe.
Healthy environment, healthy lives: How the environment influences health and well-being in Europe (EEA, 2019c)	• Provides a knowledge base to support the development of integrated policies that address the environment, health and well-being nexus. • While the report does not specifically focus on the urban environment, many of the issues and data are highly pertinent to it and it includes case studies from cities. • Some issues, such as the accessibility of green space across Europe, focus specifically on the urban environment.
Air quality in Europe: 2019 report (EEA, 2019d)	• Includes indicators on population exposure to main groups of air pollutants ($PM_{2.5}$, PM_{10}, O_3, NO_2) in urban and suburban areas across Europe.

Table 1.2 Overview of the EEA's activities on urban environmental sustainability (cont.)

Selected key reports and sources	Summary of data/indicators/examples available
Europe's urban air quality: Re-assessing implementation challenges in cities (EEA, 2018b)	• Provides data on exposure to air pollution in cities, including from main source sectors. Also gives examples of implemented and planned measures to address air pollution in some EU cities.
Environmental noise in Europe: 2020 (EEA, 2019e)	• Includes indicators on population exposure to unhealthy levels of environmental noise inside urban areas (day-evening-night noise level L_{den} ≥ 55 dB; night-noise level L_{night} ≥50 dB).
The first and last mile: The key to sustainable urban transport. Transport and environment report 2019 (EEA, 2019b)	• Provides data and case studies on urban mobility. Key indicators include passenger-km by transport mode, hours lost in congestion per city and data on transport emissions for a medium-sized city.
Unequal exposure and unequal impacts: Social vulnerability to air pollution, noise and extreme temperatures in Europe (EEA, 2018c)	• Provides indicators on population exposure to different risks in urban areas including noise and air pollution and extreme temperatures. Information on other factors such as housing conditions is also included.
Financing urban adaptation to climate change (EEA, 2017b)	• 11 case studies of financing urban adaptation.
Urban adaptation to climate change in Europe 2016 (EEA, 2016c)	• Includes case studies with examples of indicators on climate, impact, social vulnerability and resilience, as well as community engagement.
Rivers and lakes in European cities (EEA, 2016d)	• Provides case studies of best practice on managing rivers and lakes in urban areas to reduce flood risk and improve accessibility for residents.
Urban sprawl in Europe (EEA, 2016b)	• Provides indicators for measuring urban sprawl, including weighted urban proliferation; percentage of built-up area; dispersion of built-up areas; land uptake per person (per inhabitant or job); utilisation density; and urban permeation.
Soil resource efficiency in urbanised areas (EEA, 2016e)	• Includes data and case studies on costs of soil degradation in Europe.
Urban sustainability issues: What is a resource-efficient city? (EEA, 2015)	• Provides data sources to be used for assessing the metabolism of cities.
Biodiversity Information System for Europe (BISE) ([a])	• Provides data and information on biodiversity in Europe, including risks from land use change, pollution and fragmentation.
EU Climate-ADAPT platform ([b])	Provides a wide range of indicators and data related to urban adaptation that are categorised into three groups: • exposure indicators: provide information about the level of exposure to climate impacts; • sensitivity indicators: provide information about the susceptibility of cities to climate impacts, via population composition, spatial planning or physical conditions; and • response capacity indicators: provide information about characteristics that help to reduce or overcome the impacts.
Copernicus Urban Atlas ([c])	• Various indicators on urban fabric (e.g. data for functional urban areas).
European Air Quality Index ([d])	• Displays sampling points on air quality in individual countries, regions and cities. The index is based on concentration values for: PM_{10}, $PM_{2.5}$, O_3, NO_2 and SO_2.

Notes: ([a]) https://biodiversity.europa.eu
([b]) https://climate-adapt.eea.europa.eu
([c]) https://www.copernicus.eu/en/use-cases/urban-atlas
([d]) https://airindex.eea.europa.eu/Map/AQI/Viewer

SO_2, sulphur dioxide.

Source: Authors' compilation.

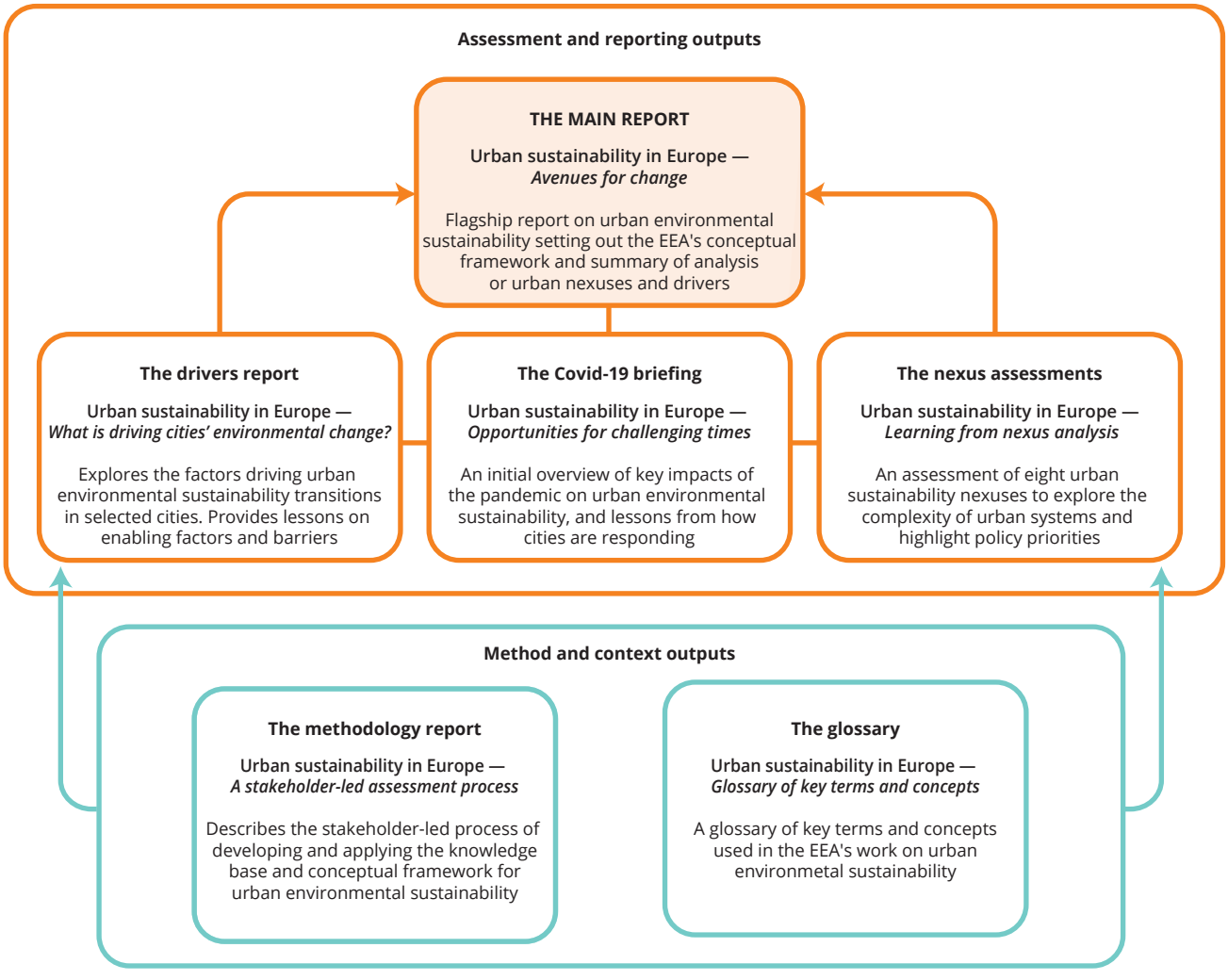
- a request for information and sources (2017) as part of the work to build a knowledge base on urban environmental sustainability (see Section 1.4);
- a series of external stakeholder workshops and meetings held between 2017 and 2020, each bringing EEA and external stakeholders together to inform and co-create a conceptual framework for urban environmental sustainability (see Chapter 2) and to help develop and implement assessments of environmental sustainability, including analysis of urban nexuses (see Chapter 3) and analysis of the drivers and barriers (see Chapter 4);
- an online survey of European cities (2018), and interviews (2019) with selected pioneering city authorities, to explore and assess the key drivers of and barriers to urban sustainability transitions (see Chapter 4); and
- throughout there have also been specific inputs to and consultation and feedback on draft reports and assessments from a range of stakeholders, and in particular the European environment Information and observation network (Eionet) and the European topic centres, which have also acted in their capacity as strategic co-creation partners, scientific advisers and networkers.

This approach, including a thorough internal (EEA) co-creation process and the series of external stakeholder workshops, has ensured an excellent degree of participation and helped build credibility for the work.

The EEA's urban environmental sustainability outputs

An overview of the EEA's initial urban environmental sustainability outputs in 2020 and 2021 is given in Figure 1.7. This shows how this report draws on the reports on the analysis of urban nexuses and analysis of the drivers and barriers and is supported by the separate methodology report and glossary.

Figure 1.7 **The EEA's reports and outputs on urban environmental sustainability transitions being published in 2020 and 2021**



Source: Authors' compilation.

1.4 What is the available knowledge base relevant to urban environmental sustainability?

As part of understanding the availability of data and information on urban environmental sustainability and where there are key gaps, a review of possibly relevant data sources, indicators and case studies was undertaken. This principally focused on those sources where data and indicators and examples are managed or owned by relevant pan-European agencies (e.g. Eurostat, European Commission) and updated frequently. Other sources, including from external European and international organisations and initiatives, as well as numerous academic and peer-reviewed research papers, were also considered (see Table 1.3) and used as part of the analysis of nexuses and barriers to and drivers of urban environmental sustainability (see Chapters 3 and 4, respectively).

Table 1.3 Overview of sources relevant to urban environmental sustainability and their scope

Type of source	Summary of data/indicators/examples available	Examples of key sources
European Commission sources (e.g. Eurostat, Horizon 2020 projects)	The various European Commission sources provide indicators and case studies at the EU city level as well as at national or international level. These sources provide a range of both qualitative and quantitative information that varies in spatial scope (i.e. size of cities covered) as well as thematic areas (socio-economic, land use, climate, environmental, resource use, technology/innovation and transport). The Eurostat sources in particular provide indicators for urban settings across various topics, including quality of life, noise pollution, air quality, housing, waste water treatment, economic activity, water consumption and waste production and land use.	• Eurostat urban audit ([a]) • Eurostat quality of life indicators ([b]) • The European Green City Index ([c]) • Urbact good practices database ([d]) • The urban data platform ([e]) • European Green Capital Award ([f]) • European Green Leaf Award ([g]) • Reference Framework for Sustainable Cities ([h]) • The urban agenda partnerships ([i]) • Eurobarometer survey 419: *Quality of life in European cities* ([j]) • The Green City Accord
Sources from external European organisations and initiatives on sustainable development (e.g. Covenant of Mayors, ICLEI, UN)	The various reports, tools and online repositories provide indicators and case studies on EU cities across various topics, including governance, engagement, social dimension, land use, resilience, resource use, climate, environment, health, biodiversity, energy and transport.	• OECD Resilient Cities project ([k]) • The Urban Adaptation Support Tool — Covenant of Mayors ([l]) • Oppla nature-based solutions — city case studies providing examples of the multiple benefits delivered by nature-based solutions ([m]) • World Health Organization report — *Environmental health inequalities in Europe* ([n]) • Convention on Biological Diversity — the City Biodiversity Index ([o]) • ICLEI/WWF One Planet City Challenge ([p]) • IEA reports (e.g. IEA Energy technology perspectives 2017) ([q])

Notes: ([a]) https://ec.europa.eu/eurostat/web/cities/data/database
([b]) https://ec.europa.eu/eurostat/statistics-explained/index.php/Quality_of_life_indicators
([c]) https://assets.new.siemens.com/siemens/assets/api/uuid:fddc99e7-5907-49aa-92c4-610c0801659e/european-green-city-index.pdf
([d]) https://urbact.eu/good-practices/home
([e]) https://urban.jrc.ec.europa.eu/#/en
([f]) https://ec.europa.eu/environment/europeangreencapital
([g]) https://ec.europa.eu/environment/europeangreencapital/europeangreenleaf
([h]) http://rfsc.eu
([i]) https://ec.europa.eu/regional_policy/en/policy/themes/urban-development/agenda
([j]) https://data.europa.eu/euodp/en/data/dataset/S2070_419_ENG ; https://ec.europa.eu/environment/topics/urban-environment/green-city-accord_en
([k]) https://www.oecd.org/fr/gov/politique-regionale/resilient-cities.htm
([l]) https://climate-adapt.eea.europa.eu/knowledge/tools/urban-ast/step-0-0
([m]) https://oppla.eu/nbs/case-studies
([n]) https://www.euro.who.int/en/publications/abstracts/environmental-health-inequalities-in-europe.-second-assessment-report-2019
([o]) https://www.cbd.int/subnational/partners-and-initiatives/city-biodiversity-index
([p]) https://wwf.panda.org/our_work/our_focus/projects/one_planet_cities/one_planet_city_challenge
([q]) https://www.iea.org/analysis

IEA, International Energy Authority; OECD, Organisation for Economic Co-operation and Development; Oppla, the EU repository of nature-based solutions; WWF, World Wide Fund for Nature.

Source: Authors' compilation.

From the review of sources, it is evident that there is an abundance of quantitative data on the environmental quality, land use, biodiversity and resilience thematic areas in an urban context. For example, urban land use is distinguished as a specific topic in several of the sources reviewed such as the Copernicus Urban Atlas, which provides data on green urban areas. Other topics with readily available data or indicators and examples are for climate change adaptation, transport and energy. A key source of case studies on climate adaptation is the Climate-ADAPT platform ([37]). The sources of information identified from the review also suggest that there is a good representation of case studies for some topics such as stakeholder engagement and community initiatives.

In contrast, in some thematic areas, such as urban agriculture and food systems, there are more limited sources of data or indicators and examples. Considering their broad scope, these topic areas do not have a unique source, data set or indicator that would provide sufficient information for the purposes of a comprehensive assessment of urban sustainability. Therefore, it is likely to be necessary to draw on a selection of multiple sources of data or indicators and examples to provide the evidence on certain thematic areas. Another common issue among various sources of data and indicators is that the scale is incompatible with the required urban focus. Across the sources there are indicators and data that fit within a specific thematic area; however, they are not necessarily available specifically for urban areas or for common boundaries, thus currently limiting their utility in the assessment of urban environmental sustainability.

It is important to note that some topics would benefit from the application of both qualitative and quantitative evidence. For example, assessing the quality of life aspects in urban environments through quantitative indicators that look at the physical environment will not provide a comprehensive characterisation of this issue. Improving the quality of the environment by itself does not improve the quality of life of individuals. Furthermore, 'good-quality' public space is not an objective issue. It will mean different things to different people.

The review also highlights some of the challenges in terms of the information likely to be available for urban sustainability assessment. These include infrequent updates and lack of standardisation of cross-country data for cities, resulting in limited comparability, which is acknowledged by Eurostat (Eurostat, 2020a). This is also affected by the lack of a consistent use of definitions between data sources. For example, the data in Eurostat's urban audit (Eurostat, 2020b) applies the Organisation for Economic Co-operation and Development-European Commission (OECD-EC) definition of a city (EC, 2012).

In contrast, the Urban Ecosystem Europe (UEE) report introduces urban indicators categorised into six different themes and applied in 32 EU cities of various sizes — metropolitan areas, big cities, medium-sized cities and medium-small cities (Berrini and Bono, 2008; EC, 2015a).

1.5 The report structure

Chapter 2 explores the complexity of urban systems and what factors may influence the transition to urban environmental sustainability. A conceptual framework for urban environmental sustainability is presented, focusing on the EEA's remit. This framework enables a consistent approach to the analysis and assessment of urban environmental sustainability. The chapter outlines examples of different forms of analysis of urban environmental sustainability that may help decision-makers to identify policy options and prioritise forms of analysis.

Chapter 3 introduces the nexus approach and its application within an urban context. The nexus approach and nexus analysis help us to understand complex systems and identify better coordinated policies and actions to support urban environmental sustainability. Eight priority urban sustainability nexuses are presented focusing on climate resilience; quality of life; urban accessibility; environment and health; food security; closing the loop; clean energy; and sustainable buildings. Key policy and governance implications from the nexus analysis are presented.

Chapter 4 presents the results of research on the experience of pioneering cities in the transition to urban environmental sustainability. This seeks to improve the understanding of the drivers of change that can either enable or hinder urban environmental sustainability transitions in European cities. The analysis was based on a mixed methods approach that combined a literature review, a survey and semi-structured interviews. It focused on frontrunner cities that have either won or been selected as finalists in the EGCA or the EGLA.

Chapter 5 presents key messages on the implications for the EU arising from this review of urban environmental sustainability. This brings together information and evidence on the importance and role of cities and urban areas in delivering the EU's sustainability transition; the support for urban environmental sustainability in Europe; how urban environmental sustainability can be analysed and assessed and lessons from the two approaches presented in the report (the analysis of the selected urban nexuses; and an assessment of drivers and barriers in cities); key messages for policy and urban governance; and further research needs.

([37]) https://climate-adapt.eea.europa.eu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2
Urban environmental sustainability: a framework

Key Messages

- **Cities need to address systemic challenges and opportunities** — many systemic social, environmental and economic challenges are concentrated in urban areas. At the same time, cities and city authorities are well placed to develop and implement the integrated solutions that the transitions to a low-carbon, resilient, resource-efficient economy requires.
- **Defining urban environmental sustainability** — overall, urban environmental sustainability is intended to be a broad concept for the foundation of future cities that captures the breadth of the EEA's interests.
- **The conceptual framework for urban environmental sustainability** will help provide a clear structure for the EEA's thinking on urban environmental sustainability assessments, including in terms of:
  - the key components and outcomes that should define a vision of environmental sustainability in an urban context in Europe; and
  - the components required to support the transition of European cities to a more sustainable future, particularly focusing on urban environmental sustainability.
- **The conceptual framework is based on four main components:**
  - **Lenses** — a range of perspectives on urban environmental sustainability that represent priority issues or concerns reflecting the EEA's environmental remit and that can be used to guide and focus assessment and analysis.
  - **Context** — the range of current and historical physical, social and institutional characteristics that create and shape the setting in which a specific city exists, develops and functions. The context has a considerable influence on the transition to urban environmental sustainability.
  - **Enabling factors** — relatively high-level forces that can facilitate (drivers) or hinder (barriers) the transition to 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.
- **Operationalising the conceptual framework** — the conceptual framework can be applied in different ways to support the analysis of cities from the perspective of environmental sustainability. There are various forms of analysis that could be undertaken as part of assessing the current status quo or transition options for urban environmental sustainability.

2.1 Cities as complex systems

Many systemic social, environmental and economic challenges are concentrated in urban areas. Yet cities can also help provide solutions to these challenges. As well as being economically important, and being home to almost three quarters of European citizens, cities are 'hubs of creativity, innovation and learning' that are 'crucial for transitions ... with the capacity to effect systemic change at local scales and to share ideas through city networks' (EEA, 2019a). Urban areas also face particular vulnerabilities that necessitate transformative adaptation (EEA, 2019a, 2020b). Cities and city authorities are well placed to develop and implement the integrated solutions that the transition to a low-carbon, resilient, resource-efficient economy requires.

Cities can be seen as 'distinct systems that can be transformed' (EEA, 2019a), and within cities are nested interconnected production and consumption sub-systems such as those for energy, food and mobility. Cities are, as a result, frequently conceptualised as complex systems that are unpredictable and dynamic. Urban sub-systems interact in bilateral and multilateral positive (i.e. reinforcing) and negative (i.e. conflicting) ways (Rode, 2019). These interactions lead to a range of outcomes for urban residents, the environment and the economy. These include intended outcomes, such as access to employment and services, sufficient and affordable food, or reliable energy supplies. However, there will also be negative impacts and interactions between the systems, for example air and noise pollution from traffic, and damage to or loss of habitats and green space from infrastructure development. Indeed, many urban problems arise as a direct result of the disregard, by policymakers and planners, of conflicting relationships between urban sub-systems (Rode, 2019).

Cities also depend on their hinterlands and on national and international connections for food, water, energy and other supplies. People, resources and goods flow in and out of cities, and, through the activities happening in cities, waste and pollution (e.g. to air and water) is dispersed within and beyond city boundaries.

Cities and urban authorities in the EU often control significant budgets (Heinelt, 2017) and can set all or some of their own policy and strategy. They have responsibility for local services such as water, mobility, energy and waste. It is increasingly recognised that 'cities are key players in implementing the EU's goals in terms of a low-carbon economy ... and resource efficiency. They are crucial in improving waste management, public transport, water management and, through integrated urban planning, the efficient use of land.' (EEA, 2019a). However, given the complex nature of urban systems, decision-makers in cities and urban authorities 'require strategies to embrace complexity and analytical devices to better understand the problems and develop courses of action' (Rode, 2019).

2.2 What is the EEA's conceptual framework for urban environmental sustainability?

2.2.1 Defining urban environmental sustainability

Although there is no single agreed definition of urban sustainability, or of what a sustainable city might look like, there is broad agreement on what contributes to urban sustainability. The World Urban Forum affirmed in 2002 that the creation of sustainable cities required addressing economic, social, environmental and governance issues in an integrated way (UN-Habitat and DFID, 2002). More recently, SDG 11 — make cities inclusive, safe, resilient and sustainable — seeks to maintain cities in a way that continues to create jobs and prosperity without straining land and resources (UN, 2020). This includes the sustainability of the linkages between cities and their rural hinterland as well as natural areas, both terrestrial and marine.

Reflecting the EEA's mandate to help the EU and the EEA member and cooperating countries make informed decisions about improving the environment, integrating environmental considerations into economic policies and moving towards sustainability, the focus of this report is on urban sustainability from an environmental perspective. The EEA's approach to urban environmental sustainability acknowledges that social and economic dimensions are important, but focuses primarily on environmental issues in urban areas. These include, for example, air and water pollution, green spaces providing space for people and nature, biodiversity loss, resource efficiency, and mitigation measures to reduce greenhouse gas emissions and manage the impacts of climate change. Such environmental issues also underpin and support the social and economic health of cities, and, as noted in Section 2.1, cities can be seen as complex systems in which all elements of sustainability interact.

The initial approaches and assessments presented in this report also consider the interactions between policy areas in moving towards urban environmental sustainability. The systemic interlinkages between environmental sustainability and broader sustainability are therefore explicitly recognised and considered in the conceptual framework and related assessments. This is in line with the EEA's focus on sustainability transitions, which reflect the need for fundamental change in core societal systems (EEA, 2019f).

Overall, urban environmental sustainability is intended to be a broad concept. It is the EEA's preferred term for capturing the breadth of its interests. As a foundation for future cities, it is a term that includes encouraging revitalisation and transitions of urban areas and cities to improve liveability, promote innovation and reduce environmental impacts while maximising economic and social co-benefits. Urban environmental sustainability is likely to be reflected in the extent to which the following characteristics are seen or can be developed in cities (Moir et al., 2014; EBRD, 2016; GPSC, World Bank, 2018):

- a relatively compact and densely populated mixed use urban form that creates efficiency gains;
- a secure and healthy urban environment where both people and nature can thrive;
- safe and high-quality public spaces, with good-quality, affordable, accessible and healthy housing for residents;
- inclusive access to services and jobs within walking distance or reachable by short and convenient public transport journeys seamlessly integrated with an active transport (walking and cycling) infrastructure;
- clean energy and smart technologies harnessed to increase well-being, reduce environmental impact and protect ecosystems;
- efficient and circular use of resources (water, energy, land, materials) and adaptive solutions to energy and water demands;
- environmental, natural and physical assets preserved and enhanced for future generations;
- resilience against and adapted to the growing impacts and risks from climate change and natural hazards;
- local governance with the capacity to carry out its functions with active participation from citizens.

Thus, in addition to the environmental dimension, urban environmental sustainability also has a 'human-centred' dimension, enhancing and changing how people live, interact and engage with cities.

2.2.2 Purpose and evolution of the conceptual framework

Urban systems are inherently complex (see Section 2.1), as is the concept of urban environmental sustainability. If we are to understand what factors may influence the transition towards urban environmental sustainability, it is important to improve our understanding of the concept. Hence, a conceptual framework for urban environmental sustainability has been developed.

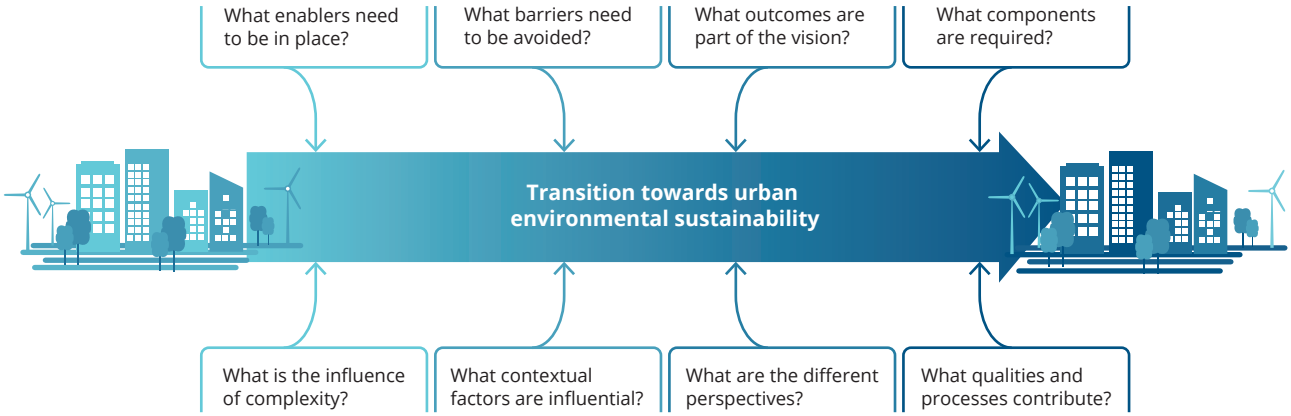
A conceptual framework attempts to explain a phenomenon. It seeks to map out a theoretical structure of assumptions, components, principles, etc., that holds together the ideas comprising a broad concept. In the case of urban environmental sustainability, it is important to understand what factors — whether they be components or variables acting as enablers or barriers, for example — need to be in place or avoided to facilitate transitions towards urban environmental sustainability.

The logic behind the development of a conceptual framework is that it is required to understand complexity and provide a framework for consistent assessment and analysis. Breaking down a concept into components also enables analysis to consider interrelationships between individual components while maintaining perspective on the whole concept, which is important in helping to understand a complex system.

For the EEA, a conceptual framework will help provide a clear structure for its thinking on urban environmental sustainability assessments (see Figure 2.1), including in terms of:

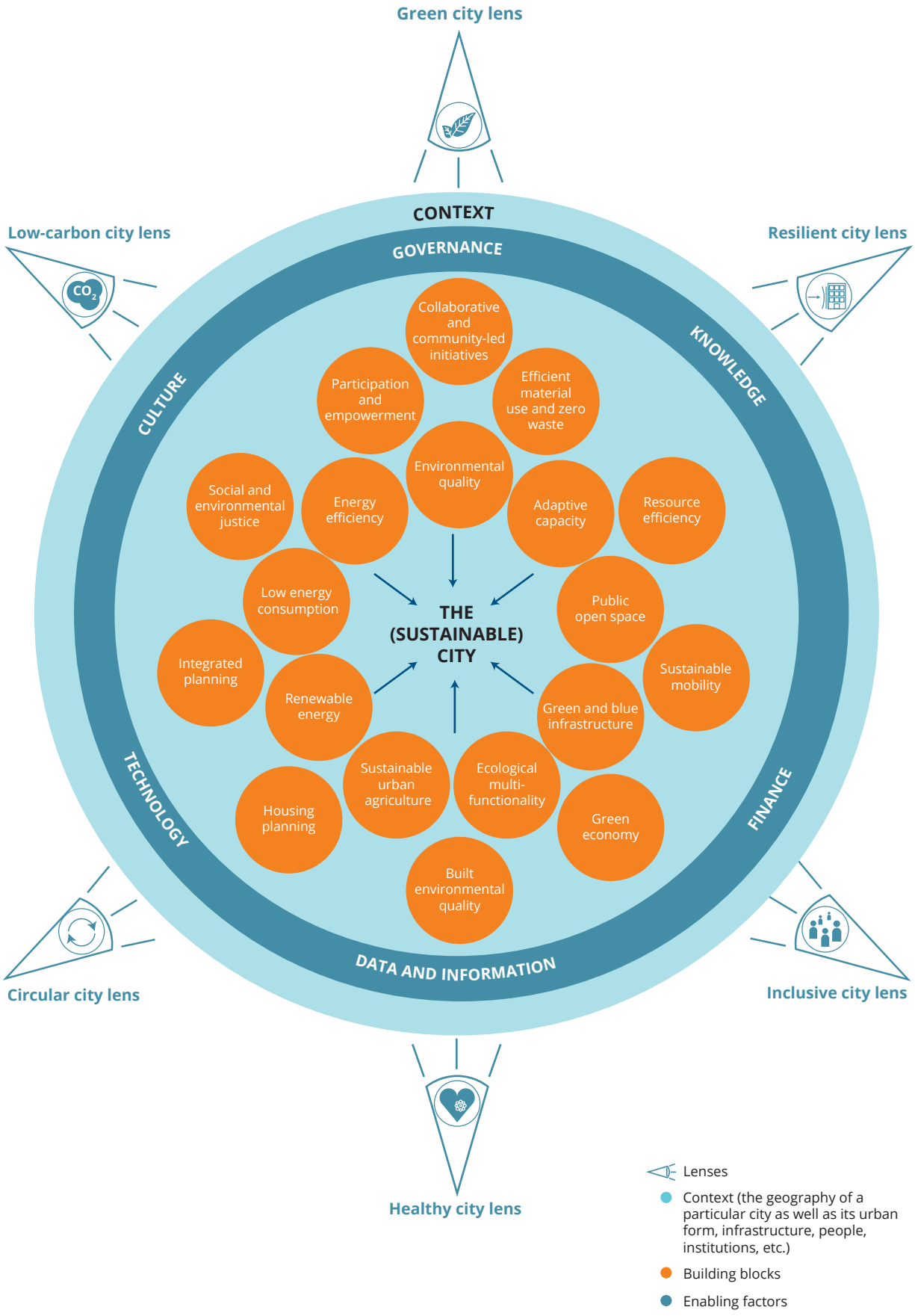
- the key components and outcomes that should define a vision of environmental sustainability in an urban context in Europe;
- the components required to support the transition of European cities towards a more sustainable future, particularly focusing on urban environmental sustainability.

Figure 2.1 Illustration of the need for a conceptual framework to help understand what influences the transition towards urban environmental sustainability



Source: Authors' compilation.

Figure 2.2 **Conceptual framework for urban environmental sustainability**



Source: Authors' compilation.

Given the complexity and interdependence of urban systems, it is acknowledged that attempting to categorise distinct elements is reductionist and potentially oversimplistic. However, a simple model or framework should help us to understand these complex concepts and will assist the EEA to develop its knowledge base and inform its assessments.

The development of the conceptual framework was informed by a knowledge review of EEA and other literature, a review of key EU policy frameworks, and feedback from stakeholders throughout. Early in the process of developing the framework, four types of cities were identified: the resilient city, the circular city, the green city and the inclusive city. This model was further developed in 2017 and tested both with internal (EEA) stakeholders and with external stakeholders at events in Copenhagen in December 2017 and November 2018. A meta-analysis of drivers of sustainability transitions was also completed to further understand the factors supporting urban environmental sustainability and to consider the extent to which benchmarking may be possible.

Between 2017 and 2020 several iterations of the proposed conceptual framework were developed in collaboration with stakeholders, both internal (EEA) and external. The starting point was the EEA's initial four broad categories of sustainable city, which were complemented with two further ones (the healthy city and the low-carbon city). Following the results of the knowledge review, the original approach was to upgrade the initial categories by adding further lenses of analysis, introducing the notion of enabling factors and developing assessment topics. This 'taxonomy' approach, comprising different 'levels' of urban sustainability components served the purpose of bringing richness to the relatively simplistic initial model while keeping track of the essential features of such a model and aligning it with environment and climate policies.

The proposed conceptual framework is presented in Section 2.2.3, which includes a description of the framework components: six lenses, six enabling factors and 19 building blocks. The conceptual framework has provided the focus for the urban nexus approach (see Chapter 3) and the analysis of drivers of urban environmental sustainability transitions (see Chapter 4).

2.2.3 *The structure and components of the conceptual framework*

Figure 2.2 presents an overarching conceptual framework for urban environmental sustainability. The conceptual framework is based on four main components. These are:

- **Lenses** — a range of perspectives on urban environmental sustainability that represent priority issues or concerns reflecting the EEA's environmental remit and that can be used to guide and focus assessment and analysis.
- **Context** — the range of current and historical physical, social and institutional characteristics that create and shape the setting in which a specific city exists, develops and functions. Each city's context has a considerable influence on the transition to urban environmental sustainability.
- **Enabling factors** — relatively high-level forces that, based on their level of availability, facilitate (drivers) or hinder (barriers) the transition to 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 the inputs required to transition towards urban environmental sustainability.

Each of these components is described in more detail in the sections below.

Lenses on urban environmental sustainability

The six lenses represent headline perspectives on urban environmental sustainability reflecting the EEA's environmental remit. They also cover the key elements of relevant EU environment and climate policies and frameworks. These perspectives are not conflicting and may overlap, and together they mutually reinforce the transitions towards urban environmental sustainability. The lenses provide a high-level frame to guide more nuanced assessment and analysis, for example at the level of building blocks or collections of building blocks. The six urban environmental sustainability lenses are presented and described in Figure 2.3.

There is a range of other terms and formations of cities that are used in the literature and by different organisations and that could represent additional lenses, such as 'smart cities', 'future cities', 'liveable cities', 'compact cities' and 'garden cities' (Moir et al., 2014). These terms and frameworks are often relatively broad and can overlap; are sometimes associated with certain contexts, geographies or disciplines; and can have hybrid or ambiguous meanings. In developing the lenses, the intention was to convey a relatively clear and simple set of perspectives on urban environmental sustainability that capture the EEA's priority interests given its remit (see also Section 2.2.1). The selected lenses are not trying to replace or replicate these other terms and framings, which have equal validity and could be used in combination with the lenses. There will also be links between some of the enabling factors and buildings blocks in the EEA's conceptual framework and these other terms and frameworks. Aspects of these terms and frameworks also emerge through the analysis of urban nexuses and drivers presented in Chapters 3 and 4, such as inclusion, liveability and compactness.

Figure 2.3 The urban environmental sustainability lenses

Taking the example of compact cities, they have long been considered to have a range of potential benefits, which include dense development patterns, better accessibility of local services and jobs, short intra-urban distances and efficient public transport systems that make positive contributions to the efficiency of infrastructure investment and reducing energy consumption and carbon dioxide (CO_2) emissions, as well as contributing to knowledge diffusion and economic growth (OECD, 2020). This concept clearly has some overlaps with the characteristics of urban environmental sustainability described above, but the lenses aim to provide a more disaggregated set of perspectives to aid analysis rather than a holistic formation of future cities.

In relation to COVID-19, there are emerging studies that investigate the correlation of cases of and deaths from the virus with both the population size and density of functional urban areas. But it is important to note in the context of compact cities that it is not density alone that makes cities potentially vulnerable to the effects of COVID-19 but the structural economic and social conditions of cities that make them more or less able to implement effective policy responses. For instance, cities marked by inequalities, inadequate housing conditions and a high concentration of urban poor are potentially more vulnerable than those that are better resourced, less crowded and more equal (OECD, 2020).

Context

Context is defined as the range of current and historical physical (e.g. geographical, environmental), social and institutional characteristics that 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.

These characteristics may include:

- geographical location (e.g. coastal, mountainous) and natural assets;
- climatic conditions;
- city size and urban form (e.g. level of compactness, ratio between green and built space, the relationship between urban, peri-urban and rural areas);
- demographics, including level of inequality, gentrification and poverty;
- structure of the economy;
- existing infrastructure (e.g. public transport network, utilities);
- institutional arrangements;
- other unique aspects that form the complex system of an individual city.

Enabling factors

Enabling factors are relatively high-level forces that facilitate or hinder environmental sustainability. Enabling factors can influence the degree of initiation and continuation of some

types of action. Each enabling factor is associated with clusters of characteristics that act as drivers or barriers to the transition towards urban environmental sustainability. They are likely to be specific to a particular city based on its unique characteristics (e.g. the governance, cultural or other characteristics of a city). Although the drivers associated with an enabling factor are not sufficient by themselves to ensure that sustainability transitions will be initiated, they will support this process, and their associated barriers may hinder, delay, or constrain such development (Lee and Klassen, 2008). Specific drivers may help initiate and motivate individuals or organisations to take action to achieve certain objectives, and conversely specific barriers may have a negative influence on or constrain taking action.

Six enabling factors have been identified — culture, knowledge, data and information, technology, governance, and finance — which help frame the transitions towards achieving urban environmental sustainability. Table 2.1 provides a description of each enabling factor and lists some of the associated drivers or barriers.

Table 2.1 Enabling factors for environmental sustainability

Factor	Description	Examples of drivers for/barriers to environmental sustainability transition in cities
Culture 	Characteristics, patterns of behaviour and understanding of/attitude to issues shared by a particular group of people in urban areas and learned by socialisation ([a]). All cities have their own specific cultural and historical settings. Actions to achieve urban environmental sustainability need to recognise, adapt to or draw on culture to improve the design and implementation of new policy measures.	• Willingness by local government and/or the general public to adopt new behaviours and practices • Values and attitudes to environmental sustainability within local government and/or 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
Knowledge 	Key insights into urban environmental sustainability processes and their management and options for action held by individuals within a group or among groups ([b]). Knowledge supported by the education system, research, innovation, networks and training is essential to identify appropriate solutions to urban environmental sustainability issues.	• Education system • Research and innovation • Skills in local government and 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
Data and information 	Data are raw, unorganised facts in various forms on relevant issues, whereas information is data processed, organised and/or structured so as to make it useful for forming knowledge on a subject, issue, event or process relevant to achieving the urban environmental sustainability transition ([c]). Accessible, relevant, compatible, clearly presented and easy to understand data and information are central for identifying and promoting sustainable urban solutions, and for measuring and monitoring progress towards the urban environmental sustainability transition.	• 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)

Table 2.1 Enabling factors for environmental sustainability (cont.)

Factor	Description	Examples of drivers for/barriers to environmental sustainability transition in cities
Technology 	Technologies used to facilitate or support practices, processes and behaviours with different forms and in various areas of technological development, including education, construction, transport, energy, and information and communications. Technological innovation, and making better use of technology, can facilitate sustainability transitions in governance and various sectors by making urban systems more efficient, reducing resource use, supporting better-informed decision-making processes, and monitoring and implementation of relevant policies.	Technology within different sectors such as transport, energy, land management, buildings, water, waste and health: • Information and communications technology (ICT) • Big data analytics • Low-carbon technologies (electric vehicles, solar photovoltaic panels, smart meters, etc.) • Technologies for environmental monitoring (e.g. air quality monitors)
Governance 	The interaction between the formal institutions and those in civil society. Governance refers to a process whereby actors in society wield power, authority and influence and enact policies and decisions concerning public life and social upliftment ([d]). Public engagement, soft governance, transparency, accountability and integrated decision-making processes involving all relevant sectors, stakeholders (e.g. civil society platforms) and levels of government is crucial to support urban sustainability transitions.	National and sub-national: • 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 Local: • Local government overall vison 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 with other sectors • Trade-offs between environmental sustainability and other objectives • Planning culture and practices • Models of public service delivery (public, private, public-private partnership)

Table 2.1 Enabling factors for environmental sustainability (cont.)

Factor	Description	Examples of drivers for/barriers to environmental sustainability transition in cities
Finance 	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. Note that financing typically refers to how upfront costs of building infrastructure, etc., are met, while funding refers to how it is paid for over its life cycle ([e]). Access to sufficient, sustainable finance from various sources is necessary to develop, deliver and maintain sustainable and high-quality urban infrastructure and services, and to support other programmes or actions for urban environmental sustainability transitions.	• 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)

Notes: ([a]) This definition draws on one set out by the Center for Advanced Research on Language Acquisition: http://carla.umn.edu/culture/definitions.html
([b]) This definition draws on the EEA MDIAK framework addressing monitoring, data, information, assessments and knowledge https://www.eea.europa.eu/publications/europes-environment-aoa/chapter1.xhtml
([c]) This definition draws on SMILE, developed by Imperial College, Loughborough University and the University of Worcester: https://www.gcu.ac.uk/library/smile/searching/whydoweneedinformation/whatisinformation
([d]) This definition draws on https://www.gdrc.org/u-gov/governance-understand.html
([e]) This definition draws on https://www.instituteforgovernment.org.uk/explainers/funding-infrastructure

Building blocks

Building blocks are defined as key qualities or inputs required to transition towards urban environmental sustainability. A total of 19 building blocks have been identified (see Figure 2.4).

Depending on the perspective, or lens, collections of a few of the building blocks are likely to be particularly relevant as part of an analysis of urban environmental sustainability. Similarly, building blocks can cut across and be relevant to several of the lenses.

Figure 2.4 Building blocks of urban environmental sustainability

Environmental quality — A healthy and clean urban environment, including good water, air, land and soil quality and keeping pollution, including noise pollution, within strict limits.

Adaptive capacity — Urban systems with the capacity to be resilient, adaptive and responsive to a variety of chronic stresses and acute shocks, reducing vulnerability to climate change and extreme events.

Public open space — Good-quality and accessible public open space for all citizens to help to reinforce local identity and civic pride and support social inclusion, community cohesion, health and well-being.

Green and blue infrastructure — An interconnected network of natural and semi-natural areas, green or blue spaces and features that deliver a wide range of benefits to urban citizens while also enhancing biodiversity and helping to restore local ecosystems.

Ecological multifunctionality — Healthy urban biodiversity, ecology and ecological networks that benefit urban ecosystem services and enhance the resilience of the urban system.

Sustainable urban agriculture — Integration of sustainable urban agriculture and food systems within cities, including the growing, processing and distribution of food and other products in and around cities.

Renewable energy — High proportion of cities' energy needs produced from decentralised renewable sources ranging from small plants to community and household microgeneration produced close to its point of use.

Low energy consumption — Low energy consumption and demand from citizens and cities, achieved through pro-environmental behaviours and practices that use less energy.

Energy efficiency — Energy used efficiently to reduce emissions of greenhouse gases and other pollutants, reduce energy costs for citizens and cities, and help ensure security of energy supply.

Efficient material use and zero waste — Materials and products used efficiently through reuse and recycling with the goal of eliminating the generation of waste.

Resource efficiency — Natural resources used efficiently and operating within the limits of the planet to bring about economic benefits and promote healthier lives and job creation.

Sustainable mobility — A well-connected urban environment based on public and active transport accessible to all, including those socially and economically disadvantaged.

Green economy — An inclusive economy that is low-carbon, resource-conserving, diverse and circular and results in improved human well-being and social equity while significantly reducing environmental risks and ecological scarcities.

Built environment quality — High-quality buildings, public spaces and supporting physical infrastructure, such as water supply, energy networks and transport systems, that are built to last, properly integrated with the wider urban system and effectively support sustainable urban living.

Housing quality — High-quality housing stock that delivers good environmental performance and healthy homes for residents.

Integrated planning — Integrated, long-term spatial planning and design that delivers healthy, accessible, compact, economically competitive cities and sustainable, multifunctional urban peripheries that also effectively manage urban sprawl.

Social and environmental justice — Social and environmental justice that protects the most vulnerable and disadvantaged and gives them access to a good-quality environment.

Participation and empowerment — Empowerment of stakeholders and citizens in relevant aspects of decision-making and knowledge creation through timely engagement and meaningful participation across all sectors of society.

Collaborative and community-led initiatives — Community-led and decentralised networks, initiatives and partnerships that foster social innovation and enhance resilience and cohesion.

2.3 Applying the conceptual framework in the analysis for urban environmental sustainability

2.3.1 Operationalising the conceptual framework

The conceptual framework is intended to be used to structure assessments and analysis of cities from the perspective of environmental sustainability. Such analyses could be top down by institutions such as the EEA or bottom up by individual municipalities or cities. The conceptual framework can be used to identify potential analytical tools (e.g. indicators and supporting data sets, assessment methodologies, case studies) as part of the analysis. This in turn will provide the basis for the EEA's current and future urban environmental sustainability assessments.

Given the complexity of and interactions between processes and policies within urban systems, the components of the conceptual framework are intended to provide a pragmatic means of structuring analysis, for example by focusing on specific building blocks. Analyses can also be focused using the lenses, such that a particular perspective (e.g. low-carbon city or healthy city) is selected to provide a logical framing of the analysis and a means of managing the complexity involved.

The six lenses and six enabling factors introduced in the conceptual framework can serve in particular as the starting points for analysis. The building blocks provide a more detailed focus for analysis through which urban sustainability is viewed. Data or indicators and examples could capture each building block. However, given the breadth and scope of the topic of urban environmental sustainability, it is likely that various analytical tools will need to be used in line with the EEA's typology of knowledge and MDIAK approach ([38]) with a focus on the indicators-assessments-knowledge aspects.

Some enabling factors and building blocks are already fully or partially reported against in pan-European assessments of empirical data (e.g. different dimensions of urban environmental quality and renewable energy production), whereas others are not supported by existing empirical data. These will need to draw on qualitative data, for example from surveys and interviews, and the findings of discrete case studies of city examples where pan-European empirical data are unavailable (e.g. integrated planning, design and policymaking). However, there are likely to be gaps and deficiencies in the evidence base and prioritising the filling of these gaps and/or addressing the deficiencies is an issue to consider in future research.

There is a danger of oversimplification when looking at analysis structured using the conceptual framework (interlinkages between elements are ignored for the purposes of using/developing single indicators, etc.). However, the identification and analysis of nexus issues (see Chapter 3) provides an example of a more integrated approach, recognising the inherently complex and transversal nature of urban sustainability issues.

The EEA approach to the analysis of urban environmental sustainability is based around mixed methods, creating narratives that draw on both qualitative and quantitative data. The EEA is developing two initial approaches to urban sustainability assessment, drawing on the conceptual framework: urban nexus analysis and analysis of drivers and barriers (learning from the experience of pioneering cities). The approach used in each of these approaches is described below.

2.3.2 Examples of forms of analysis

There are various forms of analysis that could be undertaken as part of assessing the current status quo or transition options for achieving urban environmental sustainability. This could be undertaken at a range of geographies with an urban focus, from the European or regional scale through to the scale of individual cities, metropolitan areas and urban agglomerations. Facilitating different forms of analysis of urban environmental sustainability may help decision-makers to identify relevant policy options and priorities.

Examples of types of analysis include:

- analysis of the current status of and/or progress towards achieving targets for individual or collections of building blocks;
- analysis using a specific lens (the resilient city, the green city, the low-carbon city, the inclusive city, the healthy city, the circular city) as a framework;
- analysis of drivers of and barriers to transitions towards urban environmental sustainability relevant to each of the enabling factors.

Such analysis could be used to identify key strengths and weaknesses in transitions to urban environmental sustainability, and therefore could be used to identify where to prioritise future action.

In the following two chapters, specific forms of analysis are illustrated. Chapter 3 presents an analysis using a nexus approach, which is a particularly useful approach given the complexity of the urban system and the need to focus on connections between elements, perspectives, policies and sectors. Chapter 4 provides an example of the analysis of drivers and barriers.

([38]) MDIAK: M, monitoring; D, data; I, information; A, assessment; K, knowledge, understanding, action. The MDIAK framework drives knowledge base management at the EEA and supports the implementation of European policy goals through a wide variety of data activities.

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3
The urban nexus approach: towards integrated, cost-effective actions

Key Messages

- **The urban nexus approach can help identify opportunities to coordinate policymaking and action** — policymaking and action are often developed in silos, addressing specific sectors or issues, with sometimes competing objectives. The urban nexus approach, through which two or more urban policy areas are considered together, can help to identify synergies, co-benefits and trade-offs. In this way opportunities can be prioritised to achieve better coordinated and cost-effective policymaking and action.
- **To achieve transitions policy needs to be integrated vertically and horizontally** — cities often have a degree of autonomy in their governance and so they can, to some extent, influence change independently. However, cities also have interrelationships and interdependencies at different scales, including at the EU and national scales, as well as with neighbourhoods and communities. The nexus approach focuses on the horizontal integration of policy within a city; however, it is also important to consider vertical integration of policy between a city and other scales.
- **The priority urban nexuses analysed in this chapter illustrate how interconnected and complex urban systems are** — the eight example nexuses selected for assessment (climate resilience; quality of life; urban accessibility; environment and health; food security; closing the loop; clean energy; and sustainable buildings) all operate at different levels and interact in many ways. For example, meeting the nexus objective of urban climate resilience relates to other nexus objectives, in particular quality of life, urban accessibility, environment and health, and food security. However, assessing the nexuses individually helps break down the challenges into more manageable issues while also still considering their interconnectedness.

Chapter 1 describes the systemic environmental challenges that Europe and European cities need to address. Cities also need to accommodate a greater number of people in the coming decades while improving the quality of life of their residents. To do so, European cities must urgently shift towards a more integrated approach to addressing these systemic challenges (EEA, 2017a), reflecting the role of cities as actors set out in Chapter 2. *The European environment — state and outlook 2020* report (SOER 2020) stresses the need for policy integration and cross-cutting strategies to address key systems (e.g. energy, mobility) and support the transformation to a low-carbon and circular economy. This chapter introduces the nexus concept and its application within an urban context. Nexus analysis provides a way of helping us to understand complex systems and identify better coordinated polices and actions to support urban environmental sustainability.

3.1 Urban nexus analysis

SOER 2020 stresses that achieving sustainability transitions requires coherence across policy domains and scales. Policymaking and action are often developed in silos, addressing specific sectors or issues, with contrasting objectives (EEA, 2019a). Likewise, research and knowledge development are frequently compartmentalised along disciplinary boundaries. This means that misalignment and conflicts are inevitable, and this limits shared understanding of systemic challenges and responses that fully reflect the barriers, opportunities, trade-offs and co-benefits associated with systemic change (EEA, 2019a). There is a need for policies that embrace the inherent interconnectedness of systems components, interactions across systems, and links between economic, social and environmental goals (EEA, 2019a).

This is certainly the case in cities and metropolitan areas and their peripheries, where the complexity of interactions between socio-economic and environmental factors presents significant challenges for improving citizens' quality of life while minimising environmental pressures and resource depletion. However, as noted, urban areas also provide opportunities for positive systemic change. What is needed is better coordination and prioritisation of policymaking and action across sectors. The prioritisation aspect is particularly important here, as 'total integration' of everything with everything as part of political processes is impossible. However, recognising and prioritising critical interrelationships that have not been addressed appropriately is the first key step towards achieving better integrated policymaking (Rode, 2018). By considering priority interlinkages between systems and policy areas, environmental, social and economic trade-offs and co-benefits ([39]) can be identified (Rode, 2018; EEA, 2019a).

One approach to thinking about the interactions between systems and policies is the nexus approach. Box 3.1 provides more information on the nexus concept, approach and analysis. A nexus is defined as the interlinkages and interrelationships between two or more systems (e.g. food and energy) or policy areas. Nexus analysis refers to the identification and analysis of the interactions, interrelations and interdependencies among sectors and policies or other interventions. The nexus approach involves proactive and integrated policy engagement with such interrelated sectors, resulting in a new approach to policymaking and action. In an urban context this means considering together two or more urban policy areas in order to address a specific

Box 3.1 The nexus concept and its use in an urban context

The term 'nexus' by definition refers to the interlinkages or connections between two or more elements. A 'nexus approach' implies explicitly considering these connections or interlinkages between resources or sectors and the implications of these in, for example, the context of a strategic or policy goal (Magic Nexus, 2018). Hoff (2011) puts the nexus approach in the context of system efficiency over sector productivity: 'The nexus focus is on system efficiency, rather than on the productivity of isolated sectors'. The Food and Agriculture Organization of the United Nations considers the nexus as a 'conceptual approach to better understand and systematically analyse the interactions between the natural environment and human activities, and to work towards a more coordinated management and use of natural resources across sectors and scales' (FAO, 2014).

The nexus approach therefore explicitly recognises synergies and trade-offs as necessary for the development of response options. The approach helps to ensure the sustainability of the environment and people's livelihoods, facilitating more integrated and cost-effective policymaking, planning, implementation, monitoring and evaluation.

The EEA's 2020 state of the environment report introduces the concept of the 'resource nexus'. This recognises that 'links between... systems arise because of their shared reliance on natural systems, both as a source of resources and as a sink for wastes and emissions'. This shared reliance means that 'addressing problems in one area may simply shift the burden to other systems'. A resource nexus approach can also help highlight the interdependence of production and consumption systems and their cumulative impacts (e.g. on ecosystems). Achieving the transition to a low-carbon, resource-efficient economy 'will require that the interlinkages across systems are considered and the trade-offs and co-benefits identified' (EEA, 2019a).

The focus of existing definitions of the nexus approach is predominantly on resource efficiency and the management of scarcity. However, in an urban context, a different focus may be appropriate. UNESCAP (2016) discusses the urban nexus as focusing on the interlinkages among various elements and their 'conversion pathways' — the extraction, supply, distribution, end use, disposal — in consumption and production chains of socio-economic sectors. Furthermore, UNESCAP suggests that cities serve as a nexus, or a focal point that connects and is shaped by economic, technological and social forces (UNESCAP, 2016). UNESCAP (2016) and Lehman (2018) propose an 'intra-urban nexus' and a 'nested urban nexus', the former focusing 'solely on what is urban in the nexus framing', including urban metabolism, infrastructure and human security, while the latter recognises that nexus dynamics need to be understood in the context of driving and constraining forces at both lower and higher levels, meaning that nexus analysis at a city level will need to consider developments at other levels, e.g. global, regional or national policy developments and ecosystems at sub-national and regional levels.

ICLEI and GIZ (2014) define the use of urban nexus analysis as an 'approach that guides stakeholders to identify and pursue possible synergies between sectors, jurisdictions, and technical domains, so as to increase institutional performance, optimize resource management, and service quality'. Rode (2018) discusses the urban nexus as helping to facilitate a move away from the 'functionally segregated city and its simplistic view of the relationship between urban life and city design' towards an approach that can 'better address the complexities, interrelationships and co-dependencies ... characteristic of city systems'. Rode (2018) in particular focuses on what is seen as 'the critical nexus' of urban form and transport, which provides a good illustration of the nexus approach in practice, as 'both elements need to be dealt with jointly to provide accessibility to people, goods and ideas in cities'.

([39]) A co-benefit is where the delivery of one policy area or intervention can help achieve outcomes in another policy area. For example, an intervention to encourage active travel (walking and cycling) could have the main objective of improving public health but might have co-benefits of reducing congestion and air and noise pollution, thus improving quality of life.

urban environmental sustainability problem or to advance a policy objective. By identifying priority synergies, co-benefits and trade-offs, opportunities can be identified for better coordinated and integrated policymaking and action.

Considering urban issues in this way is intended to improve understanding of interactions and enable more coherent and effective policy and other interventions that can identify and minimise trade-offs and 'reduce environmental pressures ... realising potential co-benefits for human health and well-being' (EEA, 2019a). A nexus approach can help decision-makers to choose the most appropriate policy measures or other actions to help identify cost-effective interventions and minimise hidden or unanticipated costs. Cost-effectiveness is defined as either, for a given outcome (e.g. a percentage reduction in air pollution), minimising the net-present value of costs or, for a given cost, maximising the relevant outcome(s) (EC, 2014). In the context of urban environmental sustainability, cost-effectiveness also considers the co-benefits of an intervention (e.g. the health benefits of meeting a primary objective of reduced air pollution).

In summary, the potential benefits of conducting nexus analysis for urban environmental sustainability are to:

- help manage the complexity of urban systems by identifying critical interrelationships, co-dependencies and trade-offs between selected aspects of urban environmental sustainability and/or desired policies and other interventions;
- identify and assess specific counteracting and reinforcing policies and other interventions and their outcomes;
- improve understanding of how to achieve multiple outcomes and objectives together and take advantage of co-benefits;
- identify opportunities for improved policy integration and efficacy, by jointly considering multiple objectives and desired outcomes;
- through the above, help to identify cost-effective urban sustainability policy and action.

3.1.1 Interactions with and dependencies on policy at different scales

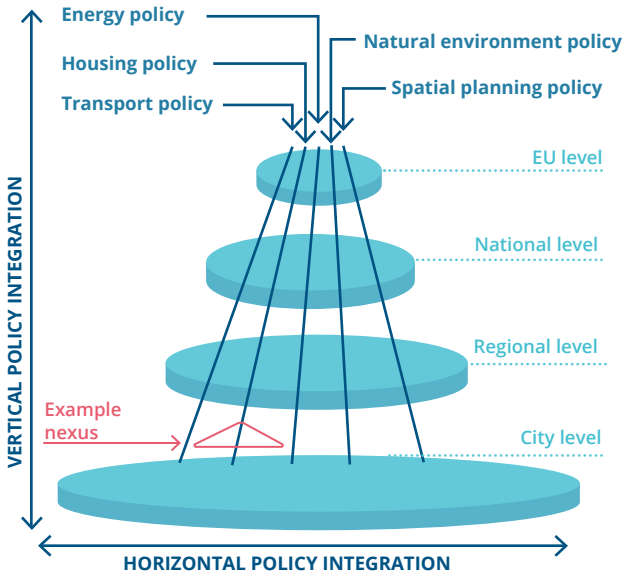
EU cities often have a degree of autonomy in their governance and budgetary arrangements. The analysis of urban sustainability nexuses presented in this chapter focuses in particular on policymaking and action that cities can directly influence and control. The extent of this control will vary between cities and metropolitan areas, depending on factors such as their size and the governance arrangements in different countries; however, the analysis aims to draw out lessons that can have broad relevance. The intention is to explore how policies and actions can be better coordinated and prioritised by city authorities (and within cities) to help achieve urban sustainability outcomes.

Although cities can be seen as representing complex systems in themselves (at the level of the city or functional urban area), they also have interrelationships and interdependencies across different scales. Figure 3.1 illustrates policy integration operating at different scales. In the EU, high-level policy, targets and visions are set at the EU level, and Member States have their own urban policy and regulatory frameworks, including those related to the implementation of EU directives. Some countries have governance at a regional scale, and below this sits city- and sub-city-level governance. As illustrated in Figure 3.1, policy integration can therefore be viewed:

- vertically — policy areas operating across different scales or levels (e.g. EU, national, city);
- horizontally — different policies or actions implemented and interacting with each other at a particular scale or level.

The nexus analysis considers both of these types of integration. Each nexus recognises the importance of EU and national policy frameworks and targets, while the analysis focuses on the identification and assessment of horizontal policy interactions. The aim is to help move towards more integrated policymaking and interventions in cities, and in this way to support the transition to urban environmental sustainability. In Figure 3.1 this is illustrated by the red triangle, highlighting as an example the nexus between the transport, housing and energy policy areas, which operate at the city level (horizontal integration) but are influenced by and need to be integrated with higher-level policy and in turn will influence lower spheres (vertical integration).

Figure 3.1 Vertical and horizontal policy integration



Source: Authors' compilation.

3.2 Priority urban sustainability nexuses

Drawing on the conceptual framework (see Chapter 2), literature review and stakeholder input, eight priority urban sustainability nexuses were identified and selected. Figure 3.2 presents an overview of these nexuses. The eight nexuses were selected to cover a range of key urban sustainability objectives, and to reflect the main topics addressed by EU environmental and climate policies. They also highlight some of the most critical interrelationships between sectors, which are currently not considered appropriately as part of policymaking and action. They are not, however, intended to be comprehensive, as a great many other sustainability objectives and critical interrelationships exist, and in meeting these objectives a very large number of critical policy interactions or nexuses could be identified.

The overall aim of the urban nexus analysis is to explore critical interlinkages and interrelationships between two or more policy areas that need to be considered together in order to advance an urban sustainability objective. The selected urban nexuses are intended to be examples of how this analysis approach could be used in practice to identify existing challenges to achieving urban sustainability objectives and opportunities to move towards better coordinated and integrated policymaking and action. The interlinked policy areas that need to be considered to achieve the nexus objectives that were selected as part of the analysis of the eight priority nexuses are illustrated in Figure 3.2.

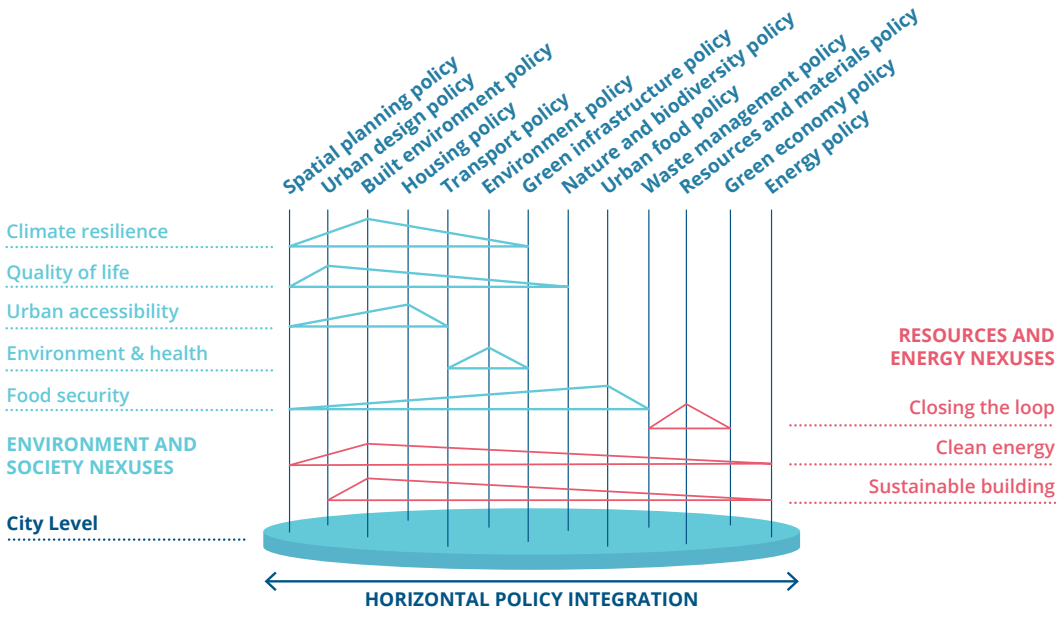
Each nexus is framed around meeting a high-level urban sustainability objective (e.g. climate resilience, food security) that is systemic in nature and requires coordinated policymaking and action. Meeting these nexus objectives could require interventions in a large number of policy areas.

However, for the nexus analysis in each case, three interlinked policy areas were selected to help identify examples of key interactions, challenges and opportunities for prioritisation and coordination of policy and interventions. Different or additional policy areas could be selected to broaden the analysis or to focus on other policy priorities. However, the selection for this analysis is intended to represent some of the key areas in which coordinated policy is required. Although different cities may use different terminology and have divergent levels of authority or autonomy, the selected policy areas are intended to be representative of strategy, policy and other interventions commonly seen in cities. For example, in areas such as housing, transport, waste management or spatial planning, specific policies, standards and budgets are often set at a municipal or city level.

The assessment draws on the conceptual framework (see Chapter 2) by considering actions in the context of the 'building blocks' of urban sustainability that are relevant to the key policy areas in each nexus. Each nexus analysis also explores one example of a challenge and the actions to address it in more detail. By focusing the analysis in this way, the intention is to facilitate a more detailed assessment than would be possible if a larger number of challenges and actions were considered. Of course, each nexus has many potential challenges and associated actions and these will differ from city to city.

The nexus analysis is based on an assessment of what challenges cities typically face in meeting urban sustainability objectives, which critical interrelationships are currently 'under-serviced' and how action can be better coordinated and/or prioritised across the selected policy areas. In doing so, the analysis can identify co-benefits and trade-offs and help to improve the cost-effectiveness of interventions.

Figure 3.2 Key interlinked policy areas considered in the analysis of the priority nexuses



Source: Authors' compilation.

Although no hierarchy of nexuses is intended, some do represent higher-level or more overarching sustainability objectives, while others are more specific. For example, meeting the high-level nexus objective of 'climate resilience' relates to other nexus objectives, in particular 'quality of life', 'urban accessibility', 'environment and health', and 'food security'. These relationships are in themselves complex and bi-directional. For example, improving 'urban accessibility' or 'environment and health' through the creation, enhancement or change in use of green infrastructure (GI) can also enhance a city's resilience to climate change ('climate resilience' nexus). Nexuses that primarily relate to 'environment and society' are grouped together in Table 3.1.

Table 3.1 Overview of the eight example nexuses

Urban sustainability objective — the 'nexus objective'	Key interlinked policy areas that need to be considered to achieve the nexus objective	Building blocks relevant to the key policy areas (see key below)	Example challenges and the actions to address them
Environment and society nexuses			
Climate resilience	• Spatial planning • Green infrastructure • Built environment		Managing urban flood risk by using nature-based solutions
Quality of life	• Urban design • Spatial planning • Nature and biodiversity		Increasing access to green space through integrated land use planning
Urban accessibility	• Spatial planning • Transport • Housing		Increasing urban density through transit-oriented development
Environment and health	• Environment • Green infrastructure • Transport		Improving air quality by creating car-free cities
Food security	• Urban food • Spatial planning • Waste management		Promoting urban agriculture through small-scale innovation projects
Resources and energy nexuses			
Closing the loop	• Resources and materials • Waste management • Green economy		Reducing waste, encouraging reuse and boosting local economies through 'urban resource centres'
Clean energy	• Built environment • Spatial planning • Energy		Decentralising energy production by using clean energy sources
Sustainable buildings	• Resources and materials • Built environment • Urban design		Reducing resource consumption in building construction and use by adopting innovative design, materials and systems

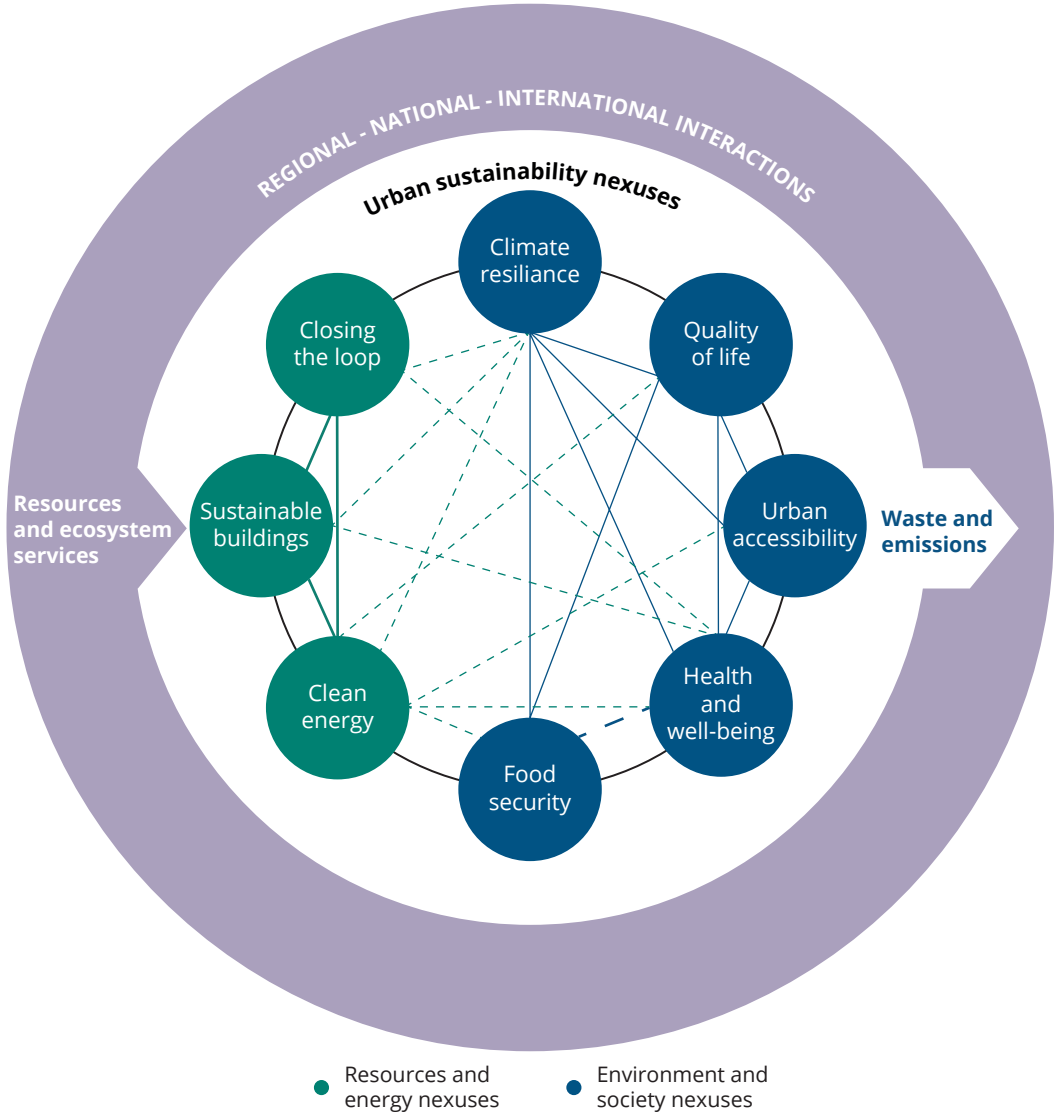
Key to building blocks:

Environmental quality; Adaptive capacity; Public open space; Green and blue infrastructure; Ecological multifunctionality; Sustainable urban agriculture; Renewable energy; Low energy consumption; Energy efficiency; Efficient material use and zero waste

Resource efficiency; Sustainable mobility; Green economy; Built environment quality; Housing quality; Integrated planning; Social and environmental justice; Participation and empowerment; Collaborative and community-led initiatives

Source: Authors' compilation.

Figure 3.3 **Interrelationships between the eight selected nexuses**



Source: EEA.

Likewise, the objective of 'closing the loop' in a city implies moving to a more circular urban economy, in which products, materials, built assets and land are kept in use while maintaining their value, and waste generation is minimised. Closing the loop represents a high-level nexus, and the achievement of other nexus objectives, in particular 'sustainable buildings' and 'clean energy', will contribute to meeting the higher-level objective of a circular urban economy and vice versa. Nexuses that primarily relate to 'resources and energy' are grouped together in Table 3.1.

In addition to the key interactions reflected in the grouping of nexuses into 'environment and society' nexuses or 'resources and energy' nexuses, there will also be a range of other relationships between the nexuses. Continuing the example of 'closing the loop', a circular economy in cities would also contribute to other nexus outcomes, including 'environment and health', as improved resource management practices can reduce local pollution levels; improved 'quality of life' through improved environmental quality and the provision of urban resource centres that can act as community hubs; and 'food security', where local food initiatives to reduce food waste improve access to food. Similar relationships will exist between all nexuses.

Each nexus is analysed separately, to keep the level of detail manageable (see Sections 3.3-3.10). However, reflecting the nature of cities as complex systems, in practice the nexuses do not stand alone but overlap and interact with each other in various ways and at different scales. Figure 3.3 illustrates the interrelationships between the nexuses.

A summary of each of the example nexuses is presented below ([40]). A template was used to develop each example nexus analysis. Following the template, each nexus analysis includes:

- an introductory section setting out **why the nexus objective is important** for urban sustainability and summarising key relevant EU and international policy frameworks;
- **a nexus figure** that presents visually the interlinked selected policy areas that the nexus is based around, as well as the key building blocks relevant to meeting the nexus objective (see Figure 3.4, an example for the climate resilience nexus);
- an overview of the main **challenges and actions** for cities in meeting the nexus objective (including policy and range of other interventions);
- an assessment of one selected **example interrelated area of policymaking and action**, including case studies from European cities;
- a summary of the **lessons** for achieving the nexus objective;
- a list of sources of **additional information and existing networks** relevant to the nexus.

Following the summary of each nexus, some overall messages and lessons from the nexus analysis are discussed.

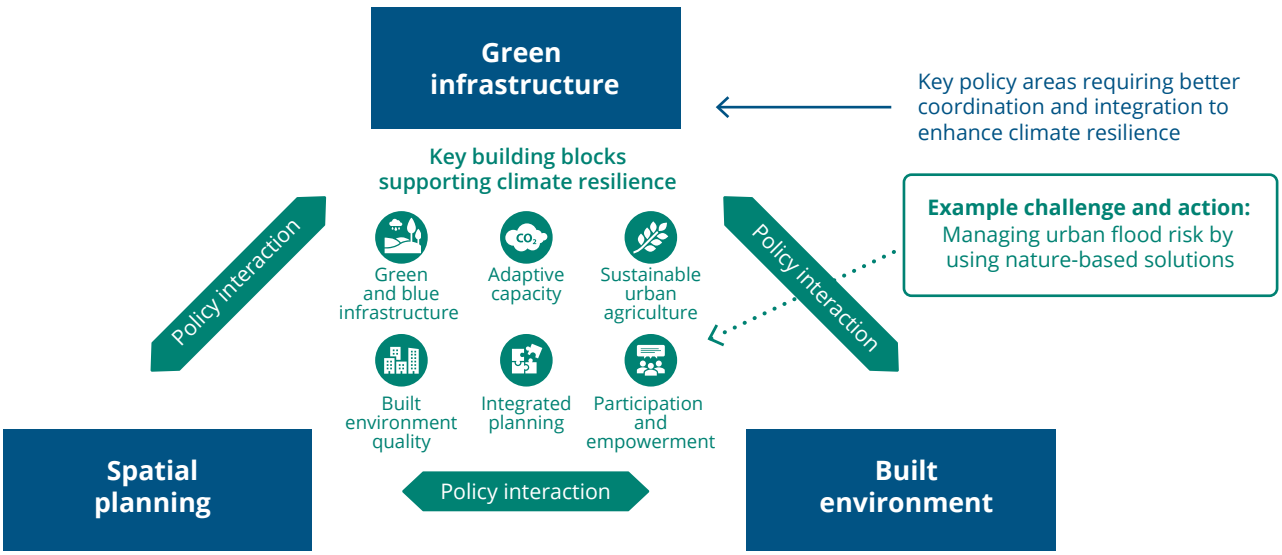
3.3 Climate resilience nexus

3.3.1 What is climate resilience and why is it important in an urban context?

A climate-resilient city is one in which individuals, communities, institutions, businesses and systems have reduced exposure to, are prepared for and can cope with, recover better from, and adapt and transform as needed in response to the impacts of climate change. The importance of urban resilience to climate change is emphasised in the EU adaptation strategy (EC, 2013) and the climate adaptation partnership of the urban agenda for the EU (Climate Adaptation Partnership, 2018). The European Commission announced in the European Green Deal communication that it plans to adopt a new, more ambitious EU strategy on adaptation to climate change in 2020/2021 (EC, 2019a; EEA, 2020b). To provide a legal basis for achieving the European Green Deal's goal of the EU being climate neutral by 2050, the European Commission has proposed the first European Climate Law (EEA, 2020b). The law aims to ensure that all EU policies and all sectors of the economy and society contribute to the goal of climate neutrality.

A range of perspectives and definitions of resilience exist across policy, practice and research. This includes narrow, engineering-based, structural definitions of resilience and interdisciplinary concepts focused on the interrelationship between social and ecological systems (Armitage et al., 2012).

Figure 3.4 **The climate resilience nexus: key policy areas and relevant conceptual framework components**



Source: Authors' compilation.

([40]) Note that fuller versions of the nexus analyses are presented in a separate EEA report, *Urban Sustainability in Europe — Learning from nexus analysis* (forthcoming).

A distinction is also made between proactive and reactive resilience. Reactive resilience focuses on resistance and 'bounce-back' after a shock and suggests a return to the status quo. Proactive resilience emphasises adaptation to and transformation in response to both shocks and stresses and suggests a need to change existing conditions (Twigger-Ross et al., 2015). Proactive resilience is particularly relevant to urban sustainability. By avoiding 'bouncing back' to previous, potentially unsustainable states, cities can adapt, transform and learn while following new trajectories for future development (Chelleri et al., 2015).

Building urban resilience implies moving away from unsustainable urban development practices while implementing measures to adapt to and mitigate climate change. Recognising and accounting for the synergies between adaptation and mitigation measures can help ensure that managing climate change impacts will also reduce greenhouse gas impacts and vice versa. Enhanced climate resilience will help cities tolerate climate change impacts and natural disasters. In doing so, it reduces the risk of potential collapse in social, economic and technical systems and infrastructures.

If cities enhance their climate resilience, this will also support progress in some of the other priority nexuses, in particular 'environment and health', such as through more sustainable uses of land and creation of GI; 'sustainable buildings', such as through standards for new and retrofitted buildings to reduce greenhouse gas emissions; and 'quality of life', such as nature-based solutions that can, for example, reduce flood risk and protect people's homes.

The climate resilience nexus and the COVID-19 pandemic

As the COVID-19 pandemic and subsequent lockdown measures altered all aspects of urban life, many cities had to reconsider their resilience to large shocks, including climate change. Ensuring access to urban green spaces for the public emerged as a fundamental strategy of cities when coping with this crisis. In addition, local authorities across Europe are reshaping their transport networks by reallocating some road space from private cars to public transport, pedestrians and cyclists. This has provided cities with an opportunity to reduce emissions from vehicles and greater opportunities for greening (EEA, 2020b).

The COVID-19 pandemic highlights the importance of cities being resilient to shocks. The growing awareness of resilience as a wider concept and the cascading effects of the COVID-19 crisis across systems (e.g. mobility, food) have highlighted the importance of planning for future risks. The pandemic has also had a disproportionate impact on the most vulnerable groups in society. In their resilience strategies and green recovery plans, city governments need to reflect on the social justice implications of climate risks and adaptation actions.

3.3.2 Challenges of and actions for achieving climate resilience in cities

Relevant interlinked policy areas

This nexus focuses on three interconnected policy areas relevant to achieving climate resilience in cities (spatial planning, GI and built environment) and on the building blocks relevant to these key policy areas (see Table 3.1). Integrating these policy areas could have multiple co-benefits, such as improved flood risk management, enhanced carbon sequestration, improved air quality, increased use of active transport and improved quality of life. Yet, there are also some potential trade-offs. For example, the creation of green spaces can lead to higher land and property prices in adjacent neighbourhoods and may trigger gentrification (Raymond et al., 2017; IEEP, 2021). Without accompanying policies and measures (e.g. related to affordable housing) this may exacerbate inequalities within cities.

Example challenges and actions

Cities face many challenges in achieving climate resilience. These include institutional, technical and capacity challenges; competing political priorities; processes that challenge the long-term planning required; and challenges in understanding the complex trade-offs between building resilience and mitigating climate change. Table 3.2 sets out some of the main challenges cities may face in achieving climate resilience and gives examples of actions that could help to address these challenges. The COVID-19 pandemic might encourage local policymakers to take action, as it has highlighted the importance of cities being resilient to unprecedented shocks.

Table 3.2 Overview of challenges of and actions for achieving climate resilience in cities

Example challenges	Example actions to address challenges
• Weak institutional capacity and lack of cross-sectoral integration acting as a barrier to building adaptive capacity and reducing vulnerability.	• Seek to build institutional capacity, e.g. by engaging with city networks on climate change (e.g. Covenant of Mayors for Climate & Energy) and training or recruiting staff. • Improve communication and integration between different departments of local administrations.
• Lack of technical expertise in and knowledge of the range of climate change adaptation approaches (e.g. incremental and transformative) and specific measures that should be implemented.	• Adopt incremental approaches that maintain the essence and integrity of systems by going beyond existing actions to deal with natural variation in climate and with extreme events (e.g. upgrading sewerage systems, improving air conditioning, getting water from deeper wells, providing additional storage, and ensuring water rationing and leakage reduction as short- and medium-term solutions to deal with climate impacts). • Adopt transformative approaches that offer longer-term solutions to deal with climate impacts, such as ensuring land use and spatial planning creates space for water, placing infrastructure on higher ground, establishing policies and design standards to cool buildings through greening, reusing and recycling water, and using GI to mitigate urban overheating, regulate water flows and mitigate flooding (see Box 3.2).
• Insufficient financial resources to design and implement adaptation measures.	• Explore funding mechanisms available at national and EU levels. For example, at the EU level, financial support for adaptation interventions can be accessed through the LIFE programme, European Regional Development Fund and the European Investment Bank, e.g. through their financial support for integrated, sustainable urban renewal programmes.
• Inadequate awareness of and insufficient accounting for social inequalities in relation to climate impacts and solutions.	• Engage local citizens (including vulnerable groups and those less likely to engage in 'traditional' citizen participation processes) through participative decision-making on the choice and design of adaptation and mitigation options to ensure local buy-in and secure uptake. • Perform specific vulnerability analysis to understand needs and identify vulnerabilities determined by social differences. • Design climate adaptation and mitigation interventions to address the needs of the most vulnerable groups. • Adopt coping approaches such as making flood insurance obligatory, providing heat alerts for those most vulnerable, harvesting rainwater and using less water-intensive sanitation techniques as short- and medium-term solutions to deal with climate impacts.
• Lack of accounting for potential interactions between climate adaptation and mitigation measures to avoid undesirable trade-offs and maximise synergies.	• Explicitly consider the synergies and co-benefits between adaptation and mitigation in city climate change action plans to reduce greenhouse gas emissions and help manage climate change impacts. • Link adaptation and mitigation policies and investments to maximise synergies.

Box 3.2 presents an example of an interlinked area of policymaking and action relevant to achieving climate resilience in cities. The example focuses on using nature-based solutions (NbS) to help manage urban flood risk in cities. By using natural processes, NbS can regulate water flows and mitigate flood risk. Box 3.3 presents an example of a sustainable strategy developed in Lodz (Poland) to mitigate urban flooding by integrating NbS.

3.3.3 Lessons for achieving climate resilience in cities

A number of lessons emerge from the analysis of the climate resilience nexus, including:

- Given that the EU has no formal authority over spatial planning, actors such as the Covenant of Mayors for Climate & Energy have an important role in facilitating cities to engage in this coordinated approach to tackle mitigation and adaptation to climate change.
- Well-informed and coordinated planning with a long long-term perspective is important in meeting the challenges posed by climate change impacts.
- Developing a joint adaptation and mitigation plan in cities is useful in optimising the use of available resources, addressing trade-offs and achieving co-benefits between sectoral policies.
- Cities may need support from the EU and national governments in the form of funding, capacity building, knowledge and data in order to support local adaptation and mitigation measures.
- Integrating GI into spatial planning policies and practices while coordinating with built environment policies could optimise and strengthen the policy coordination needed to build climate resilience.
- Horizontal coordination is important for climate resilience in cities, considering that mitigation and adaptation policies tend to be managed by different stakeholders at different spatial and governance levels (e.g. mitigation is often managed at the national level and dominated by a few sectors, whereas adaptation tends to involve a broader range of sectors and is managed more disparately by individuals or national agencies).
- There is a vast range of knowledge available to cities, from tools and data to well-established case studies on how cities can mitigate and adapt to climate impacts and determine the action necessary to achieve climate resilience.

The crisis induced by COVID-19 has enabled cities to learn lessons about increasing resilience to climate change, as this crisis has many characteristics in common with climate challenges and their impacts on society (e.g. rapid emergence, global presence, disproportionate impact on vulnerable groups).

3.4 Quality of life nexus

3.4.1 What is quality of life and why is it important in an urban context?

In many respects, quality of life (QoL) has improved in European cities in the past 50 years. The relatively high quality of urban living is often considered one of the most prominent competitive advantages of European cities compared with many other global cities. However, there are aspects (e.g. physical and mental health) in which QoL has stagnated or worsened in recent decades.

Box 3.2 Example of an interlinked policy-action area: managing urban flood risk using nature-based solutions

Climate change is expected to increase the intensity and frequency of extreme rainfall, which is one of the main drivers of urban flooding (Hammond et al., 2013). Flood risk in cities is exacerbated by the extent of impermeable land surfaces, coupled with housing and commercial development in river floodplains (EEA, 2016f; IEEP, 2021).

To mitigate urban flooding the use of nature-based solutions (NbS) can help to address a variety of environmental, social and economic challenges associated with this risk. They are actions inspired by, supported by or copied from nature (EC, 2015b), for example tree planting and creating reed beds and ponds. Maintaining and enhancing green and blue infrastructure is therefore of crucial importance, as it forms the basis for these solutions. It also requires spatial planning policy that protects existing, or supports the creation of new, open and green spaces and facilitates their use in flood management. The implementation of NbS can also replace or reduce the need for built infrastructure such as culverts and drainage.

Coordinating these policy areas to reduce flood risk in cities through NbS can result in co-benefits, for example by improving air quality and providing space for recreation (human health benefits), providing a buffer for habitats and species (environmental benefits) and carbon sequestration (climate mitigation benefits). Long-term urban spatial planning is particularly important to maximise co-benefits and limit trade-offs (EEA, 2020b).

Ensuring access to urban green spaces for the public emerged as a fundamental strategy of cities in coping with the COVID-19 crisis. This has provided cities with greater opportunities for greening, which supports flood prevention.

Box 3.3 Example of a policy response: urban river restoration — a sustainable strategy for stormwater management in Lodz, Poland

During Industrialisation, the majority of the city's many urban streams were canalised and transformed into culvert pipes. This led to frequent flooding in parts of the city during storms. In response, the city developed, in the context of the Switch project, a holistic approach to urban planning based on a blue-green network concept to reduce flood risk and improve the microclimate.

The approach was tested in a demonstration project on the Sokołówka river, where hydraulic rehabilitation measures, wetlands and three storm water reservoirs (completed in 2006, 2009 and 2010) and a sequential sedimentation bio-filtration system for stormwater purification (completed in 2011) were planned and implemented. The Sokołówka river restoration project has contributed to resolving a series of climate-related challenges including reduced urban surface flooding and extreme flows, increased groundwater levels, improved water quality and increased urban quality of life and health.

The demonstration project in the Sokołówka valley triggered follow-up actions by private investors and increased the interest of civil society. The experience has convinced the Lodz authorities and water professionals of the value of replicating these for other rivers/cities across the country.

Source: Climate-ADAPT (2020).

The disproportionate exposure of lower socio-economic groups to air pollution, noise and other negative environmental impacts tends to affect urban areas more than rural areas (EEA, 2018b). The COVID-19 pandemic has also disproportionately affected the poorest urban residents, highlighting the huge inequalities that persist when it comes to QoL. Addressing the challenge of inequality of opportunities and QoL is therefore of growing concern for most European cities.

The term QoL is widely used in the policy literature but lacks an agreed definition. It can be highly subjective and dependent on people's individual circumstances, although there is a broad consensus that a good QoL is a universal desire.

Existing definitions of and approaches to assessing QoL explicitly link it to the natural world. This link relates to material (e.g. food, water and energy security) and non-material (e.g. equity, freedom of choice, enjoyment of natural beauty) dimensions. The European Commission also recognises that the quality of the natural and physical environment are key determinants of QoL (Eurostat, 2016). The evidence strongly suggests that a greater focus on urban environmental quality is essential in policy responses that aim to enhance QoL in cities. Previous work by the EEA has established environmental quality as a fundamental issue for social well-being and urban QoL (EEA, 2009).

If a better QoL is realised in cities, this is likely to support progress in other priority nexuses, in particular 'sustainable buildings', through well-built, well-insulated and well-ventilated housing; 'urban accessibility', through the creation of safer, cleaner and more walkable streets; and 'environment and health', through sufficient and biodiversity-rich green spaces accessible to all.

The quality of life nexus and the COVID-19 pandemic

The COVID-19 pandemic and the resulting social distancing and lockdown measures are having a substantial impact on a range of urban systems that have further affected people's QoL. The significant reduction in motorised traffic as a result of the travel restrictions imposed across European countries and cities initially led to a drastic reduction in noise and air pollution levels (EEA, 2020c), although the easing of restrictions partially reversed this positive trend. For example, air pollution levels have seen a rebound in several European cities (e.g. Athens, London, Paris), driven by an increase in traffic and congestion (EEA, 2020d). To sustain the positive impacts on QoL, the longer-term recovery plans need to actively avoid a return to 'business as usual'. One of the major risks is an increase in private motorised traffic as people continue to avoid public transport. Ensuring that some of the infrastructure changes that were put in place to encourage more active travel (e.g. new segregated cycle lanes, wider pavements, traffic calming measures) become permanent will help to ensure a healthier and more sustainable mobility system in future.

The COVID-19 pandemic has laid bare and exacerbated the huge inequalities that persist when it comes to European urban residents' QoL. Local lockdowns disproportionately affected the poorest urban residents, with ethnic, racial and religious minorities, migrants, elderly people, people with disabilities and other marginalised groups particularly affected. Those with the lowest household incomes have been less able to work from home and also experienced much higher rates of unemployment. This has been compounded by poor housing conditions, including higher exposure to air pollution, crowded living conditions, poor thermal insulation and no outdoor space, all of which increase the risk of COVID-19 infections (Ahmad et al. 2020) while negatively affecting long-term QoL. To reverse some of the devastating impacts on the QoL of the most vulnerable urban groups, recovery planning needs to understand and address existing social inequalities within local communities. This includes investing in better housing, reducing air pollution and improving access to high-quality public green spaces and other urban amenities in low-income neighbourhoods.

3.4.2 *Challenges of and actions for achieving urban quality of life*

Relevant interlinked policy areas

Together, the natural and built environments create conditions that either improve or worsen social, economic and cultural elements of QoL. This nexus recognises the essential but often neglected role of the natural environment in determining QoL and the way this is integrated with the built environment in cities. The QoL nexus focuses on the need for coordinated policy related to spatial planning, urban design, nature and biodiversity, and on the building blocks relevant to these key policy areas (see Table 3.1). Integrating these policy areas could have co-benefits, such as enhanced amenity value for people and increased biodiversity.

Example challenges and actions

The challenges of successfully improving QoL in cities fall into two broad categories: methodological issues and governance issues. Table 3.3 sets out some of the main challenges cities may face in achieving good urban QoL and gives examples of actions that could help to address these challenges.

Box 3.4 presents an example of an interlinked area of policymaking and action relevant to achieving good urban QoL. The example focuses on the establishment of integrated land use planning to increase access to green space in cities. Access to high-quality green space has been shown to reliably improve people's satisfaction with where they live while also being linked to improved health outcomes and promoting physical activity, which in turn improves QoL. The COVID-19 pandemic has also restated the value of green areas for people's QoL.

Table 3.3 Overview of challenges of and actions for achieving good urban quality of life

Example challenges	Example actions to address challenges
• Methodological issues in defining and measuring QoL and determining what good QoL looks like. • The tensions between individual needs and short-term QoL improvements and desires and collective, longer-term needs for sustainable development.	• Understanding the clear causal links between specific policy actions and QoL improvements, e.g. by using established indicators to measure the health impacts of more urban green space. • Taking a systemic view and considering the distributional impacts when implementing measures to improve QoL.
• Poor sectoral policy and governance integration hindering effective mainstreaming of QoL into urban decision-making processes.	• Defining a clear and measurable set of QoL indicators that can be used to assess urban policies to track improvement over time.
• Complex interactions between many determinants of QoL mean that efforts to promote one element can result in unwanted/unexpected impacts on other QoL element(s).	• Careful monitoring of any new measures to improve QoL to ensure that trade-offs are carefully considered and the distributional impacts of different policies on all sectors of society are considered. • Establishing links between mental health benefits and access to green areas, as seen during the COVID-19 pandemic.
• Poor environmental quality (e.g. air, water, noise) and lack of access to green space affecting the physical and mental health of urban dwellers. • Excessive motorised traffic causing pollution and community severance and discouraging safe active travel options. • Housing and built environment quality not meeting the needs of residents, leading to high fuel costs and an uncomfortable living or working environment.	• Implementing NbS that provide biodiversity-rich green spaces that enhance people's QoL (see Box 3.4). • Implementing traffic reduction measures, including improved frequency and availability of public transport, reducing speeds, restricting vehicle access to certain areas, or reallocating road space to other uses to reduce air and noise pollution, all of which have health and social cohesion co-benefits. • Improving housing and broader built environment by insulating housing, using sustainable heating/cooling sources that reduce air pollution and greenhouse gas emissions, and using vegetated rooftops, all of which have tangible health benefits while also reducing issues of fuel poverty and improving resilience.

They have co-benefits such as enhancing urban biodiversity, improving air quality, improving soundscapes, providing a carbon sink, reducing the urban heat-island effect, and absorbing stormwater. Box 3.5 presents an example of compact development and green spaces in Ljubljana (Slovenia).

3.4.3 Lessons for achieving urban quality of life

A number of lessons emerge from the analysis of the urban QoL nexus, including:

- From the environmental and sustainability perspectives, implementing NbS and traffic reduction measures, as well as improving the quality of housing and the built environment, are examples of the actions that potentially address many challenges related to the QoL nexus.
- To achieve transferability of good practices that support QoL across cities, short-term, sectoral and 'siloed' governance approaches need to be transformed to facilitate more collaborative, integrated, holistic and long-term solutions. This might support the ability to replicate and adjust successful interventions to suit different types and scales of sectoral and city governance, as well as specific city contexts (e.g. spatial, cultural, geographical).
- Addressing the complexities associated with the achievement of equitable and sustainable QoL improvements in cities is a shared European policy objective; therefore, this should offer an incentive for truly horizontal and vertical integration in policymaking.
- In the post-pandemic world, as a result of changes in priorities, at the individual, societal and government level, in relation to what constitutes good urban QoL, it will be even more fundamental to address unsustainable urban lifestyles and consumption patterns. Cities need to imagine alternative urban futures in which there is a shift away from an individualistic perspective towards policies that promote good QoL for all.
- While exact definitions of QoL may differ between individuals, cities and countries, there are several commonalities. This suggests that achieving urban QoL would benefit from European cities and partnerships exchanging knowledge across different levels of government, civil society and the private sector.

Box 3.4 Example of an interlinked policy-action area: increasing access to green space through integrated land use planning

Many European cities already have an existing urban fabric that can be regenerated and reconfigured to increase access to green space. Despite this potential, 'green recycling' (whereby previously developed grey infrastructure is redeveloped as green areas) remains a marginal phenomenon.

During the lockdowns imposed in response to the COVID-19 pandemic people became more acquainted with their immediate neighbourhoods and local green spaces. There is some evidence that this has led to an increased appreciation of the importance of nature (Rousseau and Deschacht, 2020). Europe's urban planners will need to play a key role in designing compact but green cities, with key amenities within walking distances. In addition, planners should design mobility systems that reduce travel distances and times or an extensive green infrastructure network that connects all natural areas across the continent (EEA, 2019a). Another important strategy available to urban planners is the application of urban containment boundaries. These create 'hard' edges between the city and the countryside to ensure that development is not allowed to sprawl into intact natural habitats (Schulze Bäing, 2010). This not only ensures that existing natural spaces and biodiversity are preserved and cities remain compact in their growth but also allows people access to wild areas in close proximity to the city.

The COVID-19 pandemic has further increased the inequalities that persist for some European urban residents. Poor housing conditions and no access to green space further increase the risk of COVID-19 infections (Ahmad et al., 2020) while negatively impacting long-term quality of life. Land use policies that promote biodiversity and green space need to carefully monitor how investments in greening existing urban spaces affect low-income residents to avoid 'green' gentrification. Such policies should also ensure that the benefits of green spaces are experienced by a diverse range of people irrespective of their socio-economic background (Maantay and Maroko, 2018).

Box 3.5 Example of integrated land use planning: a focus on compact development and green spaces to promote well-being in Ljubljana, Slovenia

In 2007 the city centre of Ljubljana was closed to all motorised traffic as part of an urban 'ecological zone' that today covers more than 100 000 m^2. The Ljubljana urban master plan, which forms part of the city's 2025 development vision ensures that 83 % of new development will be focused on existing brownfield sites to preserve green spaces and regenerate the urban core in order to enhance the quality of life of local residents. An essential element of the city's strategy has been the ecological restoration of the River Ljubljanica, including renovated riverbanks with improved vegetation to create new high-quality public spaces.

Between 2009 and 2016 the city created more than 90 ha of new public green areas on former brownfield or degraded land. (This, among other factors, led to its selection as European Green Capital in 2016.) Today, almost 75 % of the city's surface area is green areas. 80 % of the green areas are on the outskirts of the city and are connected to the historical centre by green wedges and riparian corridors that link city centre parks and gardens. This includes a 34-km-long circular green corridor popular for sports and leisure.

Source: Oppla (2021).

3.5 Urban accessibility nexus

3.5.1 What is accessibility and why is it important in an urban context?

Accessibility is generally understood to mean the ease with which people can reach goods, services and activities and connect with one another (Litman, 2007; Rode et al., 2019). Based on this definition, urban accessibility is considered high when households can reach a wide variety of destinations in a short amount of time and at a low cost per unit of travel (Duranton and Guerra, 2016).

It is well established in the EU that providing accessibility for everyone, at the lowest cost to the environment, should be the key objective of any transport policy (EEA, 2000). Even so, many European cities continue to be confronted by major accessibility challenges. This is because decades of transport and land use planning have locked cities into prioritising a car-centric urban development model. Traffic congestion remains a significant issue for all major EU cities, costing nearly EUR 100 billion, or 1 % of the EU's gross domestic product per year (EC, 2017b).

Moving towards better urban accessibility is increasingly seen as a fundamental precondition for achieving a range of urban environmental sustainability objectives. It leads to reduced CO_2 emissions from transport, improved air quality, reduced noise, preservation of green space and reduced habitat fragmentation. This is because there is a strong link between a more compact urban form and transport demand. Denser cities generally increase accessibility through the proximity of urban functions and services while reducing resource consumption and negative environmental impacts (Rode et al., 2014, EEA, 2020e).

If better urban accessibility could be realised in cities, this would be likely to support progress in other priority nexuses and, in particular 'environment and health', through measures that reduce car use and traffic and establish multifunctional green spaces; 'climate resilience', s through the development of more sustainable transport systems; and 'quality of life', by creating more liveable streets and improving access to green spaces and other urban amenities.

The urban accessibility nexus and the COVID-19 pandemic

The need for immediate social distancing measures to contain the spread of the virus led to rapid changes in travel behaviour in most cities, with far-reaching consequences for urban accessibility. Public transport systems were either partially closed or operating at reduced capacity in many cities, especially at the beginning of the pandemic. For many travellers, reducing the risk of infection has become the main criterion for choosing a mode of transport, even overtaking time to reach the destination and the price of the trip in importance (McKinsey Center for Future Mobility, 2020). As a result, many European cities saw a significant increase in the number of people walking and cycling for leisure and as a means of transport. This demonstrated that mobility behaviours in cities are a lot more fluid than perhaps previously assumed.

To accommodate these new sustainable travel behaviours and to prevent an increase in private motorised vehicle trips, many cities responded with rapid infrastructure changes, including pop-up bicycle lanes, widening pavements and closing parts of the city to cars. For example, Paris built 50 km of temporary bicycle lanes by taking space away from motor vehicles, whereas in Rome the creation of 150 km of new bicycle lanes has been approved (Zafra, 2020). In addition, a significant increase in home working (for those with office-based jobs) also led to an overall reduction in travel demand, and the widespread adoption of technologies that facilitate virtual connectivity may cause companies to rethink the necessity of maintaining large and expensive inner-city office space (Deloitte, 2020).

In their pandemic recovery plans, many cities have started to recognise that there can be no return to 'business as usual'

and are proposing new regulatory interventions that deter car use and incentivise public and active travel. These may include investment in the active travel infrastructure; improved public transport safety and accessibility; changes in traffic regulations to increase safety; and pricing policies such as congestion charges to prevent an increase in car use. For example, Dublin started to develop a 'living' framework of mobility proposals along with the National Transport Authority. This plan proposes to provide additional space for pedestrian areas and safe cycling facilities (OECD, 2020).

As a result of the pandemic, many employers are looking at new ways of working, and there is some evidence that the idea of a '15-minute city', in which people are able to meet all of their daily needs within a short walk or cycle from their homes, is gaining some traction among policymakers (Martínez Euklidiadas, 2020). If cities are to embrace this model of urban proximity, it will require a reconsideration of how public and active transport is currently planned. In the longer term, if there is an overall replacement of physical connectivity with more virtual connectivity, this could lead to reductions in the need for travel without necessarily sacrificing accessibility. However, the impact of these changes will is likely to be unequally distributed across different population groups, and city governments will have to think very carefully about how their recovery policies can ensure that the most vulnerable groups do not experience a decline in their accessibility to urban opportunities. To help policymakers with the long-term sustainable mobility transition, a new foresight project, 'European urban mobility 2050', supported by the EEA, will provide the narratives that they need to make the transition in the right direction.

3.5.2 *Challenges of and actions for achieving urban accessibility*

Relevant interlinked policy areas

This nexus focuses on coordination between transport policy (which determines the transport options available), spatial and land use planning (which determines where different services and resources are located within the city and relative to one another) and housing policy (which determines questions of equity and inclusion), and on the building blocks relevant to these key policy areas (see Table 3.1). Many cities continue to struggle to tackle these interlinked policy areas comprehensively and move towards accessibility-based urban development.

Example challenges and actions

European cities face a key challenge in determining how to enhance mobility, ensure accessibility and create high-quality and efficient transport systems while at the same time reducing congestion, pollution and accidents. Both existing infrastructure and existing urban form are likely to be shaped significantly by the COVID-19 pandemic. Huge reductions in the use of public transport, renewed investment in walking and cycling infrastructure and, at the same time, an increase in the use of private cars will potentially have significant implications for environmental sustainability and land use change.

Table 3.4 Overview of challenges of and actions for achieving urban accessibility

Example challenges	Example actions to address challenges

• Poor spatial, housing and transport planning practices including:
  • poor policy integration across sectors and different governance levels (i.e. supranational, national, regional, local)
  • lack of long-term planning and narrow focus on directly addressing demand rather than solving underlying accessibility issues (e.g. expanding road capacity rather than reducing road use)
  • legacy of outdated spatial, housing and transport planning models
	• Improving alignment of policy frameworks at different governance levels and across sectors to eliminate unintended barriers to urban accessibility.
	• Ensuring a better spatial mix and distribution of economic activities, services and amenities at the spatial planning level by clustering new developments, including housing, around existing transport nodes and routes to promote transit-oriented development (see Box 3.6).
	• Implementing transport, housing and spatial planning policy reforms (regulatory, economic, information-based) that recognise that car-based journeys in urban areas are the least optimal.
	• Building and expanding high-quality efficient public transport systems and infrastructure that promote active travel.

• Lack of understanding of the exact meaning of accessibility and how to measure it accurately. • Lack of recognition that certain groups are more likely to experience accessibility-related disadvantages/have different accessibility needs.	• Developing clear metrics to measure progress towards achieving accessibility (e.g. PTAL, or public transport accessibility level). • Agreeing what type of accessibility should be promoted within a city and how this access is distributed across the wider population. • Diversifying transport modes as much as possible to ensure that the greatest number of people can reach the greatest number of destinations in ways that meet their needs.

Moreover, the COVID-19 pandemic has shown that homeworking is a viable alternative to office-based work for many people. As companies begin to rethink the need for office space in urban centres, this could have further impacts on land use and existing transport networks. Table 3.4 sets out some of the main challenges cities may face in achieving urban accessibility and examples of actions that could help to address these challenges.

Box 3.6 presents an example of an interlinked area of policymaking and action relevant to achieving urban accessibility. The example focuses on the establishment of transit-oriented development (TOD) to help to reduce passenger travel demand and promote compact urban development. TOD can take many different forms and can be adapted by cities to suit their context and needs. The transport infrastructure can be retrofitted to improve the accessibility of existing high-density developments. It can also be used to encourage densification around existing stations or to encourage new urban developments. Box 3.7 presents a case study of using TOD to develop new neighbourhoods in Copenhagen (Denmark).

3.5.3 Lessons for achieving urban accessibility

A number of lessons emerge from the analysis of the urban accessibility nexus, including:

- Policies that explicitly aim to achieve better accessibility address a multitude of interlinked urban challenges. These go far beyond the environmental burden of excessive motorised transport in cities and have the potential to fundamentally reconfigure how we live, work and interact with each other. Implementing transport policy reforms that promote walking, cycling, public transport and other forms of sustainable mobility can play an important role. However, these need to be linked to spatial planning and housing policies to achieve real urban accessibility.

- Defining and measuring accessibility currently presents a challenge. It can mean different things to different people, and accessibility disadvantages are likely to affect some social groups more than others, something that was highlighted very clearly by the COVID-19 pandemic. To be truly effective, equity and social inclusion must be central to any policy responses. This will ensure that the move towards greater accessibility does not come at the expense of the most vulnerable urban residents.

- To ensure equality, city governments need to agree what type of accessibility should be promoted and how this access should be distributed across society.

- A lack of integration and collaboration across the different governance levels (i.e. national, regional, local) and policy sectors that characterise this nexus can lead to wide-ranging socio-economic and environmental costs and challenges (e.g. urban sprawl, congestion, poor road safety) and can be an obstacle to accessibility-based planning. However, sector-specific actions can be implemented to advance urban accessibility without fundamental reform of the policymaking process or of existing institutional arrangements.

Box 3.6 Example of an interlinked policy-action area: increasing urban density through transit-oriented development

Urban density and mixed use tends to be strongly correlated with greater accessibility; however, it is not without its detractors. If not carefully managed, greater urban density can lead to increased traffic congestion and air pollution, accelerate gentrification and increase house prices, thus exacerbating urban inequalities (Salat and Ollivier, 2017; Dingil et al., 2018). It can also reduce access to urban green spaces, which are essential for human health and well-being (Kabisch et al., 2015), provide space for nature and have a role in managing climate risks. Liveable urban density therefore relies on the concurrent development of excellent public and active transport infrastructures, as well as social policies that pre-empt urban inequalities.

There is a range of policy responses that can promote urban density. Transit-oriented development (TOD) builds on the well-established European precedent of concentrating urban development along railway lines, metro routes and other public transport routes (e.g. trams, buses). At its heart is the idea that transport, land use and economic growth can all be managed more efficiently if planned in an integrated way (Salat and Ollivier, 2017). This is because high-quality public transport and compact urban development mutually reinforce each other. Mass transit can support the large passenger numbers that come with high-density development, while the concentration of jobs and housing around stations helps make public transport financially viable.

Well-managed TOD measures can create important co-benefits, such as relieving congestion and shifting to more sustainable transport modes, improving air quality, boosting economic growth, improving the quality of places and increasing physical activity levels.

Source: Gouldson et al. (2018); Linton and Bray (2019).

Box 3.7 Example of transit-oriented development: developing new neighbourhoods in Copenhagen, Denmark

Copenhagen developed Ørestad new town on a strategic piece of reclaimed land owned jointly by the city (55 %) and the Danish government (45 %). The city government identified the area between the city boundary and the bridge connecting Copenhagen to Malmö in Sweden as suitable for high-density housing. Ørestad is designed to be highly accessible by public transport and bicycle. Car parking within Ørestad is restricted for both residents and visitors and is largely confined to multi-storey car parks. The Ørestad Development Corporation created a masterplan and provided critical infrastructure, including the new Copenhagen metro, before selling plots along the line to developers. The finance captured from land sales was then used to pay for a significant chunk of the metro's development.

Ørestad has helped to improve Copenhagen's international competitiveness by expanding its so called Copenhagen Business District and developing highly accessible sites for office, media, retail and leisure activities. The large investment in mass transport infrastructure in the central parts of Greater Copenhagen has increased its accessibility and encouraged commuting from a much wider area, including more than 20 000 commuters a day from the Malmö area. (This is an interesting example of a case in which better accessibility has led to an increase in overall transport demand, which will have to be studied further to see if the benefits of greater accessibility outweigh the costs of the increased number of trips).

Source: Knowles (2012).

- The extent to which cities can effectively implement accessibility policies will depend on the specific institutional and governance context and the overall decision-making powers that have been devolved to them. This can vary significantly from one EU country to another and even between cities (e.g. large capitals sometimes have more decision-making powers than other cities in the country).
- The EU faces significant limitations in developing overarching policies on spatial and urban planning, as land use policies are mostly a national, regional or local competence.
- The EU's limited role in spatial and urban planning presents a challenge for achieving greater policy coherence around accessibility at the EU level. However, the EU can play an important role in several ways, such as developing standards and guidelines on public transport access requirements for new developments, stipulating desirable urban densities, and promoting knowledge sharing and peer-to-peer exchange.
- Cities will require an agile regulatory environment that can proactively respond to rapid changes, such as new disruptive technologies from automation to smart mobility, to ensure that these enhance urban accessibility rather than undermine it.
- Addressing the urban accessibility nexus requires new cross-sectoral metrics, analysis and appraisal methods and the introduction of standardised measurement indicators.
- The COVID-19 pandemic has highlighted the urgent need for city governments to rethink their transport policies to change the focus from mobility to accessibility. By investing in TOD and active transport infrastructure, cities can build resilience to future pandemics while also ensuring significant environmental and health benefits.

3.6 Environment and health nexus

3.6.1 What is environment and health and why is it important in an urban context?

Urban areas are often unhealthy places to live, characterised by heavy traffic, pollution and noise. In 2013 the European Commission introduced the clean air policy package to reduce the health and environmental impacts of air pollution by 2030 (EC, 2021b). With the urban mobility package, the European Commission reiterated measures to address these issues (EC, 2020b).

Human health is closely linked to the state of the environment. Although emissions of air pollutants have declined in recent years, almost 20 % of the EU's urban population lives in areas where air pollutant concentrations exceed at least one EU air quality standard (EEA, 2019a). Noise pollution is also a major environmental health concern in cities, especially from road traffic (EEA, 2019e, 2019g). For example, regular exposure to noise pollution can trigger elevated blood pressure and heart attacks and causes approximately 12 000 premature deaths each year in Europe (EC, 2015c; EEA, 2018d, 2019c, 2019e). An estimated 82 million people in European cities are exposed to noise levels in excess of 55 dB from traffic during the day-evening-night period (EEA, 2019e). Furthermore, light pollution in urban areas affects both flora and fauna as well as human health (Falchi et al., 2011; Škvareninová et al., 2017; Coogan et al., 2020). Exposure to environmental stressors (e.g. air, noise and light pollution) differs among social groups in cities. As a result, the health of some groups (e.g. low-income groups and ethnic and racial minorities) is more affected by the state of the urban environment than others (Brulle et al., 2006; EEA, 2014, 2018a). This is due to the unequal distribution, quality and maintenance of urban infrastructures and services, such as transport systems and high-quality green spaces (Barnes et al., 2018).

In addition, the quality and accessibility of urban green spaces are considered important elements of healthy urban communities (Bertram and Rehdanz, 2015; Edwards and Dulai, 2018; EEA, 2019c). The COVID-19 pandemic has also shown the positive impact of green spaces on people's physical and mental health. These dimensions can be addressed through urban design and policies related to public transport, walking and cycling infrastructure. Together these can contribute to improvements in environmental quality, human health and social equity and justice issues. Achieving high-quality urban environments that enhance the health of all citizens should thus be a priority for urban policymakers.

If environment and health is improved in cities this is likely to support progress in other priority nexuses, in particular 'quality of life', through planning and measures to improve GI and prioritise access and multifunctionality to enable active transport; and 'climate resilience', through the creation and enhancement of green areas that can incorporate measures to manage climate impacts and extreme weather events.

The environment and health nexus and the COVID-19 pandemic

The pandemic has highlighted the importance of environmental quality in cities for people's physical and mental health. For example, continued exposure to poor air quality leads to increased risk of mortality from respiratory diseases such as COVID-19. The strict travel restrictions imposed across European cities during the height of the lockdown led to a significant reduction in motorised traffic. This reduction had an immediate and positive impact on air quality, with emissions from cars and motorcycles falling by 88 % compared with pre-pandemic levels (EEA, 2020c; OECD, 2020). However, the easing of some COVID-19 restrictions in late summer 2020 saw air and noise pollution levels rebound across European cities (EEA, 2020d). The need for social distancing to reduce the risks of spreading COVID-19 meant that public transport systems were either closed or running at limited capacity.

The pandemic has provided cities with an opportunity to reconsider mobility with an emphasis on active travel, improved local environments and human health benefits. In their pandemic recovery plans many cities have proposed long-term and permanent strategies including investment in active mobility infrastructures; improved public transport safety and accessibility; changes in traffic regulations to increase safety; and pricing policies, such as congestion charges. Public green spaces should play a key role in the green recovery. Local policymakers need to prioritise the provision of safe and accessible green space, especially in areas of deprivation or where there is poor or unequal access.

3.6.2 Challenges of and actions for achieving improved environment and health in cities

Relevant interlinked policy areas

There are many important policy areas that can contribute to improvements in the environment and human health in cities. Given their relative importance for human health, this nexus focuses on the need for coordinated policy related to transport, GI and environment, and on the building blocks relevant to these key policy areas (see Table 3.1). There can also be important trade-offs and co-benefits between these policy areas, for example using GI to create safe active transport corridors can help reduce congestion, ease environmental pollution and provide space for nature.

Improving environment and health in cities is a multidimensional challenge. It requires above all coordinating action on air quality, mobility and access and the quantity and quality of green spaces, among other things. Table 3.5 sets out some of the main challenges that cities may face in achieving improved environment and health and gives examples of actions that could help to address these challenges.

Box 3.8 presents an example of an interlinked area of policymaking and action relevant to improving environment and health in cities. The example focuses on the establishment of policies that support car-free cities to improve urban air quality. As shown by the COVID-19 pandemic, measures reducing traffic congestion in urban areas have had notable impacts on air quality. Reduced traffic can also reduce emissions of greenhouse gases such as CO_2 and nitrogen oxides (NO_x). Car-free cities have the potential to create multiple co-benefits for both the environment and human health. The pandemic has provided cities with an opportunity to reconsider mobility with an emphasis on active travel, improved local environments and human health benefits. Box 3.9 presents a case study of encouraging sustainable mobility habits to reduce air pollution in Cornellà de Llobregat, Barcelona (Spain).

Table 3.5 Overview of challenges of and actions for achieving improved environment and health in cities

Example challenges	Example actions to address challenges
• Lack of cross-cutting and coordinated policy approaches that consider mobility, access, green spaces and air quality, among others, together.	• Working across policy areas, in particular transport/mobility, land use planning (especially for green spaces), nature/environment, air quality, health and equality to achieve coordinated outcomes and co-benefits. • Adapting existing policies to create co-benefits and improve human health in cities, e.g. GI can be planned to contribute to climate resilience and food security.
• Poor existing urban design and form, which limits options for or provides little space for active transport, community and green space.	• Redesigning urban form and space to improve GI and prioritise multiple uses, including environmental quality and active transport but also social meeting places and areas for biodiversity conservation.
• Current unsustainable transport patterns, especially dominance of motorised transport (cars) even for short journeys and commuting. • Existing infrastructure that does not support or enable active travel.	• Introducing policies that reduce car use/motorised traffic (e.g. improved frequency and availability of public transport, subsidised public transport and incentives for cyclists, reducing speed limits, restricting access and reallocating road space) and promote active transport to reduce air and noise pollution (see Box 3.8). • Promoting teleworking to reduce the number of people commuting to work during the busiest periods of the day.
• High levels of social inequality: vulnerable communities, including ethnic and racial minorities, experience higher rates of morbidity and mortality due to the cumulative effects of exposure to environmental stressors; and more deprived populations often have poorer access to and lower quality GI in their vicinity than groups with higher incomes.	• Working with community groups and citizens to ensure that the needs of all are considered and to collaboratively create policy and interventions. • Focusing action to create and enhance GI in areas of economic and social deprivation seeking to ensure equality of access in all areas of the city. • Ensuring monitoring of environmental drivers of health outcomes (e.g. air quality, noise, access to green space) also includes social and economic equality measures.

Box 3.8 Example of an interlinked policy-action area: improving air quality through car-free cities

Over 400 000 premature deaths each year in the EU are linked to air pollution (EEA, 2019e), and the health impact of road traffic emissions alone cost EUR 67-80 billion a year (CE Delft, 2018). The EU-funded ClimateCost study on the costs and benefits of the adverse economic, health and environmental impacts of air pollution calculates that the annual air quality co-benefit in the EU-27 in 2050 under a 2 °C (mitigation) scenario falls within the range of EUR 44-95 billion. Most sources of outdoor air pollution are well beyond the control of individuals. Improving air quality demands concerted action by local, national and regional policymakers working in sectors such as transport, energy and urban planning (WHO, 2018).

In relation to transport, a wide portfolio of policies is needed to support car-free cities. These include improved frequency and availability of public transport, infrastructure for cyclists and pedestrians, shared car and bicycle programmes, and access for emergency vehicles and delivery trucks. Cities can provide incentives and build capacities among business start-ups and community-based innovation projects that enable ride sharing or alternative modes of transport. However, policies must be carefully considered. The popularity of electric scooters in European cities has demonstrated that some alternative forms of transport can raise both environmental and safety concerns (Tapper, 2019).

Some cities have subsidised public transport, and others have established incentives for cyclists. Another policy option is to promote teleworking, which involves working remotely and reducing the number of people commuting to work during the busiest periods of the day. However, initiatives that promote car-free cities may be contested by businesses and interest groups who feel that it will put particular sectors at an economic disadvantage. Car-free cities may also be opposed by those who are sceptical of policies aimed at reducing greenhouse gas emissions. An emphasis on co-benefits is thus important — this includes human health (EEA, 2018c).

Box 3.9 Example of a car-free city: encouraging sustainable mobility habits to reduce air pollution in Cornellà de Llobregat, Barcelona, Spain

Air pollution is one of the main public health problems in the metropolitan area of Barcelona, where Cornellà de Llobregat is located. This issue is mainly caused by motorised traffic. In 2016, Cornellà de Llobregat municipality, in collaboration with the Área Metropolitana de Barcelona, launched the Cornellà Natura project, which shaped the city's strategic plan for 2016-2026. The project aims to increase and improve green areas in the municipality and encourage sustainable mobility habits to improve urban liveability by 2026. It focuses on three main goals that provide the focus for all interventions:

- achieve a green municipal infrastructure;
- promote sustainable mobility;
- improve environmental quality.

Many of the actions promoted within the project are aimed at reducing air pollution levels and encouraging sustainable mobility habits. For example, these include reducing the speed limit to 20-30 km/h, traffic restrictions during weekends and the expansion of the bicycle lane network. A key objective is to have more than 50 % of all journeys made on foot or by bicycle by 2026, with public transport accounting for another 30 %.

The COVID-19 pandemic has accelerated the implementation of some of the actions within the project. The initial lockdowns enabled the municipality to test closing streets to traffic and improving the public transport service. These measures have now been consolidated and new streets will be calmed by increasing the green infrastructure and creating more space for pedestrians.

Source: EC, 2019b.

3.6.3 Lessons for improving environment and health in cities

A number of lessons emerge from the analysis of the environment and health nexus, including:

- While urbanisation has contributed to an overall decline in poverty (subsequently improving human health), some environmental challenges (e.g. air, noise, light pollution) put the health of people in cities at risk (Chen et al., 2019). As shown by the COVID-19 pandemic, a better understanding of the linkages, dynamics and complexities of urban environments is needed (InterAcademy Partnership, 2021).
- Policies must prioritise both people's health and the quality of the environment. Strategies for sustainable urban development must therefore recognise people as part of the environmental system.
- National legislative frameworks should encourage local authorities to better integrate transport within their health and environment policies (Flausch, 2016).
- Cities have a key role in improving environment and health through coordinated policy actions. For example, local authorities should seek to implement effective policy to reduce the use of cars through the provision of public and active transport options (and actions to encourage their use and discourage car use), creating multifunctional spaces and improving GI.
- Many of the measures required to improve the environment and health in cities depends on collaboration across diverse stakeholder groups. In particular it is important to foster the participation and inclusion of deprived, low-income and minority groups, who are often most exposed to environmental stressors, and reach a multi-stakeholder consensus.
- The articulation of co-benefits is critical to reaching a consensus across diverse stakeholder groups on measures to reduce the use of cars and improve GI and the environment in cities.
- Good-quality urban green spaces can provide a restorative environment to mitigate the impacts of urban stressors such as air and noise pollution (Payne and Bruce, 2019). When multiplied by the thousands of people who use it, green space can have a large positive impact on public health (Gilbert, 2016).
- Indicators that capture the quality of human-environment connections can provide a good picture of human health in cities, especially when combined with indicators of deprivation and inequality.

The COVID-19 pandemic has highlighted the urgent need for cities to reimagine the way their infrastructure supports the environment and health for all. By investing in infrastructure that encourages active transport and improves access to green

space, cities can contribute to a green recovery and achieve multiple co-benefits for both the environment and human health.

3.7 Food security nexus

3.7.1 What is food security and why is it important in an urban context?

Food security is defined as all individuals at all times having physical, social and economic access to safe, sufficient and nutritious food (FAO, 2003). It also refers to the ability of a nation to provide such access for its people, through its food production systems, self-sufficiency and stable trade agreements and networks.

The demand for food and evolving tastes (e.g. for out-of-season produce) in cities has outgrown the capacity of their hinterlands to supply it. As a result, reliance on imported food continues to grow. Any disturbance (e.g. climate risks, food prices, pandemics) to these supply chains could lead to social inequality in terms of access to affordable nutritious food in cities. Food security is an urban policy issue as much as a national and rural one. Yet, European policy to date has not had a transformative effect on urban agriculture and food security, as it mainly views food production as a rural activity. For example, food system initiatives in cities are not eligible for common agricultural policy funding (De Schutter et al., 2019).

Enhanced urban food security can reduce the environmental footprint of the increasing demand for food. It can also decrease reliance on external food provisioning systems and imports. Both issues are critical in the context of climate change and any future pandemics.

If enhanced food security is achieved in cities, this can help to support progress in other priority nexuses, in particular 'quality of life', through ensuring access to healthy, fresh and affordable food for all; 'environment and health', through measures supporting urban food production and changes in people's diets; and 'closing the loop', through improving the management of food waste in households and service industries.

The food security nexus and the COVID-19 pandemic

The COVID-19 pandemic has increased awareness of the nature and vulnerability of the food system and food production, supply and distribution chains. The initial responses to COVID-19 caused significant disruption to food systems, including in urban areas. This posed several challenges, including, rapid changes in food demand, availability, accessibility and affordability. During the height of the pandemic many supermarket shelves across European cities were empty because of spikes in demand and a reliance on long and complex supply chains and just-in-time delivery. Closed borders, grounded planes, missing ship containers and a reduced workforce led to disruption in supply chains, particularly for fresh produce (EC, 2020c). In some communities and households, there was a shift away from supermarkets towards local, small scale provision/self-sufficiency in certain goods and services, including food.

For example, Paris (France) is planning to produce more of its food locally. The aim is to reduce the average distance travelled by food from producer to consumer, which is currently 660 km. In Valencia (Spain), there are plans to use the urban green belt as an immediate and direct source of fresh food for the city (OECD, 2020). There is a risk that those from lowest income households will not be able to afford locally grown and organic food, as it tends to be more expensive than food found in supermarkets. The pandemic-induced economic recession is also likely to have an impact on vulnerable households, further reducing their ability to purchase healthy, nutritious and locally grown food.

In their green recovery plans, city governments could plan for a diversity of green spaces, including urban agriculture. This could have several co-benefits, for example increased biodiversity, a reduced urban heat island effect and a reduced risk of flooding and soil erosion (OECD, 2020). However, there may also be trade-offs with other land uses, such as for housing or commercial development, requiring coordinated policy and action.

3.7.2 Challenges of and actions for achieving food security in cities

Relevant interlinked policy areas

The food security in cities nexus focuses on coordination of policymaking and action in relation to urban food, waste management and spatial planning, and on the building blocks relevant to these key policy areas (see Table 3.1). A lack of coordination between these three policy areas may constrain secure and sufficient access to food for the growing urban population today and in the future.

Urban areas are not immune to impacts on food systems, such as the impacts of climate change. This can affect all of the elements of urban food systems, including food distribution and supply chains, transport and food storage. The COVID-19 pandemic has also highlighted the vulnerability of these elements, particularly of the production, supply and distribution chains. Table 3.6 sets out some of the main challenges of enhancing food security in cities and gives examples of actions that could help to address these challenges.

Table 3.6 Overview of challenges of and actions for achieving food security in cities

Example challenges	Example actions to address challenges
• Low level of resilience of urban food systems to various impacts, including from climate change and a growing urban population. • Over-reliance on external food supplies.	• Increasing urban agricultural production using practices ranging from household and community gardens to rooftop, vertical and indoor farms. • Establish initiatives to promote urban agriculture through small-scale innovation projects (see Box 3.10).
• Lack of fair access to nutritious food, particularly among low-income communities. • Lack of understanding of how the values and attitudes of all stakeholders can influence both the design and the implementation of food systems.	• Engaging citizens and stakeholders in land use planning to ensure that space is available for, and communities are engaged in, local food growing initiatives. • Promoting urban community gardening and farming projects to, for example, help new immigrants and refugees build social ties and increase community cohesion. • Working with the private sector (e.g. supermarkets, local convenience shops, food distributors), non-governmental organisations/charities, community groups and citizens to understand food access challenges and encourage the provision of affordable, healthy and fresh food in all areas. • Encouraging and supporting local food cooperatives and community shops in low-income communities and deprived areas.
• Reducing food waste.	• Providing incentives and building capacity among start-ups and community-based innovation projects to reduce food waste. • Promoting innovative solutions for the redistribution of surplus food supplies within urban areas, including by using technology.

Box 3.10 presents an example of an interlinked area of policymaking and action relevant to achieving food security in cities. The example focuses on the establishment of small-scale innovation projects to promote urban agriculture in cities. While there are no definitive figures for the percentage of food grown in urban areas across Europe, individual case studies suggest a significant potential. Such projects can also have environmental benefits, including increased biodiversity, a reduced 'urban heat island effect' and a reduced risk of flooding and soil erosion. As a result of the pandemic, more municipal and city authorities are realising the value of growing local, organic and more seasonal food (e.g. fruit and vegetables) in and around urban areas (EC, 2020d; iPES, 2020). Box 3.11 presents a case study of urban farming in Berlin (Germany).

3.7.3 Lessons for achieving food security in cities

A number of lessons emerge from the analysis of the food security nexus, including:

- It is essential that awareness of how climate change will affect the various interlinked elements of food systems is built into all policy decisions and actions.
- Food security is closely linked to urban climate resilience; thus, urban food production, land use and waste programmes must be aligned with urban adaptation strategies.
- Achieving food security will require cooperation between a wide range of stakeholders (e.g. policymakers, producers, distributors, retailers and consumers), including the different cultural groupings and age cohorts that make up urban populations.
- A shift towards more integrated perspectives on urban food systems will also require cooperation between a wide range of sectors and interests, including health and education, transport and logistics, disaster and emergency management, urban food networks for the urban poor, food infrastructure and greening local economies.
- Urban food security requires a cross-policy response related to several EU policy areas including agriculture, fisheries and food, business, sustainable development, climate action, employment and social rights, energy and natural resources, environment, consumers and health, regional and local development, and science and technology.

Box 3.10 Example of an interlinked policy-action area: promoting urban agriculture through small-scale innovation projects

There are growing opportunities for cities to provide incentives and build capacity among start-ups and community-based food-related innovation projects. Many cities have set up their own systems to support the development of urban agriculture as part of wider circular economy and resilience-building initiatives (GIZ and ICLEI, 2014). Based on an analysis of land use, Rome is the most agricultural municipality in Europe. One of the best urban agricultural practices there is the multifunctional agricultural cooperative Agricoltura Nuova. It occupies some 250 ha and sells all of its food directly to local markets. The cooperative is also involved in the social integration of marginalised individuals (Cavallo et al., 2016).

There are various factors that influence the viability of expanding urban agriculture through small-scale innovation projects. Some of these include the climate, existing urban layout, attitudes towards the use of urban space for food production, and the wider policy and institutional set-up.

Urban agriculture does not require large amounts of land, as vacant plots or disused land can often be brought back into use. However, there might be trade-offs with other land uses, such as for housing or business development in response to increasing urban populations. It can also be integrated into existing parks and private gardens. This can also improve biodiversity and local amenity value. Even in dense urban areas with limited green space, rooftops or vertical structures can support food production. This would require the right set-up and support from technologies such as hydroponics.

Box 3.11 Example of a small-scale innovation project: urban farming in Berlin, Germany

ECF Farmsystems is a 1 800 m^2 aquaponic start-up in Berlin's central Schöneberg district producing 30 tonnes of fish (tilapia) and 400 000 basil plants each year. The founders have created a symbiotic system in which basil plants are grown from seed using nutrient-rich water filtered from the fish-farming tanks using bacteria.

The system avoids the usual use of pesticides in the basil production and antibiotics in the fish production. An added benefit is that 90 % of water is reused. Shorter transport distances for the fish and basil result in fresher food and lower emissions, especially because of the reduced need for refrigeration. Start-up finance of EUR 1.4 million came from private investors and the Investitionsbank Berlin, a state-owned development bank. The business employs three gardeners and two fish farmers and has a contract to supply basil to the Rewe supermarket chain throughout Germany.

Source: Rosenbach (2019).

- Urban authorities have a crucial role in the design and implementation of urban food policies, including in reconnecting food producers and consumers and involving different local actors at different scales to co-create innovative solutions (Magarini et al., 2018).
- The COVID-19 pandemic has highlighted the disproportionate impact of food availability, accessibility and affordability on socially and economically disadvantaged groups. As part of their green recovery planning, city governments can help address food security by expanding urban agriculture, introducing 'zero-waste' food systems and implementing measures that ensure accessible and affordable food for all.

3.8 Closing the loop nexus

3.8.1 What is closing the loop and why is it important in an urban context?

Closing the loop refers to a circular model of resource management. It means keeping products, materials, built assets and land in use while maintaining their value. It also means minimising waste generation. Current, predominantly linear (take-make-dispose), consumption and production patterns are unsustainable. Recognising this, in 2015 the European Commission adopted *Closing the loop — An EU action plan for the circular economy* (EC, 2015d). Partnership on a circular economy is also one of 12 thematic partnerships under the urban agenda for the EU (EC, 2016a).

Around three quarters of Europeans live in cities (EEA, 2019a). As a result, most of Europe's production meets demand originating in cities, as they are major consumers of resources and products. Urban areas depend on land and production outside their boundaries to meet resource needs and dispose of their waste. At the same time environmental and social problems associated with the linear economy are focused in urban areas.

Major disruptions in supply chains due to the COVID-19 pandemic have highlighted the importance of keeping resources within the value chain, minimising waste and maximising reuse and repair. Closing the loop can 'decrease our reliance on imports and ...reduce environmental pressures' (EEA, 2019a), including in cities. Cities can benefit from the circular economy and, given their environmental and economic importance, act as 'centres for change' (Ellen MacArthur Foundation and ARUP, 2019).

As closing the loop is a high-level objective, progress towards circular economy cities would imply progress in some of the other example nexuses, in particular 'sustainable buildings', through better management of construction waste and resource and material use in construction (e.g. reuse); and 'clean energy', through the development of systems where waste energy is reused and clean energy is generated at a small scale to meet local energy demands.

The closing the loop nexus and the COVID-19 pandemic

The pandemic has highlighted the importance of supply chain resilience. At the height of the COVID-19-induced lockdowns many businesses across European cities were negatively affected because of their reliance on long and complex supply chains and just-in-time delivery. This has led to increased interest in local goods and services, which may support more circular production and consumption (e.g. making reuse of packaging easier and encouraging industrial ecology). There is a risk of social impacts, however, as low-income households may be less able to afford locally sourced and produced goods, because they tend to be more expensive than those provided by global supply chains. The pandemic has also puts extra pressure on waste management and recycling systems and practices and may lead to inappropriate and illegal waste management activities (Adyel, 2020) caused by, for example, the closure of recycling centres, an increase in home clearances, and an increase in plastic waste from personal protective equipment, take-away meals and home-delivered groceries.

The COVID-19 pandemic has provided cities with an opportunity to put the circular economy at the centre of a green recovery. By favouring short supply chains, designing out waste and keeping products and materials in use, it could create opportunities for economic growth that also restore the environment, create jobs and benefit society. To be inclusive, recovery planning needs to understand and address existing social inequalities within local communities and ensure that the needs of the most vulnerable are met. The long-term effects on other aspects of consumer behaviour that effect the circular economy remain unclear. For example, there may be continued resistance to the concept of using products as a service and sharing certain goods (due to real or perceived risks), which could undermine some efforts to encourage circularity.

3.8.2 Challenges of and actions for closing the loop in cities

Relevant interlinked policy areas

The closing the loop nexus focuses on resources and materials, waste management and green economy policy areas, and on the building blocks relevant to these key policy areas (see Table 3.1). Many challenges to closing the loop result from a lack of coordination between these three policy areas. For example, there is a risk that a waste policy that focuses on landfill and incineration misses out on opportunities for growing the green economy by using waste as a resource. By coordinating waste management and green economy policymaking and action, the value of resources can be better recognised and processes established to keep resources and materials in the value chain. Integrating these policy areas could also have co-benefits, such as through reduced pollution and creating local employment. Challenges to closing the loop in cities relate to wider governance of the transition to a circular economy as well as challenges in peri-urban and rural areas, which often experience the negative externalities of urban sustainability (e.g. urban waste, soil contamination). This nexus assessment focuses on challenges and actions at the city scale. Table 3.7 sets out some of the main challenges that cities may face in closing the loop and gives examples of actions that could help to address these challenges.

Table 3.7 Overview of challenges of and actions for closing the loop in cities

Example challenges	Example actions to address challenges
• Lack of comprehensive strategies and roadmaps for circularity at the city or city region scale.	• Establishing circular city strategic policy documents or roadmaps. Such roadmaps should be based on an understanding of the local and regional contexts to reflect local needs and resources. • Engaging citizens, businesses and other stakeholders in setting strategy.
• Inadequate understanding/addressing of the social and behavioural changes required to shift to more sustainable consumption behaviours. • Insufficient investment by businesses in industrial ecology practices for the use of secondary raw materials.	• Convening cross-sectoral engagement, and encouraging partnerships, to catalyse cross-sectoral action. • Raising awareness and building capacity among citizens and businesses. • Encouraging industrial symbiosis and ecology and supporting businesses in integrating industrial wastes or by-products into production processes, including brokering supply and demand of secondary resources and helping markets for secondary resources to develop.
• Understanding and making use of new technical knowledge and capacity.	• Establishing networks to share scientific and applied knowledge in the field of the circular economy. • Exploring solutions through practical experimentation (testing approaches) and innovation at a small scale before scaling up.
• Lack of holistic approaches to moving from 'waste management' to 'resource management'. There is a need to focus on waste prevention.	• Focusing efforts on preventing waste by reducing consumption, encouraging repair and reuse and finding uses for and the value of waste as a resource (to the extent that cities can influence this). • Understanding resource use characteristics and resource flows by mapping resource flows (e.g. quantities, flow rates, owners, quality) and monitoring progress towards resource efficiency in the city, with the use of appropriate indicators.
• Recycling rates remain low due to insufficient administrative capacity, a lack of investment in recycling infrastructure and limited use of economic instruments (e.g. pay-as-you-throw). • Overcapacity in infrastructure to treat residual waste represents a technological and economic lock-in. • Lack of designated facilities to support waste prevention, reuse and repair.	• Using city-level procurement to influence local markets for circularity, e.g. setting standards and criteria and holding funding competitions to encourage new ideas, cooperation and innovation, as well as focusing on areas where there is the most potential to influence the market. • Redesigning city-level waste management investment, processes and structures to keep resources in the value chain, minimise waste and maximise reuse and repair. • Working with communities, civil society or the private sector to set up consumer repair and reuse hubs (see Box 3.12).

Box 3.12 presents an example of an interlinked area of policymaking and action relevant to closing the loop in cities. The example focuses on the establishment of urban resource centres to help manage domestic waste more effectively in cities. Such centres provide a physical space and facilities that are designed to encourage reuse and repair and provide educational opportunities, and they represent spaces in which communities can come together. They have co-benefits, such as providing employment and other local economic benefits and reducing the amount of waste going to landfill, which has benefits in terms of reducing pollution. Box 3.13 presents a case study of urban resource centres established in Oslo (Norway).

The COVID-19 pandemic presents a risk to the success of such centres, as it has significantly affected consumer behaviour, with hoarding, panic buying and home clearances becoming more prevalent during the height of the lockdowns. The long-term effects on other aspects of consumer behaviour that affect the circular economy remain unclear

Indicators for closing the loop in cities

Closing the loop or achieving circularity in cities is a high-level objective and is likely to require a range of indicators. These will also need to reflect local contexts and priorities. A comprehensive set of proposed indicators for measuring the transition to a circular economy in cities has been developed by the thematic Circular Economy Partnership under the urban agenda for the EU (EC, 2019c), with 30 indicators in total proposed. These include a small number of overarching indicators and thematic indicators related to production and consumption; waste management; secondary raw materials; and competitiveness and innovation. Some cities have also explored circular city indices, for example the Circular City Analysis Framework, being piloted in Porto, Portugal (Cavaleiro de Ferreira and Fuso-Nerini, 2019).

3.8.3 Lessons for closing the loop in cities

A number of lessons emerge from the analysis of the closing the loop nexus, including:

- Achieving circularity will require the development of far-reaching and ambitious strategic plans and roadmaps. Many examples of such roadmaps already exist. A recent study for the European Economic and Social Committee (EESC, 2019) identified 17 existing regional or local (including city level) circular economy strategies in Europe. These could be used by other cities as examples to learn from.
- Implementing a circular economy requires an understanding of local context (such as existing industries and materials flows) and quite specific, locally relevant actions. In many ways cities are uniquely suited to taking such actions and making such changes, and therefore they are well placed to be leaders in the transition to a circular economy.
- Closing the loop will require cooperation between a wide range of sectors and types of stakeholder (e.g. public, private, community). Cities will need to develop partnerships and seek new ways of working involving collaboration across the public, private and social sectors.
- Cities may also need to work with the EU, national and international partners to explore and implement the changes needed to close the loop (e.g. in relation to value chains and fiscal measures), as not all actions needed are within the jurisdiction of cities.
- The engagement of citizens is also key, as they are consumers of goods and services and important actors in the circular economy (e.g. reusing or recycling). The establishment of consumer repair and reuse hubs is an example of a way of increasing citizen involvement.

Cities should take advantage of the circumstances brought about by the COVID-19 pandemic to accelerate the transition to a circular economy. This transition could offer investment opportunities that will contribute to ensuring a more competitive and cleaner post-pandemic recovery.

3.9 Clean energy nexus

3.9.1 What is clean energy and why is important in an urban context?

Clean energy generally refers to energy from renewable natural resources, such as wind, water (hydro), sunlight, geothermal heat and tides. Clean energy sources have less impact on the environment throughout their life cycle than their conventional counterparts (coal, petroleum, natural gas and nuclear energy). Although the share of renewables in EU energy production reached an all-time high in the first quarter of 2020 because of the COVID-19 lockdowns, fossil fuels still dominate primary energy production and are a key driver of climate change (IEA, 2020a). In 2019 the European Parliament declared a climate emergency in Europe to which the transition to clean energy would be a major response. In 2016, the European Commission revised the EU's energy policy framework to focus on the transition to clean and fair energy.

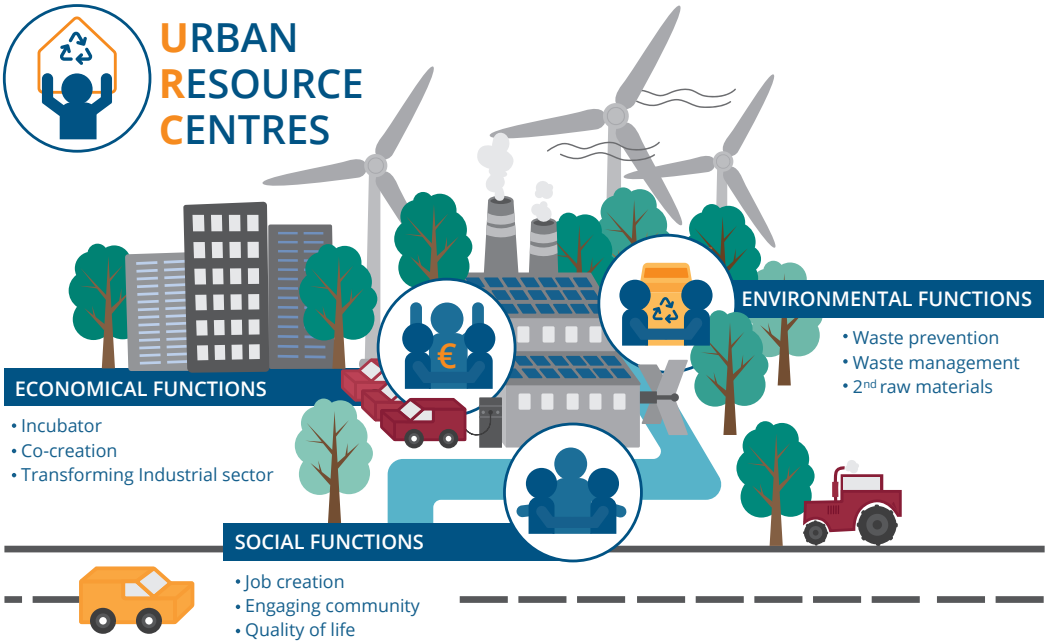
Box 3.12 Example of an interlinked policy-action area: reducing waste, encouraging reuse and boosting local economies through 'urban resource centres'

The role of citizens in the transition to a circular economy in cities is not currently adequately addressed (Circular Economy Partnership, 2018b). At the same time prevention is the highest priority in the European waste hierarchy, yet it is rarely integrated into local waste strategies.

To enhance citizens' involvement in the circular economy, one solution is the creation of urban resource centres (see figure below from EC, 2019c). Urban resource centres are designated multifunctional places where waste prevention, repair and reuse can be promoted and put into practice (Circular Economy Partnership, 2018b).

- The centres provide facilities and enhance the capacity for the reuse and repair of materials and goods that otherwise would end up as waste. This requires better coordination of the resources and materials and waste management policy areas.
- The centres also generate local economic benefits, for example by creating employment and serving as 'incubators' for social enterprises. This requires coordinating the waste management and resources and materials policy areas with policies to promote a green urban economy.

Coordination of these policy areas by establishing urban resource centres can also result in co-benefits for communities and authorities by providing hubs for activities, awareness raising and training.



Box 3.13 Example of urban resource centres: mini-recycling stations in Oslo, Norway

Ten 'mini-recycling stations' have been established in Oslo, managed by the Agency for Waste Management, and focusing on waste reduction, reuse, repair and recycling. They aim to improve the quality of residual household waste by encouraging people to dispose of larger waste articles at these mini-stations. The stations are located centrally (in densely populated areas and accessible by walking and cycling).

The stations provide opportunities for people to participate in repair workshops, sale and exchange days and waste prevention activities. They include space for people to leave items and also to take reusable items for free. In some areas of the city the mini-stations have become 'social arenas' for local communities.

The mini-recycling stations have contributed to increasing the overall level of reuse in the city. In 2018, 1 499 tonnes of reusable goods were exchanged at the centres.

Source: EC (2019c).

As part of this transition, the clean energy for all Europeans package includes various elements related to the EU's targets for reducing greenhouse gas emissions (EC, 2019d). The Commission refers to this as a 'new energy rulebook' which is fundamental to the implementation of the Energy Union Strategy adopted in 2015 (EC, 2015e). Supplying clean, affordable and secure energy is also one of the cornerstones of the European Green Deal (EC, 2019a).

Urban areas are essential for the transition to clean energy production and a carbon-neutral economy. They account for 60-80 % of global energy consumption and a similar share of CO_2 emissions (IRENA, 2016; Sharifi and Yamagata, 2016; EC, 2021c).

Achieving the climate goals will require maximising the deployment of clean energy sources. In 2018, renewable energy accounted for 18.9 % of energy consumed in the EU-27. This represented an increase of over six percentage points in just a decade (Eurostat, 2020b). According to the International Renewable Energy Agency it would be cost-effective ([41]) for the EU to reach a 34 % share of renewables in its energy mix by 2030. National- and city-level commitments and implementation are essential to achieve this potential (IRENA, 2018).

If more clean energy is produced in cities, this is likely to support progress in other example nexuses, in particular 'climate resilience', through reduction in energy-related greenhouse gas emissions from using clean energy sources; and 'environment and health', through reduced air and water pollution as a result of using clean energy sources.

The clean energy nexus and the COVID-19 pandemic

The EU energy sector witnessed a fall in energy demand and supply amid the sharp reduction in air and road transport and industrial activity as a result of the COVID-19 lockdown. During the first quarter of 2020 the share of renewables in EU energy production reached an all-time high, with reduced generation from coal, gas and nuclear energy (IEA, 2020a). Although these trends indicate that EU is likely to meet its 2020 renewable energy target, the COVID-19 pandemic slowed the progress of renewable energy projects in the first six months of 2020 (IEA, 2020b, 2020c). This trend has also been seen in cities, where many urban homeowners have been cancelling or postponing installation of solar photovoltaic panels and renovation projects. Delays in construction (e.g. due to supply chain disruption), lockdown measures and social distancing guidelines, as well as financing challenges, have largely been responsible for the limited number of clean energy projects completed. The pandemic has also had an impact on local authorities. The economic challenges facing cities has negatively affected the funds available for investment in clean energy. In particular, this has affected the decision-making, granting of permits and adoption of spatial planning arrangements that allow the construction of renewable energy projects (McElroy, 2020).

In their green recovery plans, city governments acknowledge the need for investments in clean energy to reinvigorate local economies. For example, the mayors of the C40 Cities network have launched a green and just COVID-19 recovery plan. One of the key actions proposed in this plan is to invest in urban renewable energy programmes (C40 Cities, 2020a). The next generation EU recovery package is also prioritising investment in cleaner technologies, including those for generating energy. The green recovery investment in clean energy sources can also provide good value for money. The impact on local energy initiatives will depend on cities' approach to recovery. Cities choosing to focus on community-based recovery, self-sufficiency and the social economy could increase interest in community energy schemes.

3.9.2 Challenges of and actions for achieving the clean energy transition in cities

Relevant interlinked policy areas

This nexus focuses on the need for coordinated policymaking and action in cities related to spatial planning, the built environment and energy, and on the building blocks relevant to these key policy areas (see Table 3.1). A lack of coordination between these three policy areas will undermine efforts to increase clean energy production in cities. For example, spatial planning and built environment policies should consider the land use and infrastructure requirements for new clean energy production and transmission. Integrating these policy areas can also have co-benefits, such as reduced carbon emissions, that help to mitigate climate change and environment and human health benefits arising from reduced air and water pollution.

For cities to transition to clean energy and carbon neutrality implies a structural change in energy production, moving away from fossil fuels. Broadly this could be achieved in two ways (either individually or in combination): either by replacing existing large energy plants with clean energy alternatives or by replacing existing large plants with a more decentralised approach in which there are many local producers of clean energy. Table 3.8 sets out some of the main challenges cities may face, irrespective of their chosen route to clean energy, and gives examples of actions that could help to address these challenges.

([41]) Cost-effectiveness is defined (EC, 2014) as either, for a given outcome (e.g. a percentage reduction in air pollution), minimising the net-present value of costs or, for a given cost, maximising the relevant outcome(s). In the context of urban environmental sustainability, cost-effectiveness also considers the co-benefits of an intervention (e.g. the health benefits of meeting a primary objective of reduced air pollution).

Table 3.8 Overview of challenges of and actions for achieving a clean energy transition in cities

Example challenges	Example actions to address challenges
• The considerable initial investment in clean and decentralised energy systems needed, in particular for those cities with ageing energy infrastructures. • Insufficient infrastructure to connect clean energy plants to the main grid.	• Switching from fossil fuel energy producers to clean energy producers. • Providing guidance and recommendations for potential clean energy micro-producers. • Planning and integrating clean energy generation within new infrastructure development policies to ensure that the orientation and spacing of new buildings allows for solar photovoltaic panels on roofs and walls.
• Lack of appropriate technologies limiting the capacity to harvest, store and transport clean energy.	• Investing in grid extension and capacity expansion to harvest and transport energy from remote locations to cities. And investing in the development of affordable battery systems and storage technologies.
• Bureaucracy and regulatory challenges, including complex regulations; lack of coordination between different authorities; planning delays and long lead times in obtaining authorisation; and planning restrictions on installing clean energy infrastructure. • The space required for some forms of clean energy infrastructure (e.g. wind, solar) in order to make a substantial contribution to the growing energy demand.	• Implementing a set of coherent and coordinated cross-sector actions at the EU, national and city levels, given the interlinked nature of the energy transition challenges. • Reducing administrative hurdles and incentivising new clean energy producers to enter the market. • Ensuring coordination and positive synergies between energy policy measures and a range of other policy areas, including climate change, environmental protection, circular economy, digital transition, economic development, mobility, and land use planning. • Integrating spatial and energy planning to find solutions for decentralised clean energy development (see Box 3.14). • Development of one-stop shops where homeowners can virtually and/or physically find 'under one roof' all the information and services they need to implement an ambitious energy renovation project.
• Public concerns and resistance to the transition from conventional to clean energy sources in cities, in particular due to loss of visual amenity and noise pollution from wind turbines. • Lack of an affordable clean energy transition for communities at all income levels.	• Providing information (e.g. public awareness campaigns) on the social, ecological and financial benefits from clean energy transition. • Engaging with communities to understand their sentiments and opinions, perceptions and fears about the development of a new clean energy infrastructure. • Ensuring that energy transition measures (e.g. incentive mechanisms, tax exemptions) are affordable for communities of all income levels.
• Inadequate knowledge and skills within the community or among individuals to interact with the clean energy technologies.	• Engaging with communities/individuals to provide the knowledge and training required. • Sharing best practice in terms of technical, financial, legal, regulatory and management solutions.

Box 3.14 presents an example of an interlinked area of policymaking and action relevant to clean energy transition in cities. The example focuses on decentralised energy production from clean energy sources to help reduce energy use, reuse available waste energy sources and generate clean energy at a small scale to meet remaining local energy demand (Energy Transition Partnership, 2019). Box 3.15 presents a case study of local clean energy production in Barcelona (Spain).

Box 3.14 Example of an interlinked policy-action area: decentralised energy production from clean energy sources

Moving towards a decentralised clean energy system requires establishing coherent overall policy goals, developing institutional capacity, encouraging stakeholder buy-in and financial support. The economic recession following the COVID-19 pandemic may delay the necessary investment in many European cities. This transition will also require long-term structural changes. The production of clean energy in a city will depend on geography and climate, but it is likely to rely on wind power, rooftop solar photovoltaic installations and hydropower (EEA, 2015; World Economic Forum, 2018). To achieve ambitious clean energy targets, cities may need to explore opportunities in surrounding rural areas, which may be more suitable (e.g. because they have more land surface for solar and wind power installations) (IRENA, 2016).

Clean energy systems made up of small, localised grids and designed in accordance with circular economy principles can have a range of co-benefits for climate (by lowering carbon emissions), environment (by reducing emissions of harmful pollutants and waste), urban resilience (by providing a more secure energy supply), economy (by reducing transmission losses) and communities (by creating new jobs). However, this transition will inevitably bring some trade-offs, for example between the increase in decentralised clean energy systems and the availability of rare materials and land for development (EEA, 2017c; Giurco et al., 2019; Seetharaman et al., 2019). Another important trade-off is between clean energy production and unemployment in the conventional energy sector (Rivers, 2013). The EU Just Transition mechanism aims to provide reskilling opportunities for those workers from carbon-intensive industries and facilitate employment opportunities in new sectors and those in transition.

Box 3.15 Example of decentralised clean energy sources: solar hot water ordinance in Barcelona, Spain

Since 2000 (upgraded in 2006), a Solar Thermal Ordinance (STO) has been in place in Barcelona, making it compulsory to use solar energy to supply 60 % of running hot water in all private and public buildings. The Barcelona Energy Agency (BEA) was established to evaluate the planned installations provided when a building developer seeks approval for both the building design and construction permit. Building inspectors are then responsible for ensuring that construction meets the specified criteria.

The Barcelona STO is an example of the early adoption of such practices and is considered a success because it has achieved significant energy savings and reductions in carbon dioxide emissions since it took effect. Stakeholder engagement and education on the use and maintenance of solar panels were identified as the main factors contributing to the success of this project. The BEA worked with the neighbourhood association and the body corporates of buildings to enable tenants and the public to measure their energy savings and check to ensure that the solar installations are working.

Source: Center for Clean Air Policy (undated).

3.9.3 Lessons for achieving a clean energy transition in cities

A number of lessons emerge from the analysis of the clean energy nexus, including:

- Integrating the nexus policy areas can have a range of co-benefits, including climate mitigation (e.g. reduced carbon emissions), environment and health (e.g. reduced pollution) and social and economic (energy resilience, reduction in energy poverty, democratic participation, climate awareness). However, there are also trade-offs, for example between the increase in decentralised clean energy systems and the availability of rare materials and land for development.
- The clean energy transition will require stakeholder cooperation across different sectors and governance and spatial scales (EU, interregional, national). Such integrated decision-making requires a deep understanding of planning processes across sectors (and governance levels) and may include location-specific actions.
- It is important that energy policy reforms recognise the critical interrelationships between spatial planning, the built environment and energy sectors, bringing stakeholders together to explore optimal solutions for clean energy production.
- Energy policy reforms need to be adapted to local conditions and provide the necessary policy tools (e.g. green building codes, certification programmes, and education campaigns) for their implementation.
- Cities will need to ensure effective policy and regulatory conditions to encourage new clean energy producers to enter the market. To further stimulate a clean energy transition, reductions in or the removal of subsidies in the conventional energy market is likely to be required.

- A clean energy transition is likely to require support from innovative private-public partnerships and the EU through various tools, policies and funds (e.g. URBIS ([42]), European Fund for Strategic Investments ([43]), European Regional Development Fund and Cohesion Fund).

- While many policies are still enacted at the national or regional level, cities are increasingly taking control of their own clean energy futures, for example by bringing municipal energy utilities back into local public and collective ownership (WWI, 2016). This can empower cities to unlock the clean energy transition through a range of actions, such as target setting, use of local regulations, clean energy consumption in public buildings, street lighting, financing and advocacy work (IRENA, 2016).

National governments and multilateral agencies need to support cities' efforts to achieve the clean energy transition as part of their green recovery from the COVID-19 pandemic (C40 Cities, 2020a).

3.10 Sustainable buildings nexus

3.10.1 What are sustainable buildings and why are they important in an urban context?

Sustainable buildings have high levels of energy and resource efficiency and reduce environmental impacts across their life cycles. Their users enjoy better health and well-being and productivity gains. In turn this translates into cost savings (EC, 2016b). The European Commission states that emissions in the building sector could be reduced by around 90 % by 2050. Recognising this, the Europe 2020 strategy stresses the need to improve resource efficiency in the building sector (EC, 2010). This is also reflected in the EU action plan for the circular economy (EC, 2015d). Under the European Green Deal, the European Commission has introduced a Renovation Wave initiative to encourage faster and deeper renovation (EC, 2020e). In partnership with industry, the European Commission has also developed Level(s) ([44]), a voluntary reporting initiative for environmental performance in the built environment (EC, 2019e).

The scale of the challenge, and the potential for energy and resource savings through sustainable buildings, including retrofitting, is clear. Taking the example of improving energy efficiency, it is estimated that approximately 75 % of the existing building stock in the EU is energy inefficient (BPIE, 2017). These buildings would benefit from retrofitting to incorporate energy-efficient technologies and approaches. Such retrofitting could bring co-benefits, such as reducing energy costs and creating healthier buildings for residents. This is also essential in the context of the COVID-19 lockdowns, as it has increased pressure to ensure that building standards provide sufficient and suitable living and working space in residential buildings.

Sustainable buildings are a key priority, given the need to ensure not only that buildings use more sustainable heating and cooling sources to reduce their associated greenhouse gas emissions but also that they are designed to make them resilient to future climatic changes and pandemics.

If more sustainable buildings are present in cities, this would support progress in other example nexuses, in particular 'climate resilience', s through using sustainable heating and cooling sources; 'closing the loop', through improving management of construction waste; and 'environment and health', through well-insulated housing.

The sustainable buildings nexus and the COVID-19 pandemic

The COVID-19 outbreak left office and commercial buildings in urban centres dormant for a period of weeks or even months as businesses closed and/or homeworking became the norm. An increase in homeworking has increased the pressure to ensure that building standards provide sufficient and suitable living and working space in residential buildings. Homeworking is also increasing pressure in terms of energy consumption. Housing is also an important social determinant of health, with those living in sustainable buildings enjoying better health, well-being and productivity. For those in poor-quality housing, the lockdown meant more time exposed to cold, damp and other hazardous conditions, which had consequences for both physical and mental health. The COVID-19 pandemic also caused significant disruption to construction supply chains.

The COVID-19 pandemic could result in significant changes in future in land use planning and building design and construction, including designing for energy-efficient and healthy buildings. Such changes could include adopting a minimalist design in buildings; flexible entrance areas and more balconies; local landscapes, views from windows and access to sunlight prioritised in planning; and more natural ventilation (including linear flow extraction, increased humidity control, recovery) (Pinheiro and Luis, 2020). As part of their green recovery plans, city governments could take advantage of the next generation EU recovery package to invest in their ageing housing stock — to retrofit and renovate public buildings, improve energy efficiency, reduce greenhouse gas emissions and create green jobs that will kickstart the economy. Energy efficiency retrofits could provide another important opportunity for green recovery through job creation, as well as reducing energy costs and ensuring healthier buildings through improved housing for residents.

([42]) https://eiah.eib.org/about/initiative-urbis.htm
([43]) https://www.eib.org/en/efsi
([44]) Levels — a voluntary reporting framework that provides a common EU approach to the assessment of environmental performance in the built environment. It provides a set of core indicators for performance assessment. For more information, see: https://ec.europa.eu/environment/eussd/pdf/Level(s)_factsheet-EN-web.pdf

3.10.2 Challenges of and actions for achieving sustainable buildings

Relevant interlinked policy areas

This nexus focuses on three interconnected policy areas relevant to achieving sustainable buildings in cities (resource and material use, built environment and urban design), and on the building blocks relevant to these key policy areas (see Table 3.1). Many challenges in achieving sustainable buildings result from a lack of coordination between these three policy areas. For example, sustainability principles need to be integrated into building design while ensuring that these principles are supported by policy related to the use of resources and materials in the city. Integrating these policy areas could also have co-benefits, such as reducing buildings' lifecycle costs (e.g. energy efficiency or material reuse) and creating healthier buildings.

The sustainable buildings nexus focuses on the design, construction and use phases in the life cycle of residential, public and commercial (e.g. retail, office) buildings. Taken together these represent approximately 99 % of total building stock in the EU (Ecorys, 2014). The main challenges in achieving sustainable buildings are associated with how, in practice, to reduce resource and energy consumption. Table 3.9 sets out some of the main challenges cities may face in achieving sustainable buildings and gives examples of actions that could help to address these challenges.

Box 3.16 presents an example of an interlinked area of policymaking and action relevant to sustainable buildings in cities. The example focuses on the use of innovative design, materials and systems to help reduce resource consumption in building construction and use. This could reduce the negative environmental and social impacts, particularly in mining regions and on production sites (e.g. cement and steel production). Box 3.17 presents a case study of optimised material use in a reconversion project in Loos-en-Gohelle (France).

Table 3.9 Overview of challenges of and actions for achieving sustainable buildings in cities

Example challenges	Example actions to address challenges
• Inefficient resource and energy use throughout the building's life cycle (including energy consumption and efficiency, water and material use and waste management).	• Promoting innovative building design to help ensure efficient material use in construction and reducing ongoing running and maintenance costs, which enables adaptation and reuse of the building over its life cycle (see Box 3.16). • Coordinating building design, construction and associated resource management, which ensures efficient use of resources and energy. Including setting standards and targets (local building codes, sustainable design and retrofitting standards) and providing tools (e.g. sustainable resource sourcing, smart energy-saving technologies) to encourage sustainable building design and construction. • Including water use and efficiency requirements in construction specifications. This may include eliminating leaks and recovering grey water for reuse. • Improving the management of construction materials to help to reduce resource use, e.g. identifying and procuring locally sourced and/or recycled materials to minimise the need for imported materials.
• The scale of the problem with a large proportion of the existing building stock that is inefficient and would benefit from retrofitting.	• Focusing efforts on retrofitting to incorporate energy-efficient technologies and approaches. • Facilitating financing models that enable energy efficiency investments to be repaid over time using energy cost savings.
• The need to raise consumer awareness and influence behaviours to improve the overall sustainable performance of buildings.	• Providing information and services that raise consumer awareness and encourage behaviour change to realise energy and water efficiency gains in the use of buildings. • Organising events (e.g. workshops) involving local residents to enable dialogue on the principles of practising resource and energy efficiency in homes and learning about the requirements regarding their living space (to help design space that achieves its sustainability potential in practice). • Establishing well-managed policy platforms to facilitate discussions and enable stakeholders to share knowledge and best practices.
• A range of contextual factors and conditions affecting achieving more sustainable buildings and resilience to future climatic conditions (e.g. existing planning policy and building regulations, needs and preferences of stakeholders, clients' design and use requirements, climate and location).	• Ensuring that an understanding of and adaptation to the local contextual factors is factored into to decision-making regarding design solutions and choice of materials for building construction and retrofitting.

Box 3.16 Example of an interlinked policy-action area: reducing resource consumption in building construction and use through innovative design, materials and systems

Reducing resource consumption focuses on natural resources, building materials and water. Various interventions are aimed at reducing resource consumption in building construction and use. Common interventions include innovative design, improved management of natural resources and building materials and resource management systems in buildings (e.g. water, waste).

Innovative building design can ensure efficient material use in construction and reduce ongoing running and maintenance costs. This is achieved through resource-efficient features, materials and appliances. Well-designed houses can further reduce building material consumption by incorporating approaches that enable adaptation and reuse of the building over its life cycle (Mohamed and Alauddin, 2016). Improved management of construction materials can also help to reduce resource use, for example by identifying and procuring locally sourced and/or recycled materials to minimise the need for imported materials (Pullen, 2012). Using waste for construction can reduce environmental impacts compared with using virgin materials.

Coordination of these policy areas by using innovative design, materials and systems can also lead to climate, environmental, health and economic co-benefits from reduced pollution and energy use, improved indoor air quality and increased returns on investment.

Box 3.17 Example of sustainable use of materials: optimising material use in a reconversion project in Loos-en-Gohelle, France

The building's owner in partnership with local small to medium-sized enterprises reconverted a historic house (Rehafutur engineer's house) into office facilities.

The project prioritised the reuse of all types of materials, bearing in mind the building's significant heritage value. For example, marble fireplaces were moved to be reused as ornamental features in public rooms, spruce floorboards were re-laid after installing high-performance floor insulation, and rubble was reused to level the parking spaces and access paths. A particular focus of the project was the use of building materials from renewable sources (animal and vegetal) and from recycled material. The project used a range of bio-based and recycled materials to demonstrate the effectiveness of renewable insulation materials. For example, a regional material made out of old clothes (mainly cotton) called Métisse was used for the insulation.

Source: Ellen MacArthur Foundation (2016).

3.10.3 Lessons for achieving sustainable buildings in cities

A number of lessons emerge from the analysis of the sustainable buildings nexus, including:

- More sustainable buildings can provide a range of benefits and co-benefits, including social (e.g. health), environmental (e.g. ecosystem health, reduced pollution), climate mitigation (e.g. reduced carbon emissions) and economic (e.g. increased returns on investment).
- The engagement of residents (e.g. through public dialogue) is key, as their willingness to change behaviour to reduce energy and water consumption in their homes is also important for sustainable buildings to achieve their purpose (Hayles, 2015).
- To achieve more sustainable building stock in cities, it is important to involve all stakeholders (e.g. planners, architects, builders, building owners, residents) in the process.
- City governments can play a key role in encouraging sustainable buildings. They will often manage a sizeable building stock and can also lead by example in developing new public buildings. Green public procurement is one of the tools available to city governments. Through public procurement, standards and criteria can be set for suppliers of materials and services, including those in the construction sector.
- City governments are increasingly instigating policies and standards within their geographical limits to encourage sustainable buildings (e.g. building and energy codes, fiscal or financial incentives that reward private sector uptake of measures such as retrofitting) (ClimateXChange, 2018).
- Achieving sustainable buildings will require the fragmented policies and current complexity of relevant legislative frameworks to be addressed (Debacker and Manshoven, 2016).
- By recognising the urgency of improving their building stock, city governments could take advantage of the jobs created by energy efficiency retrofitting to contribute to a green recovery. In the longer term the pandemic provides cities with an opportunity to establish and implement their own building stock sustainability standards.

3.11 Policy and governance implications

3.11.1 Policy action to achieve urban environmental sustainability objectives

The eight priority nexuses presented above illustrate the range of potential actions needed to transition towards urban environmental sustainability. The assessment also identified that different categories of actions were seen across multiple nexuses, for example new or revised:

- standards or regulations;
- policies, plans, roadmaps and strategies;
- economic incentives;
- information, knowledge sharing and behaviour change;
- physical development, infrastructure and facilities;
- management regimes.

The case studies illustrate that many cities across Europe are already undertaking these types of actions.

Looking across the assessment of the eight selected nexuses, 15 high-level policy agendas were identified (see Table 3.10). These policy agendas relate to the building blocks for urban sustainability, and each agenda is relevant to at least two nexuses, and generally three or more. This shows that, although cities are complex systems in which there are myriad interactions between interventions and sectors, in practice a relatively small number of policy agendas can be identified through which urban environmental sustainability can be achieved.

Table 3.10 Policy agendas for achieving urban environmental sustainability objectives

Policy agenda	Examples of specific actions from the nexuses
Improving urban environmental quality	• Policies that reduce car use and motorised traffic (e.g. improved frequency and availability of public transport, reducing speed limits, restricting access and reallocating road space) and reduce air and noise pollution. • Nature-based solutions and/or creating or improving green infrastructure for multiple benefits, including reducing air, water and noise pollution.
Building adaptive capacity and reducing vulnerability to climate change	• Linking adaptation and mitigation policies and investments to maximise synergies. • Land use planning policies to create space for water and nature-based solutions. • Nature-based solutions to regulate water flows and mitigate flooding. • Policies and design standards to create cooling through greening. • Preparing comprehensive resilience strategies.
Improving the quality of and access to public open space, and creating or improving green infrastructure and urban ecology	• Using standards such as the Green Space Factor to determine green infrastructure requirements for new developments. • Designing green spaces and green infrastructure for multiple uses and benefits, including active transport, environmental quality, social meeting points, biodiversity conservation and enhanced quality of life. • Urban containment boundary policies to create 'hard' edges between cities and the countryside.
Supporting urban agriculture and food systems	• Initiatives to promote urban agriculture through small-scale innovation projects. • Providing incentives and building capacity among start-ups and community–based food-related innovation projects.
Increasing the production of renewable energy, reducing energy consumption/demand and improving energy efficiency	• Integrating spatial planning and built environment policies to ensure that the orientation and spacing of new buildings allows for solar photovoltaic panels on roofs and walls. • Planning and integrating clean energy generation within new infrastructure development. • Local building codes and sustainable design standards that promote reduced energy consumption and improved energy efficiency in buildings and reduce running costs. • Information and services to encourage behaviour change (e.g. public awareness campaigns) to reduce energy demand, and measures to make the energy transition affordable.

Table 3.10 Policy agendas for achieving urban environmental sustainability objectives (cont.)

Policy agenda	Examples of specific actions from the nexuses
Reducing material use and waste and improving resource efficiency	• Organisational restructuring, policies, investment and training of workforces to reduce material consumption, encourage material repair and reuse and find uses and value for waste as a resource. • Local building codes and sustainable design and retrofitting standards that promote resource efficiency and reduced material use and waste in building construction and use, including reduced maintenance costs. • Setting up consumer repair and reuse hubs by working with communities, civil society and the private sector. • Investing in the waste management infrastructure to minimise waste and maximise reuse and repair. • Systems to support urban agriculture as part of a wider circular economy and resilience effort.
Using digital technology	• Initiatives to use developments in telecommunications and e-commerce to reduce need for conventional transport. • Using technology that provides real-time information about available food (e.g. food donation-matching software).
Improving urban connectivity and sustainable mobility	• Economic incentives (e.g. road pricing, congestion charging) or regulations (e.g. parking restrictions, speed limits) to encourage a shift to active transport modes. • Information and services to encourage behaviour change (e.g. public awareness campaigns) to shift away from cars towards walking, cycling and public transport. • Policies to cluster new developments around existing transport nodes and routes to promote transit-oriented development. • Policies to promote car-free cities.
Strengthening transitions to a green economy	• Awareness-raising campaigns, networks and capacity building among citizens and businesses on the economic opportunities of the circular economy (e.g. new jobs, reduced costs, supply security).
Enhancing built environment and physical infrastructure	• Policies and initiatives to promote regeneration through pedestrianisation schemes and greening 'grey' areas or brownfield sites. • Integrating clean energy generation within new infrastructure developments.
Improving the quality of housing stock	• Retrofitting buildings to improve environmental performance (e.g. energy efficiency) and to reduce greenhouse gas emissions. • Setting targets and providing tools to encourage sustainable building design and construction.
Promoting integrated, long-term spatial planning and policymaking	• Land use planning policies to develop and protect green infrastructure for flood management. • Bringing municipalities together to coordinate transport across a wider metropolitan area. • Developing circular city strategies, policies and/or roadmaps.
Enhancing social and environmental justice	• Profiting from investments in greening existing urban spaces to ensure that they benefit low-income residents and avoid 'green' gentrification. • Designing climate adaptation and mitigation interventions to address the needs of the most vulnerable groups.
Promoting participation and empowerment of stakeholders and citizens	• Using land use planning to empower stakeholders to contribute to both food security and community cohesion. • Involving citizens, businesses and other stakeholders in the development and design of strategies or plans (e.g. adaptation and mitigation, circularity).
Encouraging partnerships and community-led initiatives and facilitating social innovation	• Facilitating community-civil society-private sector partnerships to set up consumer repair and reuse hubs (e.g. urban resource centres). • Removing legal barriers to facilitate community and/or private investment in decentralised clean energy systems.

3.11.2 Improved urban policy integration — co-benefits and trade-offs

The nexus approach can be useful for decision-makers, as it encourages communication and coordination. By considering the perspective of a selected lens (e.g. circular, resilient), the conceptual framework can also help focus analysis and highlight potentially critical policy agendas. Focused assessment and improved coordination can help realise co-benefits from policies and action across policy areas. It can also uncover potential blind spots in decision-making processes that lead to unintended consequences and undermine progress in other policy areas. This is achieved by highlighting potential trade-offs.

Box 3.18 provides some examples of co-benefits. There are also trade-offs, for example 'urban accessibility' can be achieved through increasing urban densities. However, focusing on density without considering wider mobility and connectivity could lead to trade-offs such as increased traffic congestion and associated air pollution and noise; pressure on green spaces; and social impacts due to gentrification and high housing costs. Such outcomes could conflict with the 'quality of life', 'environment and health' and 'climate resilience' nexus objectives. Table 3.10 also illustrates how policymaking and action intended to help achieve one nexus objective can lead directly to and/or have co-benefits and trade-offs in achieving other nexus objectives.

3.11.3 Identifying cost-effective policy and interventions

The example nexus assessments show that some actions can deliver multiple benefits simultaneously across urban sustainability objectives. Maximising the (co-)benefits of coordinated and integrated policymaking and action has the potential to achieve urban sustainability objectives in a cost-effective way. Clearly, generating multiple benefits does not necessarily mean that the action has achieved those benefits in a cost-effective way. Such an assumption needs to be compared with achieving the same benefits in an unconnected way. However, it is likely that this approach will deliver cost-effectiveness.

3.11.4 The role of cities in delivering urban environmental sustainability — top-down and bottom-up

The nexus analysis confirms that cities are well placed to be leaders in delivering the transition to a low-carbon sustainable economy, through their ability to address many of the systemic challenges that Europe faces. It should be noted that this is partially a result of the nexuses being selected based on their relevance to cities and city governance. Nonetheless, for most of the nexus policy areas the role of cities is well defined (e.g. transport, housing, spatial planning).

Box 3.18 Examples of co-benefits of measures to achieve urban environmental sustainability

Developing and improving green infrastructure in cities can help to deliver multiple objectives including:

- **Climate resilience** — reducing flood risk and urban overheating.
- **Environment and health** — reducing air and noise pollution and encouraging active travel.
- **Quality of life** — improving people's satisfaction with where they live.

The 'urban accessibility' nexus highlights that transit-oriented development and the promotion of active transport modes can help achieve:

- 'environment and health', 'quality of life' and 'climate resilience' objectives by, for example, improving air quality, increasing physical activity levels, improving the quality of places and reducing greenhouse gas emissions.

Action for 'sustainable buildings' can also support:

- **Closing the loop** — improving the management of construction waste and material use.
- **Clean energy** — using rooftops and walls for clean energy production.
- **Climate resilience** — using sustainable heating and cooling sources to help buildings adapt.
- **Environment and health** — through well-insulated housing achieving better indoor air quality and reduced exposure to outdoor noise.
- **Quality of life** — designing housing in which residents feel comfortable and safe.

This enables cities to design, resource (although financial autonomy varies between cities) and implement sector-specific policymaking and actions without necessarily requiring reforms to the policymaking process at national and/or EU level. For example, cities are key actors in setting out and implementing land use and spatial planning policies and standards within their geographical limits, and the solutions required are often location specific.

However, EU and national governments also have an important role in setting coherent policy at different scales and helping cities overcome challenges to achieving the nexus objectives through, for example, setting high-level strategic targets and goals (e.g. related to greenhouse gas reductions), developing clear standards and guidelines, providing financial support (e.g. Urbact III (2014-2020), LIFE, European Regional Development Fund), and promoting knowledge sharing (e.g. Urbact good practices database, Climate-ADAPT) and peer-to-peer exchange.

3.11.5 New governance approaches for urban environmental sustainability

Addressing the challenges to achieving urban sustainability requires governance approaches that are able to combine short- and long-term goals and work across sectors and silos. The nexus assessment highlights the importance of systematic identification of conflicts and barriers across policy sectors and the need for horizontal and vertical integration and coordination of measures.

Horizontal integration of measures will require an understanding of processes and objectives across sectors that might be resource intensive. For vertical integration of measures, the importance of multilevel governance is evident in several nexuses. For example, some policy areas (e.g. transport, built environment) relevant to achieving 'urban accessibility' and 'climate resilience' are potentially managed by different stakeholders at different spatial levels. Improved communication and coordination between the actors from the private and public sectors and at different governance levels (e.g. EU, national, city) will help move cities towards reaching their urban sustainability objectives.

3.11.6 Citizens and communities are at the heart of the transition

Moving towards greater urban environmental sustainability requires an acknowledgement that people are a fundamental part of the various systems (food, energy, transport, etc.). To change such systems means engaging with citizens in designing and implementing solutions and encouraging sustainable behaviours. For example, the 'closing the loop' nexus highlights the value of community-led initiatives such as repair cafes, which are enabling citizens to drive sustainable change in their communities.

Across all nexuses, in order to be truly effective, equitable action and collaboration must be central to any policy responses. Vulnerable groups are often most affected by poor urban conditions (e.g. air pollution, noise pollution, access to green space) but also the least able to benefit from improvements, as they are often not part of the decision-making process. Decision-makers in cities need to ensure that achieving urban sustainability objectives does not come at the expense of the most vulnerable urban residents.

3.11.7 Indicators and data measuring progress towards achieving urban sustainability

Each of the priority nexuses is framed around a nexus objective (e.g. clean energy, accessibility) and selected interacting policy areas. Measuring progress towards nexus objectives could be achieved by either using existing indicators or creating new overarching indicators or indices, for example an overall index of urban climate resilience, or through monitoring a range of outcomes associated with achieving the nexus objective, for example, in the case of climate resilience, measuring change in flood risk to urban communities. The nexus analyses presented in this report are intended to be illustrative and explore selected examples of interacting areas of policy and action. However, a comprehensive compilation of potential nexus indicators has not been completed, and this is something for further research (see Section 5.4.4).

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4
Pioneering cities: learning from their experience

Key Messages

- **Scope of the research** — all of the cities that participated in this research were either winners or finalists of two prestigious awards — the European Green Capital Awards or the European Green Leaf Awards — and can therefore be seen in many ways as leaders when it comes to urban sustainability. An obvious potential expansion of the research in future would be to obtain a more nuanced perspective of the experiences of cities at different stages of their sustainability journeys.
- **Methodological approach to the meta-analysis** — the analysis was based on a mixed methods approach and was structured around a series of potential drivers and barriers — actions that are 'supporting or inhibiting' transitions to urban environmental sustainability. These were in turn grouped under 'context' and the set of six enabling factors, namely governance, culture, finance, knowledge, data and information, and technology, as defined within the urban environmental sustainability conceptual framework.
- **Drivers of and barriers to urban environmental sustainability transitions** — key drivers and barriers emerged from this research; however, there was also a divergence between cities in terms of the importance of the different factors. This indicates that what drives sustainability transitions, at least to some extent, varies between cities and there is no 'one-size-fits-all' solution to achieving sustainability transitions.
- **Lessons from the analysis of drivers and barriers of sustainability transitions** — a number of early lessons related to drivers of and barriers to sustainability transitions in European cities emerged from the research, and these may be helpful to policymakers and other urban stakeholders.

4.1 Background to understanding the drivers of and barriers to urban environmental sustainability transitions

The *European environment — state and outlook 2020* report (SOER 2020) (EEA, 2019a) emphasises that cities are key drivers of change when it comes to the wider sustainability transitions across Europe. Cities are hubs of creativity, learning and innovation and have the capacity to effect systemic changes across a range of critical environmental issues (EEA, 2019a, 2020b). Cities concentrate people, jobs and economic activity but this also means that they are disproportionately affected by systemic social and environmental challenges such as segregation, poverty, inequality, vulnerability to climate change and other environmental stresses (EEA, 2019a). Environmental challenges are often most acutely felt in urban areas because of the higher densities of people and infrastructure, their dependence on their hinterlands for food, water, energy and other resources, and negative economic impacts caused by climate change (EEA, 2019a, 2020b).

Cities are therefore both places where these systemic challenges (e.g. inequality, climate change, environmental stress, resources security) originate and are most acutely felt and places offering opportunities to address them. Their potential as places for experimentation and technological and social innovations emerges, because the systemic challenges and opportunities to address them are fundamentally embedded in the day-to-day dynamics and experiences of urban life, which puts cities at the forefront of tackling sustainability issues.

Many of the most important innovations to counteract unsustainable behaviours and practices originate 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 forms of living (EEA, 2020a) but also energy-efficient housing, urban farming and decentralised renewable energy systems (Frantzeskaki et al., 2017).

Urban authorities are often the level of government closest to citizens and are therefore at the frontline of determining the overall success of European sustainable urban development (EC, 2016a). Since the signing of the 2016 Pact of Amsterdam and the urban agenda for the EU that emerged from it, this important role has been recognised and, as a result, cities have begun to have a much more substantive 'seat at the table' of EU governance (Potjer and Hajer, 2017). Globally, the role of cities as key governance actors in the transition towards more sustainable systems is being recognised, with city networks and associations taking on a much more central role in shaping global climate and sustainability agreements (EEA, 2020a, 2020b).

It is increasingly recognised 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 in our production and consumption systems, technologies, infrastructures, cultures and lifestyles, as well as in the corresponding governance and institutional frameworks. Systemic realignments, such as sharing and the circular economy, shifts towards sustainable mobility, urban farming and decentralised renewable energy systems, can be referred to as urban environmental sustainability transitions: fundamental and structural changes in urban systems through which persistent environmental and societal challenges are addressed.

SOER 2020 shows that there is a rapidly closing window of opportunity for such transformational change to take place, and cities are a vital source in this context (EEA, 2019a). The good news is that we already have much of the knowledge, technologies and tools we need for sustainability transitions to take place — the question now is how to accelerate and scale this process (EEA, 2019f). Understanding the enabling conditions and drivers of change needed to achieve sustainability transitions 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 sub-optimal environmental outcomes and preventing more radical change from taking place.

Local governments across Europe are rising to this challenge and proactively leading the way towards a more sustainable, resilient and just urban future. Of course, cities differ enormously in the challenges they face and the tools they have available to address them. Sharing practical 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 chapter presents the results of a meta-analysis as presented in the EEA report nr 16/2020 (EEA, 2020f) aiming to improve the understanding of the drivers of change that can either enable or hinder urban environmental sustainability transitions in European cities. Given the EEA's remit and interests, the focus of this research is on urban environmental sustainability transitions — note that throughout this chapter where the term 'sustainability transitions' is used the principal focus is on the environmental dimension of sustainability transitions within an urban context.

It should be noted that all cities that participated in this research were either winners of or finalists in two prestigious awards and can therefore be seen in many ways as leaders when it comes to urban sustainability. This may contribute to an overall positive view of the factors influencing urban environmental transitions. If cities that have to date been less successful in advancing the sustainability agenda had been included in this research, it is likely that the assessment of drivers and barriers would have been different. However, this does not make the research approach less applicable to any given city, it merely highlights that this study may need to be expanded in future to obtain a more nuanced perspective of the experiences of cities at different stages of their sustainability journeys.

4.2 Methodological approach to the meta-analysis

The analysis was based on a mixed methods approach combining literature review, a survey (EEA survey on urban transitions towards environmental sustainability) and semi-structured interviews with representatives of seven case study cities that help to deepen and contextualise the survey results. 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). It was structured around a series of potential drivers and barriers — actions that are 'supporting or inhibiting' transitions to urban environmental sustainability. These were in turn grouped under 'context' (i.e. distinct context of every city) and the set of six enabling factors, namely governance, culture, finance, knowledge, data and information, and technology, as defined within the urban environmental sustainability conceptual framework (see Chapter 2).

The geographical 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. Cities in eastern Europe were the least represented, followed by cities in southern, northern and western Europe. Most of the city representatives who completed the survey work in environment and climate change departments.

After completing the survey, representatives of seven of these cities (Cornellà de Llobregat, Gabrovo, Leuven, Lisbon, Mikkeli, Stockholm and Tallinn) were interviewed to achieve a more nuanced understanding of what drives urban environmental sustainability transitions in some European cities. Map 4.1 shows all participating cities, including those that responded to the survey and those for which an interview was carried out.

Given the relatively limited scope of this study, these findings should be seen as a starting point for a wider conversation about the drivers of urban sustainability transitions rather than a definitive overview of the multitude of complex and interrelated factors that shape sustainability outcomes in European cities. Detailed information on the methodological approach adopted in this research, and its limitations, is available in the stand-alone SEC report.

Map 4.1 **European Green Capital and European Green Leaf Award winners and finalists and survey respondents**

Reference data: ©ESRI

4.2.1 About the cities that participated in the research

The cities that were analysed for this research face a wide range of environmental challenges, with the most commonly identified challenges including severe storms and flooding, air pollution, stormwater management, decline of native species and natural habitats and heat waves. This was confirmed by the interviews, in which storms, flooding, air pollution, water scarcity, heat waves and lack of green space were identified as major challenges by the representatives of the seven case study cities.

Most cities in the survey have been considering environmental sustainability objectives as an important part of their political agendas since the period between 1992 (the Rio Conference) and 2000. This means that they have had several decades to mainstream these considerations into their wider policymaking processes and can be considered to have a fairly well-established track record in this area. In the interviews, several city representatives felt that sustainability only really emerged as a core aspect of their political agenda in the past 10 years or so (e.g. Tallinn), while others felt that sustainability had been an important priority for several decades (e.g. Stockholm).

According to the survey findings, public opinion and 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. These findings were confirmed by the interviews, in which growing public awareness of environmental issues and the political vision of individual leaders was repeatedly highlighted as important triggers.

4.3 Key drivers and barriers of urban environmental sustainability transitions

This section summarises the key drivers of and key barriers to urban environmental sustainability transitions identified through this research. Looking across all of the enabling factors, it highlights particular factors that stood out from the survey results and subsequent interviews. While there was certainly a consensus among the participating city representatives regarding the importance of some factors, this did not apply universally. Factors that were identified as extremely important to the sustainability transition by some city representatives were highlighted as a barrier or considered less relevant by others. Despite this heterogeneity of opinions, some important findings in relation to the key drivers of and barriers to urban environmental transitions emerge from this work. In future research, these should be tested further to confirm their robustness in different urban contexts.

4.3.1 Key drivers supporting urban environmental sustainability transitions

Contextual drivers

- The most significant contextual factors identified in the survey as supporting the sustainability transitions in cities are existing infrastructure, air/water/soil quality, city size, climatic conditions and gross domestic product (GDP) per capita.
- Although the survey identified existing infrastructure as the most important supporting factor, the interviews highlighted that it can also be a barrier (e.g. car-centric road use, urban sprawl, outdated/energy inefficient infrastructure). As this is one of the more dynamic contextual factors, it can be adapted to align it with new sustainability objectives (e.g. removing parking to make space for cycle lanes, retrofitting buildings).
- Close proximity to natural assets and exposure to green spaces and natural areas was seen in the interviews as an important contextual factor that can encourage people to care about environmental sustainability, which then becomes an important driver for more action.

Governance drivers

- Among the factors related to national and supranational governance, international treaties and EU laws, standards and regulations stand out as the most strongly supporting factors. These are followed by national laws, standards and regulations and then by distribution of state powers and the level of political decentralisation.
- While all the factors related to local governance are considered as mostly supporting, local government's overall vision and plans were seen as the most important local governance factor (see Figure 4.1).
- Effective multi-level governance across sectors and governance scales (see Box 4.1), as well as better collaboration with non-governmental stakeholders such as civil society, the private sector and academia, were also highlighted as important drivers in the interviews.

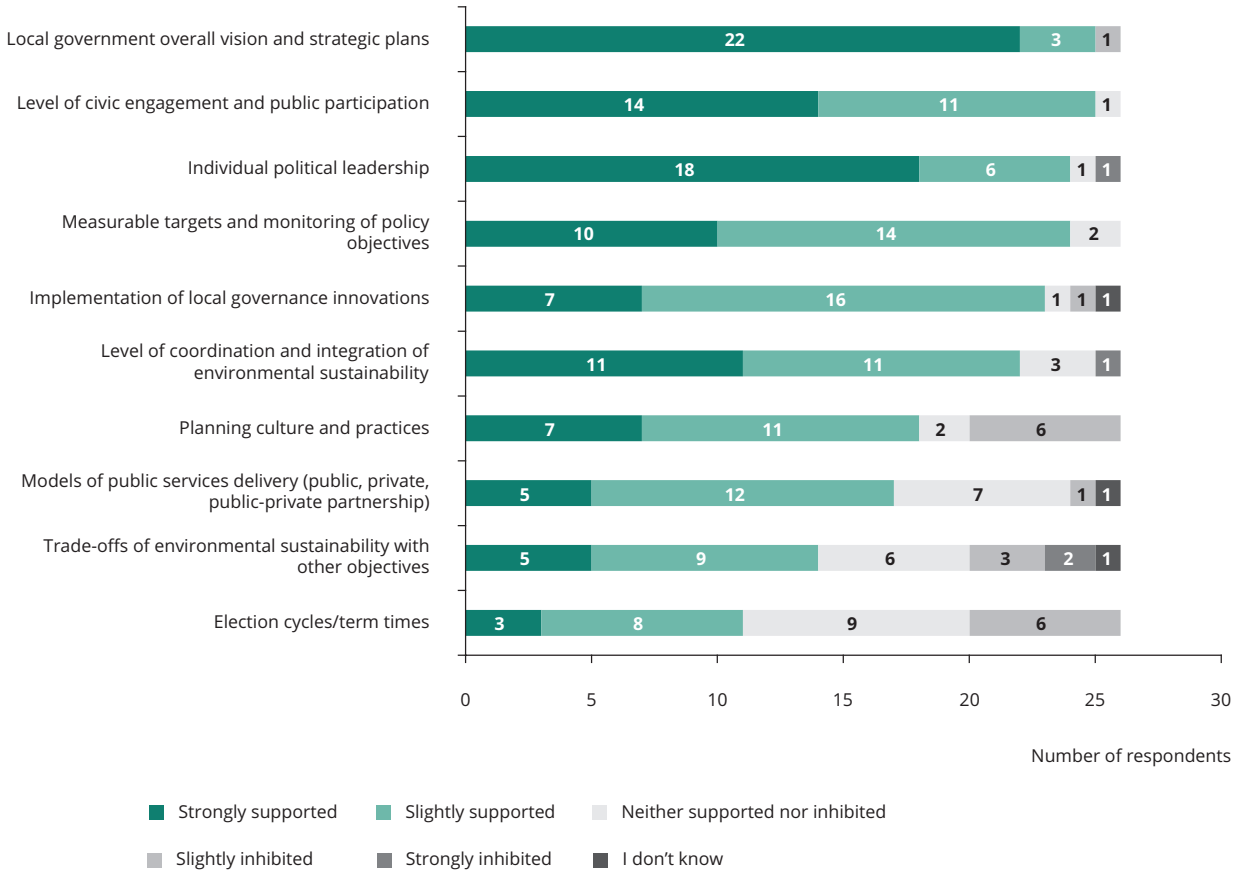
Box 4.1 Metropolitan governance supports sustainability transition in Cornellà de Llobregat

Spain has a decentralised system of governance, with 17 autonomous regions that have the ability 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 mostly coordinated with the autonomous region of Catalonia, the province of Barcelona and, most importantly, the Barcelona Metropolitan Area (AMB). The last is a public authority that consists of the city of Barcelona as well as 36 other municipalities. The AMB is responsible for managing territorial and urban planning, mobility, housing, environment, economic development and social cohesion (AMB, 2020).

Efforts by the AMB to tackle the metropolitan areas' environmental challenges comprehensively 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, meaning that 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. For example, to alleviate the crisis arising from the COVID-19 pandemic the AMB has added a new investment programme for municipalities — the environmental sustainability plan. The AMB will allocate EUR 110 million for the next three years, of which Cornellà de Llobregat will receive approximately EUR 5 million. These investments will be used to achieve a more accessible mobility system and to adapt it to the needs of the current and future pandemics. These resources will also be used to promote the ecological and energy transition through investments in resource management (energy and water) and municipal waste.

Although political parties may not be aligned across the municipal, metropolitan, provincial and regional level, there is broad cross-party agreement over the importance of acting on climate change and other shared environmental priorities. This has helped to depoliticise the topic of sustainability and to ensure that there is continuity in the strategic vision for all municipalities in the wider metropolitan area.

Figure 4.1 Responses to survey question 'Have the following factors related to local governance supported or inhibited the environmental sustainability transition in your city?'



Source: Authors' compilation.

Knowledge drivers

- All factors related to knowledge were mostly seen as supporting the sustainability transition. 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 level of awareness of environmental sustainability.
- These findings were confirmed in interviews in which the role of city networks and the learning and innovation they enable were emphasised as an important positive driver in all cities, with the EGCA and EGLA standing out as particularly important drivers (see Box 4.2).
- Research and innovation, particularly if done in a collaborative and inclusive way across public, private and third sectors, and raising awareness of environmental sustainability were also highlighted repeatedly.

Cultural drivers

- The cultural factors that were seen as most important in supporting the sustainability transition include the general public's values and attitudes to environmental sustainability; local government's willingness 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 the sustainability transition 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 environmental sustainability transitions in cities. Nevertheless, the increasing digitalisation of economies and societies raises concerns over social inclusion and equity, as some social groups with poor computer literacy or limited access to information and communications technology (ICT) devices (e.g. elderly people, low-income families) are at risk of not only being excluded from spheres of community participation and involvement but also of having reduced access to vital public services.
- While all the factors related to technology were seen as largely supporting the environmental sustainability transition, technologies for environmental monitoring (e.g. air quality monitors) and low-carbon technologies (e.g. electric vehicles, solar photovoltaic power) 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.

Box 4.2 The European Green Capital and Green Leaf Awards: powerful drivers of change

The European Green Capital and European Green Leaf Awards emerge as an important driver of environmental sustainability for the winners and finalists of the awards. All of the city representatives interviewed emphasised the central role that these awards had played in accelerating their sustainability journey.

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

1. **Benchmarking** — the stringent requirements set out in the application for the awards push cities to take stock of their current environmental performance and identify gaps in their knowledge. Cities are encouraged to systematically assess what they are doing and how they could improve: many cities reported that this was an important driver for tackling the environmental challenges that they were struggling with most.
2. **Strategic thinking** — the application for the awards promotes more strategic thinking around environmental sustainability and how it is integrated into wider city visions, as well as how it links to 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.

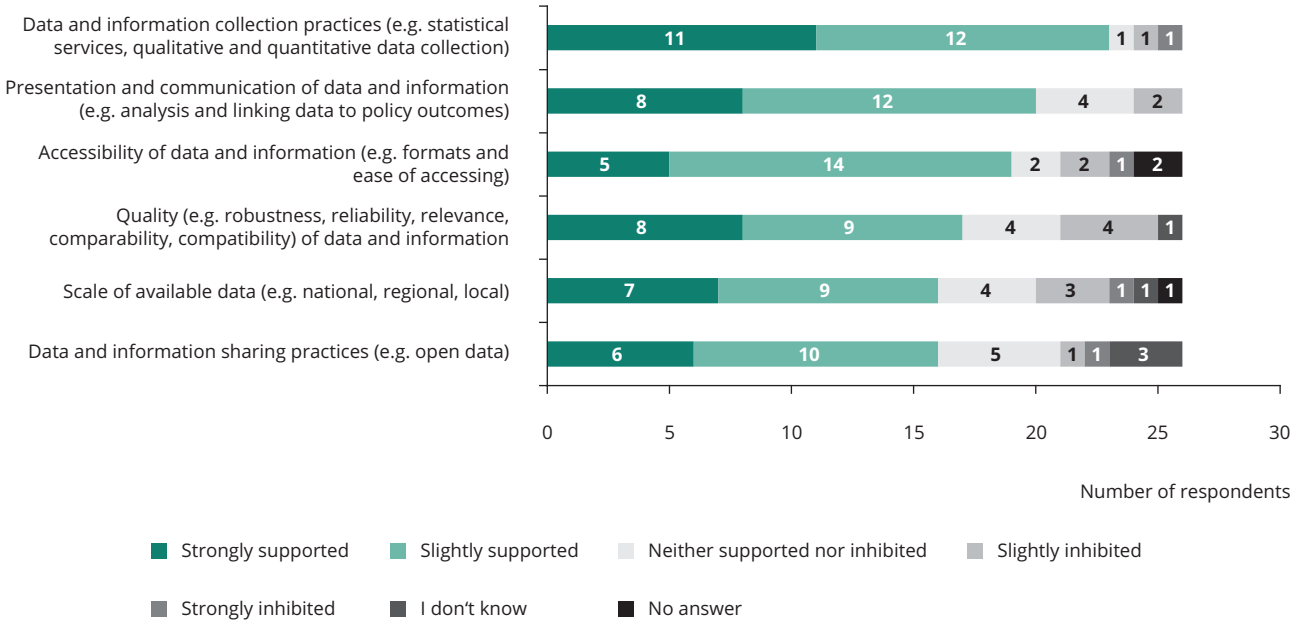
Data and information drivers

- The survey highlighted that most factors related to data and information are recognised as supporting the environmental sustainability transition (see Figure 4.2). Factors that stand out in the survey and that were also mentioned frequently by interviewees are data and information collection practices and presentation and communication of data and information (both considered as supporting factors by more than two thirds of respondents).
- Most interviewees mentioned the significance of data and information for monitoring and presenting a city's progress, setting relevant objectives and prioritising policies and actions needed to achieve sustainability targets.
- Several cities highlighted that they are working on enhancing their information collection and communication practices and that there is a 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 the sustainability transition 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 interviewees, providing support for sustainability investments ranging from energy efficiency through transport improvements and upgrades to improving water and sanitation infrastructures.
- Green public procurement was also seen as an important driver, and the role of EU procurement policies was highlighted as particularly valuable in supporting cities to improve their procurement processes and embracing green procurement as a vital part of their sustainability transitions.

Figure 4.2 **Responses to survey question 'Have the following factors related to data and information supported or inhibited the urban environmental sustainability transition in your city?'**



Source: Authors' compilation.

4.3.2 Key barriers to urban environmental sustainability transitions

Contextual barriers

- Key barriers identified in the survey as hindering the transition are gentrification demographics, existing urban form and the 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 present a barrier in different ways: growing populations put more pressure on existing services, while sparse populations make delivering certain services such as public transport more challenging. An ageing population and the 'brain drain' caused by the migration of young people was also seen as a major challenge.

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 might 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 between environmental sustainability and other objectives.

Knowledge barriers

- The following factors were identified as barriers by a small selection of cities (suggesting that all of these factors were not sufficiently well developed or lacking in the city): level of awareness of environmental sustainability; level of shared understanding of sustainability issues in local government; communication within local government and 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 at times 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 willingness of the general public to adopt new behaviours and practices emerged as the main barrier from the factors tested through the survey.
- This was supported by some of the interviewees who 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 factors, big data analytics and ICT were seen as a barrier by some cities and as neither supporting nor inhibiting the sustainability transition by others.
- The different views expressed and experiences could be because 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. 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 progress towards sustainability, cities face challenges such as the timeliness (e.g. 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 create a barrier to implementing their sustainability measures.
- 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, thus preventing more locally targeted responses.

Financial barriers

- In terms of factors that were identified by some cities in the survey as inhibiting the sustainability transitions, the level of fiscal decentralisation stands out as the most important barrier.
- This is aligned with the findings of the interviews, in which limited municipal budgets (as a result of insufficient fiscal decentralisation) was repeatedly highlighted as a barrier.
- Another challenge related to this 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 on environmental policy priorities (see Box 4.3).

Box 4.3 EU funding allows Gabrovo to overcome limited municipal budget

Low levels of fiscal decentralisation in Bulgaria mean that Gabrovo has only a very limited operating budget. This funding challenge is exacerbated by the costs the city faces in providing good-quality services, such as water and sanitation, that meet strict EU standards across a highly dispersed hinterland of unconnected villages.

But this has not prevented the city administration from thinking in innovative ways about its funding constraints. Gabrovo today receives more funds 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 been at the forefront of applying for and accessing EU funding. This includes funding from the European Regional Development Fund for energy efficiency improvements, improved green spaces and better urban infrastructure. In 2018 the city was recognised as a role model by Members of the European Parliament for the funding it received from the EU Cohesion Fund to upgrade its water infrastructure.

Given that most of these funds are distributed on a competitive basis, the significant number of successful EU-funded projects in Gabrovo is testament to the hard work of the administration in ensuring that the city can advance its sustainability agenda with the help of EU funding.

4.4 Lessons from the analysis of drivers of and barriers to sustainability transitions

The EEA report nr 16/2020 (EEA, 2020e) aims to help improve understanding of the drivers of and barriers to achieving urban environmental sustainability in Europe. A number of early lessons related to the drivers of and barriers to sustainability transitions in European cities have emerged from this research. Given the relatively limited scope of this study, these findings should be seen as a starting point for a wider conversation about the drivers of and barriers to urban sustainability transitions. However, the following lessons may be helpful to policymakers and to other urban stakeholders, including local citizens, non-governmental organisations and the research community, in accelerating urban environmental sustainability transitions across European cities:

- **Cities are heterogeneous and transition pathways need to be tailored to local contexts**, as drivers and barriers can differ greatly between cities. A factor that acts as a barrier in one city can be a driver in another. 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 policymaking and targeted policy interventions. Understanding the complex relationships between the existing urban context and its constantly evolving nature and sustainability efforts can help cities to prioritise the environmental policies that will be most appropriate 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 levels.

- **EU laws and policy frameworks have a key role to play in accelerating sustainability changes in cities.** Such laws, standards, regulations and funding opportunities provide strong incentives, support and even inspiration for cities. 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. Following the emergence of the COVID-19 pandemic, it is likely that leadership on and funding for key sustainability issues from the EU will play an even bigger role in accelerating change in European cities.

- **National and supranational governments can facilitate — and inhibit — systemic change** to achieve urban sustainability transitions in cities. While they are crucial in fostering knowledge exchange and supporting strong networks that enable peer-to-peer learning (e.g. EGCA, EGLA), 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 limits cities' ability to accelerate their sustainability transitions, particularly when it comes to big investments such as new transport infrastructure. The COVID-19 pandemic 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**, 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 value they add for individual member cities. Having a safe space to share not only successes but also failures was highlighted as an important aspect of such networks. The COVID-19 pandemic has also shown how city networks can be essential not just for information sharing but also in enabling cities to speak with a unified voice, raising their collective profile in important policy conversations.

- **Local research and experimentation can accelerate innovation** and is critical for identifying locally appropriate solutions by using the city as a 'test bed' 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 critical policy sectors. A supportive research agenda at the EU and national levels is also needed to support and reinforce efforts by individual cities.

- **Involving stakeholders and supporting effective public engagement in decision-making processes leads to better sustainability outcomes.** The sense of ownership and shared responsibility for dealing with environmental challenges 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 public that will encourage them to make positive 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. 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.

- **Updated and accessible data and information are needed to monitor progress.** This leads to better environmental management and makes it easier to demonstrate how a city is advancing towards achieving its specific goals. Collaborating with national and EU statistics offices and members of other EU networks, and complying with the EU directives, helps city governments 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, using high-profile 'champions' to promote more sustainable behaviours, accessible and attractive ways of data visualisation and presentation, and increased 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 them. While wealthier cities usually have more control over their investments, for cities with less revenue-generating capacities knowing how to access other sources of funding at EU and national levels 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. Influencing individuals to use their purchasing power for good can be a challenging area for cities, but achieving more sustainable consumption patterns within wider society was seen as an important complement to local government efforts.

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5
Key messages for Europe and European cities

Key Messages

- **Cities are key in the transition to a low-carbon sustainable economy** — it is estimated that 80 % of Europeans will live in urban areas by 2050. Cities are centres of population, economic activity, production and consumption. Many systemic environmental challenges are concentrated in cities. Yet cities can drive innovation and be at the forefront of the systemic changes needed. They can act as 'test beds' for innovative policy and action and can provide opportunities for coordinated interventions that can lead to changes in systems.

- **The need for integrated policy, networks and financial support** — while cities have some autonomy in policy- and decision-making, there is a need for better integration and coherence in policymaking. This applies horizontally (across policy areas and sectors) and vertically (from EU to national to local scales). The EEA and European Commission can play important roles in assessing and promoting environmental policy integration. Funding for sustainability actions (e.g. through the EU Cohesion Fund) and opportunities to learn from others and share experiences are also key.

- **Cities are unique, but common lessons emerge** — there is a high level of heterogeneity among European cities in terms of their size and physical, institutional, social and political characteristics. However, common themes for drivers of urban sustainability include the importance of high-level strategies, visions and plans; the key role of infrastructure; and the value of policy and fiscal autonomy. Urban sustainability will also require governance approaches that support cross-sectoral working and involve relevant stakeholders.

- **Future research needs and opportunities** — a number of research needs and opportunities are identified, including applying the nexus approach at different scales, such as within cities and at national and European levels; expanding research on and analysis of drivers of urban sustainability to include more cities and explore specific topics in more detail; using cities to test and experiment with solutions to complex transition challenges, for example through EU and national research agendas; and developing new measures of progress to urban sustainability, including composite indicators and measures combining quantitative and qualitative evidence.

- **Localising the EEA-Eionet strategy 2021-2030** — there are opportunities to localise the EEA-Eionet strategy through activity focusing on urban sustainability. Key messages from stakeholder discussions include the need for the following: co-creation with cities and their networks; integration with different levels of decision-making; timeliness evidence gathering to support policymaking in a proactive manner innovation by connecting with citizen and industry data; equality and a focus on understanding winners and losers; and equipping cities with the capacity and skills they need to develop and work with data and evidence.

5.1 Urban environmental sustainability: a key piece in the EU transition puzzle

Around three quarters of Europeans live in urban areas, and it is estimated that this will rise to 80 % by 2050 (EEA, 2019a). Cities have been called the 'engines of the [EU] economy' (Nabielek et al., 2016), and much of Europe's production and imports is to meet demand originating in cities as major consumers of resources and products. Cities also interact in many ways with their hinterlands, for example in relation to food production and supply, energy generation and movement of people (e.g. commuting for work). One illustration of the importance of urban areas in the transition to a low-carbon sustainable economy is the fact that they are responsible for at least 70 % of global carbon emissions (EEA, 2019b).

Many systemic environmental issues and challenges are also concentrated in urban areas, which face significant challenges relating to, for example, air and noise pollution, resource use and waste, pressure on ecosystems and habitats, and ensuring a good quality of life for all.

However, the concentration of people, consumption and economic activity in urban areas that underpins their importance as drivers of many environmental issues also means that they can be key to the transition to a more sustainable Europe. As centres of economic activity and population, urban areas can drive innovation and be at the forefront of the systemic changes needed. Cities can act as 'test beds' for innovative policy and action. Although they are connected to national, European and global systems (e.g. of production and supply), urban areas are distinct systems in their own right in which opportunities exist for coordinated interventions that can lead to systems change with far-reaching effects.

Addressing urban sustainability challenges can also play a pivotal role in achieving a range of EU policy objectives, for example:

- Developing green infrastructure is a key step towards ensuring the success of the European Commission's green infrastructure strategy and the EU biodiversity strategy for 2030.
- Mainstreaming urban adaptation strategies (e.g. in land use planning) can help to achieve the objectives of the EU adaptation strategy.
- Encouraging active transport modes, public transport and car-sharing/-pooling schemes can help meet the EU Ambient Air Quality Directive targets and deliver the low-emission mobility strategy.
- Minimising waste generation and maintaining the use and value of products, materials, built assets and land can help to meet the objectives of the EU action plan for the circular economy.
- The transition to decentralised clean energy production in cities will help to meet the objectives of the EU 2030 climate and energy framework.

By addressing challenges and progressing these and other policy objectives, cities will play a key role in delivering the urban agenda for the EU.

5.2 Key overall messages for European policy and action

5.2.1 The need for vertical and horizontal policy integration

Cities and urban areas have a key role in supporting the transition to a resilient and low-carbon sustainable economy in Europe, including as part of an overall green recovery from the COVID-19 pandemic. However, they require a consistent policy framework. The nexus analysis and assessment of drivers highlight the importance of higher-level (e.g. national, European) priorities and objectives being aligned and consistent — vertical integration:

- The response to key systemic environmental challenges for Europe and in cities, such as climate change, mobility or resource use, are dictated or influenced by a range of stakeholders and policy frameworks set at different spatial scales.
- Cities can achieve much on their own, but their efforts will be much more likely to succeed if their actions are aligned with clearly defined EU and national frameworks, standards and guidelines that support action at the city (and other local area) scale.
- In some policy areas (e.g. climate, energy, circular economy) the role of European and national policy is important, as many aspects will be beyond the ability of individual cities to influence. There is a need to ensure that higher-level policy is coherent and integrated such that the goals and targets in different policy areas are not conflicting. Ensuring that environmental policy goals are integrated into other sectoral policy (such as transport and energy) would help provide coherence. The EEA and European Commission can play important roles in assessing and promoting environmental policy integration.

- Other support, in the form of networks, research and funding will also be key (see Section 5.2.2).

The nexus analysis emphasises the potential for positive and negative interactions between policy areas and the need for cross-silo and cross-sectoral coordination and alignment with cities — horizontal integration:

- Within cities this is key to the prioritisation of policy and action and critical to the realisation of co-benefits and minimisation of trade-offs (see Section 5.3.4).

- There are myriad interactions between interventions and sectors; however, a relatively small number of policy agendas can be identified through which urban environmental sustainability can be achieved (see Table 3.10 in Chapter 3). The policy agendas cut across traditional policy areas and require coordinated action from both public and private sectors.

The research and analysis completed for this report also highlight the critical role of people in successful transitions:

- In cities policies related to, for example, mobility, climate and energy, or to the circular economy, will not succeed without the acceptance and support of citizens.

- This means understanding distributional effects (e.g. on the most vulnerable) and involving citizens and communities in designing and implementing policy and action that affects them (see also Section 5.3.3).

5.2.2 Support for urban environmental sustainability in Europe

Although the analysis of drivers and nexuses indicates the value of cities having autonomy in how they address sustainability issues, it is also clear that cities need support in the form of high-level visions and strategies, funding for sustainability actions and opportunities to learn from others and share experiences:

- International initiatives such as the United Nations (UN) Sustainable Development Goals and UN urban agenda are considered important by cities in providing high-level framing and prioritisation.

- EU laws, standards and regulations also strongly shape local sustainability ambitions and actions. The drivers assessment shows that cities are incentivised, supported and inspired by EU legislation and strategies such as the European Green Deal and the EU urban agenda and EU environmental directives (e.g. Water Framework Directive, Energy Efficiency Directive, Energy Performance of
Buildings Directive).

- Implementing urban sustainability transitions will require investment, and many urban areas will require financial support to realise their transition ambitions. A range of options exist including the EU LIFE programme, the European Regional Development Fund, the European Investment Bank and funds such as Jessica (Joint European Support for Sustainable Investment in City Areas), the European Bank for Reconstruction and Development Green Cities programme and the Next Generation EU recovery package (particularly associated with recovery from the COVID-19 pandemic). The economic and investment implications of COVID-19 are likely to increase the importance of external funding for urban environmental sustainability measures.

- Networks are also increasingly important within Europe and between European and global cities for the sharing of knowledge and experiences in finding solutions and overcoming barriers. Key networks include EuroCities, Local Governments for Sustainability (ICLEI) Europe, United Cities and Local Governments, Metropolis, the C40 Cities Climate Leadership Group and the Global Covenant of Mayors for Climate & Energy.

- EU initiatives, such as the proposed European urban initiative, part of the 2021-2027 EU programming period, are important mechanisms to support cities with capacity building, innovative solutions, knowledge, policy development and communication.

- European awards, especially the European Green Capital Award and the European Green Leaf Award, are also seen as an important means of facilitating knowledge exchange and networks that enable peer-to-peer learning and best practice.

- The COVID-19 pandemic has also highlighted the value of city networks in sharing knowledge and information and providing a common voice for cities in important policy conversations. Good examples are the C40 Global Mayors COVID-19 Recovery Taskforce (C40 Cities 2020b) and calls from the Global Covenant of Mayors and EuroCities (EuroCities 2020) for a green recovery and cross-border solidarity.

5.2.3 *COVID-19 is creating challenges and opportunities for European cities*

COVID-19 has had significant and far-reaching implications for the functioning of cities and the lives of their residents. It is a challenge of unprecedented proportions, and cities have been at the frontline of managing the crisis. European cities have been bearing some of the worst impacts of the crisis but are also becoming key actors in proactively advocating for a green and just recovery.

There is still considerable uncertainty about the longer-term impacts for cities. However, a growing agenda of issues that will have to be tackled in the months and years ahead is beginning to emerge. All of these will have an impact on environmental sustainability transitions in cities (ICLEI, 2020).

These include, for example, what a green recovery looks like for different types of cities; new requirements for the design of the public realm and green spaces and how this links to urban adaptation; opportunities and challenges presented by new forms of mobility and wider questions of urban accessibility; 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 businesses and service providers (e.g. less inner-city footfall); the role of technology and digital futures in the context of a just transition; urban and regional production and value chains and their link to the circular economy; and considerations of new forms of urban decision-making.

It is hoped that the European Green Deal will provide the framework that will support a green recovery. Some initial key lessons from the COVID-19 pandemic for cities include:

- Cities are facing a triple crisis in the wake of the pandemic: tackling the health impacts of COVID-19; dealing with the climate and ecological emergency; and addressing social and economic inequality. Despite these challenges, they have the potential to become a major driving force for a green and just recovery in Europe — provided that they are actively involved in the decision-making process from the beginning.

- While it is too early to know what some of the longer-term legacy of the pandemic will be when it comes to urban environmental sustainability, it is clear that the unprecedented EUR 1.8 trillion stimulus package agreed by the EU will reshape cities in fundamental ways.

- Infrastructure investment will play an important role in stimulating urban economic activity after the crisis, creating an opportunity to align the recovery with climate, environmental and social equity agendas in cities. This will need to be accompanied by better integration of policy sectors and actions to maximise the co-benefits.

Key opportunities for a green and just recovery appear in the following sectors: rethinking urban mobility and land use; retrofitting the urban building stock; enhancing the role of green infrastructure and nature-based solutions; and transforming urban food systems and the circular economy.

5.3 Key messages for urban policy and governance

Looking across the nexus analysis and assessment of drivers and barriers, five key messages for urban policy and governance emerge.

5.3.1 *Cities are unique and will have their own transition pathways*

Europe has two megacities (London and Paris), 26 cities with a population of more than 1 million, and more than 800 cities with a population of 50 000 or more (Nabielek et al., 2016; EC and UN-Habitat, 2016). Given this range and each city's physical, institutional, social and political characteristics, there is a high degree of heterogeneity among European cities and a resulting diversity in the pathways to urban sustainability:

- Larger urban areas and cities often have more autonomy, capacity and resources to develop and implement sustainability measures, and to access funding, awards and networks or participate in research. By contrast smaller cities may lack some capacity for achieving sustainability transitions and may also face challenges due to having less financial and political autonomy than larger cities. Smaller cities and urban areas may therefore require greater support from national and EU governments and may also benefit from working together, for example within regions.

- Contextual factors will influence and interact with sustainability objectives, and understanding them can help cities prioritise environmental policy and action. A clear finding from the nexus analysis and drivers research is that a good understanding of a city's context, and its constantly evolving nature, are prerequisites for successful sustainability planning.

- Some aspects of cities' context will be largely beyond any one city's ability to change, for example where they are fixed, such as geography or topography, or happen at a European or global scale, such as climate change. Understanding and embracing the influence of such factors can help shape efforts more effectively in addressing sustainability transitions.

- Other urban contextual aspects may evolve, and cities will be more able to influence them, for example city size and

form, inequality and poverty or institutional arrangements. Such aspects will evolve of their own accord because of the influence of external factors such as demographic changes or national or European economic growth, thus presenting emerging challenges (and opportunities). However, they can also be shaped by the actions of urban authorities.

- That cities are unique and will have their own transition pathways is also important for EU and national policy frameworks and legislation. It suggests that, while clarity is required, the options for local implementation also need to be flexible, so that cities can develop and deliver policy and action in ways that are relevant and effective for them.

5.3.2 Themes emerge in relation to key drivers of and actions for urban sustainability

While an understanding of the existing urban characteristics and context will shape the priorities in individual cities and dictate to some extent what may be achievable, some common themes emerge from the research into drivers of urban environmental sustainability and the actions cities have taken and plan to take. Looking across the nexus analysis and assessment of drivers, the following themes can be seen:

- The development of overall urban sustainability strategies, visions and plans is seen as a key prerequisite for a successful transition, together with local political leadership. Strategies and plans could be sectoral (e.g. buildings, climate, transport), but coordinated, cross-sectoral action and the prioritisation of policy that considers interactions between sectors and sectoral objectives is key to a successful transition (see also Section 5.3.4)

- The physical infrastructure of a city is one of the key barriers (e.g. car-centric transport infrastructure) but also a driver of and opportunity for urban sustainability. Re-imagining and redesigning the transport infrastructure (e.g. allocating road space to active travel), public spaces (e.g. increasing access to green space and building in flood protection) and buildings (e.g. retrofitting for energy efficiency and generation of renewables) will be key to achieving sustainability transitions in most cities.

- The ability to make local policy decisions and a degree of fiscal autonomy can benefit cities' urban sustainability transitions, by enabling local revenue generation and actions, investment and economic signals (taxes, incentives) to focus on local needs and objectives.

- Green public procurement is identified as a key area of action and a driver in both the nexus analysis and the assessment of drivers. Through the use of standards and requirements in procurement, cities can influence a range of environmental sustainability outcomes, including resource use and waste generation (supporting the circular economy), climate adaptation and mitigation, sustainable buildings and clean energy.

- Collaborative working, cross-sectoral governance and effective working between the public and private sectors, civil society and communities also emerges as an important enabling factor and driver of effective transitions in cities (see also Section 5.3.3).

- As noted in Section 5.2.2, international treaties and EU laws, standards and regulations are strong enabling factors for urban environmental sustainability, together with national laws, standards and regulations and the degree of political autonomy a city has.

5.3.3 New approaches to governance

Addressing the challenges of achieving urban sustainability requires governance approaches that combine short- and long-term goals and facilitate effective working across sectors and between different stakeholder groups:

- The assessment of drivers highlights that involving stakeholders from various sectors and across all levels of government and society in decision-making leads to better outcomes in terms of urban environmental sustainability transitions. Participatory approaches to governance can build ownership of and shared responsibility for environmental challenges and the measures required to address them.

- Engaging urban communities and residents is also key: any transformational change will require the participation of a city's population to succeed. In many cases it is the socially and economically vulnerable who have most to gain from sustainability transitions, as they often face the greatest exposure to environmental risks (e.g. air and noise pollution, poor housing, limited access to green space). However, the effects of fundamental changes will also be distributed unevenly, and understanding and reflecting these, and the needs of the most vulnerable in society, is critical to maximise the benefits and avoid exacerbating inequalities.

- Being transparent and providing clear, understandable information on policies and measures proposed can help empower individuals and engage them in the changes needed. This may include their own behaviours and choices but also acceptance of innovative ways of working, technologies or infrastructure changes that may challenge habits and current patterns of life. Transformational

systemic change will only happen in cities when people are at its heart.

5.3.4 *The multiplier effect of coordinated action*

The analysis of eight selected nexuses has the key objective of better understanding the interactions between selected policy areas such that trade-offs and co-benefits can be identified and, importantly, policy and associated action prioritised.

- By exploring the selected nexuses, high-level relationships and interactions can be seen. They have thematic and hierarchical links, with the key point being that achieving any one nexus objective can, if interactions are considered, deliver or support other nexus objectives. However, the opposite is also true: if the interactions and trade-offs are ignored, action in one area risks undermining progress in others. This latter situation can be considered perhaps to be a common issue in current policy and action for sustainability in cities (and at other scales).

- At the level of specific policy and measures, the nexus analysis identifies 15 key policy agendas that each help to deliver at least two nexus objectives (e.g. enhancing climate resilience and improving quality of life and health); see Table 3.10. Taken together, these provide a thorough overview of the key areas for strategic intervention and policy coordination in urban areas where multiple objectives can be delivered through coordinated action.

- Coordinated action that is explicitly designed to minimise trade-offs (negative effects in other areas) and maximise co-benefits (positive effects in other areas) can also support cost-effective interventions. Generating multiple benefits does not necessarily mean that delivery is cost-effective; however, it seems likely that minimising trade-offs and prioritising policy that maximises co-benefits will deliver cost-effective outcomes.

5.3.5 *Technology, data and information challenges and opportunities for cities*

Technological innovation and digitalisation are seen as a potentially important enabler of sustainability transitions, particularly in some sectors and systems (e.g. energy, mobility). However, technologies also bring challenges and will in themselves have impacts, for example:

- Electrification and the introduction of smart technologies, such as in mobility, will increase the demand for electricity and also the need to produce and use new products and devices that will have energy and resource implications themselves in and beyond cities, which should not be overlooked.

- Digitalisation will have social implications too, including for inclusion and equity (e.g. due to differential access to technologies and the skills required to use them) and for data use and privacy. This could lead to resistance or a lack of uptake, undermining progress. Solutions that maintain or worsen social inequalities should be avoided.

- Developments in information and communications technology (ICT) and smart technologies can provide opportunities for monitoring and measuring progress in, or close to, real time. This can potentially address the challenges that many cities face in accessing data that are aligned with, and timely enough, to inform decision-making around complex environmental issues. However, this does require cities to have access to and the capacity to integrate such technologies in existing (sometimes ageing) systems and infrastructure, and the skills and capacity to use them.

- Cities should seek to harness technologies that are supportive of environmental sustainability (e.g. enhanced monitoring of environmental problems, improvements in the efficiency of renewable energy systems) but be cautious of seeing technology as a solution to all environmental challenges.

Low-technology solutions may be more effective in some contexts, for example reallocating road space to active travel may be cheaper to implement yet have a greater impact on the sustainability of mobility than smart traffic management systems. Likewise using nature-based solutions to manage heat, provide natural shading or mitigate flood risks may be more effective than technological solutions, especially when the co-benefits for nature, human health and quality of life are considered.

5.4 Future research needs and opportunities

This report has provided an initial overview of urban environmental sustainability in Europe. It brings together information and evidence on the importance and role of cities and urban areas in delivering the EU's sustainability transition; on the support for urban environmental sustainability in Europe; on how urban environmental sustainability can be analysed and assessed and lessons from the two approaches presented in the report (the analysis of selected urban nexuses, and an assessment of drivers and barriers in cities); and on key messages for policy and urban governance. However, the findings and emerging lessons should be seen as only a starting point for a wider conversation about the transition towards urban environmental sustainability. Further research is needed to develop a more definitive overview of the multitude

of complex and interrelated factors that shape sustainability outcomes in European cities. Some further research needs that emerge from this initial work that the EEA and other interested parties may wish to explore are outlined below.

The COVID-19 crisis has also added 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'.

5.4.1 Develop the application of the nexus approach at different scales

Almost all decisions at the city level are in some ways interrelated, which highlights the importance of a systems perspective when thinking about urban sustainability. Recognising interrelationships across the different elements of urban sustainability (i.e. nexus) can thus be an important starting point for cities to explore progress towards their sustainability objectives.

The priority objectives for urban environmental sustainability will vary among European cities given their different contexts (e.g. historical, physical, social and institutional). Therefore, cities should seek to establish their own nexuses and explore progress towards their prioritised sustainability objectives.

On a larger scale, the development and analysis of nexuses could also come from both European and national levels. The European topic centres (ETCs) could have a key role in coordinating this process. By doing this, the approach could be developed, for example by integrating the measurement of progress towards urban environmental sustainability (see also Section 5.4.4). Further testing by national governments could also provide a better understanding of environmental sustainability in selected cities in their territory and be fed back to inform the overall approach.

5.4.2 Expand the analysis on drivers of urban environmental sustainability transitions

The findings and emerging lessons from the meta-analysis summarised in Chapter 4 and presented in the report *Sustainable European Cities (SEC) — Understanding the drivers of urban environmental sustainability transitions* should only be seen as a starting point for 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 pieces of follow-up work that emerge from this initial analysis that the EEA and other interested parties may wish to explore, including:

- **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, thus ensuring that there is a larger sample size and the experiences of cities that are at an earlier stage of their sustainability journey are included.

- **Interviewing a wider range of cities or using interviews as 'deep dives' into specific topics** — as with the survey, it would be valuable to expand the number of city representatives interviewed, including to understand the perspectives of cities that may either be at a much earlier stage in their sustainability journey or of cities that are potentially struggling with particular barriers. In addition, further interviews might be used as deep dives to better understand the specifics of a particular driver or barrier in relation to different topics.

- **Linking the findings to major new EU policy initiatives** — the research was completed ahead of the publication of a number of important EU initiatives, including 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 are aligned with the priorities set out in these new policy documents and to use this to identify important gaps in which the efforts of cities to transition might be better supported through existing EU initiatives and legislation.

- **Linking the findings to the COVID-19 pandemic** — the survey and interviews were completed before the coronavirus pandemic swept across Europe. 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 a starting point for these discussions. Of course, the emergence of COVID-19 has also fundamentally changed priorities across European cities — repeating this research and comparing how drivers and barriers may have changed over the past year would therefore also be a valuable approach.

- **Exploring wider themes and subject areas that may be driving the sustainability transition** — there were some themes that did not emerge clearly from this research or were not within its scope and would benefit from further research, including:
    - how differences in planning and urban development contexts between different cities may shape their sustainability transitions;
    - governance for transformation, including discussions of how cities are creating a climate for innovation within local/regional authorities and the difference between more top-down leadership on sustainability versus more bottom-up drivers emerging from civil society and the public;
    - understanding interlinkages between drivers of environmental sustainability transitions and social and economic drivers; and
    - the role of lock-ins and path dependencies and how cities might be supported to move from incremental improvements and a fairly linear progress to more transformative action and accelerated change.

5.4.3 Cities as a test bed for innovative action

In their efforts to achieve sustainability objectives cities are facing inherently complex transitions and problems that can be difficult to solve or have unintended trade-offs. Research and experimentation are critical to identifying locally appropriate solutions:

- Using the city as a test bed can accelerate innovation, because it ensures that new approaches and technologies are appropriate for the local context. It also enables cities to identify different sustainability nexuses and find solutions that can lead to co-benefits across different policy sectors.
- The EU- and national-level research agendas need to support and reinforce efforts made by individual cities to achieve their sustainability transitions. Existing research should also provide important insights into issues that are shared by a wide range of cities.
- If a city has an integrated strategic vision, that can help to create a common understanding of sustainability issues across all sectors of government. This could ensure that sustainability issues are not dealt with in a 'siloed way' but instead become a shared responsibility.

5.4.4 The need for new measures of progress to urban environmental sustainability

Measuring progress towards achieving urban environmental sustainability is essential to better understand the effectiveness of policies and measures used to achieve the sustainability objectives. However, measuring sustainability can be challenging and may require new measures to enable comprehensive analysis of urban environmental sustainability:

- There is an abundance of quantitative contextual indicators focusing on a single topic (e.g. environmental quality, land use, transport and energy) in an urban context. However, cities using cross-sectoral analysis (e.g. a nexus approach) would benefit from using of more complex composite indicators. For example, a composite resilience metric suitable for European cities could facilitate analysis of climate resilience. Establishing such indicators should be a priority to provide extensive evidence on the challenges of achieving urban sustainability.
- Some objectives of urban sustainability could make use of the application of qualitative evidence as well as quantitative evidence. For example, using quantitative indicators to assess quality of life aspects of urban environments will not provide a comprehensive characterisation of this aspect.
- Many existing indicators on topics of interest are not exclusively focused on urban areas. If such indicators are to be used as a standardised measurement, they would need to be available for only urban areas.

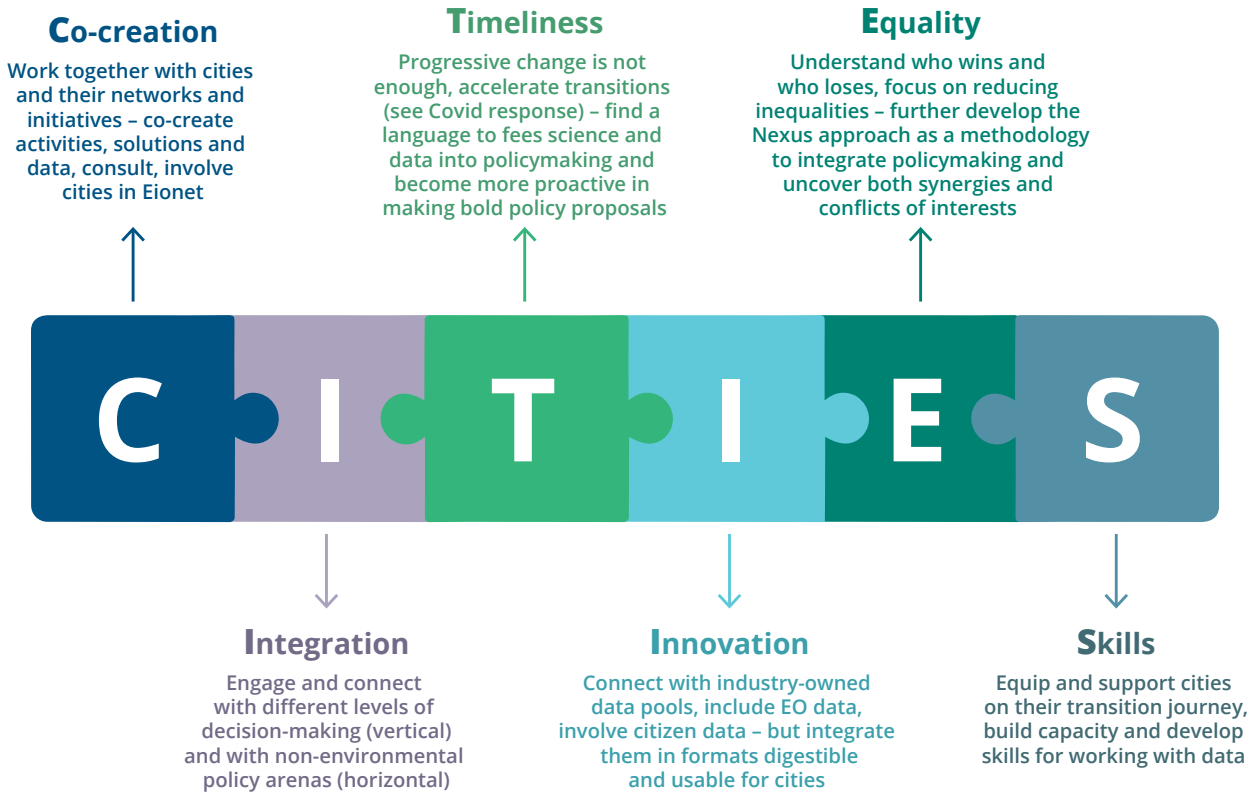
5.4.5 Localising the EEA-Eionet strategy 2021-2030

In January 2021 the EEA published its EEA-Eionet strategy for the period 2021-2030 (EEA, 2021). The strategic vision is that by 2030 the EEA and Eionet will 'enable a sustainable Europe through trusted and actionable knowledge for informed decision-making on priorities and solutions, in line with Europe's policy ambitions'. This is to be achieved through work under five strategic objectives:

- SO1 — Supporting policy implementation and sustainability transitions;
- SO2 — Providing timely input to solutions for sustainability challenges;
- SO3 — Building stronger networks and partnerships;
- SO4 — Making full use of the potential of data, technology and digitalisation;
- SO5 — Resourcing our shared ambitions.

An urban stakeholder meeting in December 2020 explored how urban sustainability can provide a focus for localising the EEA-Eionet strategy. Figure 5.1 summarises the key messages from this stakeholder event, setting out six key ways in which the EEA's work on urban sustainability can provide an important mechanism for and exemplar of localising the EEA-Eionet strategy.

Figure 5.1 **Localising the EEA-Eionet strategy to an urban level**



Source: EEA.

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Abbreviations

BEA	Barcelona Energy Agency
BISE	Biodiversity Information System for Europe
CEMR	Council of European Municipalities and Regions
CO_2	Carbon dioxide
CoR	Committee of the Regions
dB	Decibel
EAP	Environment Action Programme
EEB	European Environmental Bureau
EEA	European Environmental Agency
EGCA	European Green Capital Awards
EGD	European Green Deal
EGLA	European Green Leaf Awards
Eionet	European environment information and observation network
EO	Earth Observation
ETC	European topic centre
EU	European Union
GDP	Gross domestic product

GI	Green infrastructure
ICLEI	International Council for Local Environmental Initiatives (also known as Local Governments for Sustainability)
ICT	Information and communications technology
IEA	International Energy Agency
Jessica	Joint European Support for Sustainable Investment in City Areas
QoL	Quality of life
MDIAK	Monitoring, data, information, assessment, knowledge, understanding, action
NGO	Non-governmental organisation
NO_2	Nitrogen dioxide
NO_x	Nitrogen oxides
NbS	Nature-based solutions
O_3	Ozone
OECD	Organisation for Economic Co-operation and Development
PM_{10}	Particulate matter (diameter 10 μm or less)
$PM_{2.5}$	Fine particulate matter (diameter 2.5 μm or less)
PTAL	Public transport accessibility level
SDG	Sustainable Development Goals
SO_2	Sulphur dioxide
SOER	*The European environment — state and outlook* report
STO	Solar Thermal Ordinance
TOD	Transit-oriented development

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