Managing Environmental and Energy Transitions for Regions and Cities

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Foreword

To prepare regions and cities for the transition to a climate-neutral and circular economy, the OECD Centre for Entrepreneurship, SMEs, Regions and Cities (CFE) and the European Commission's Directorate General for Regional and Urban Policy (DG REGIO) held five high-level expert workshops on "Managing Environmental and Energy Transitions for Regions and Cities". The workshops gathered academic and policy experts to share today's frontier thinking and practical examples of regional and local policies to advance these transitions. This report summarises these workshop discussions, building on background papers prepared by academic and policy experts.

The report highlights multiple and diverse pathways for regions and cities to manage the transition to a climate-neutral and circular economy. Many OECD member countries have adopted the target of net-zero GHG emissions by 2050 to contribute to the objectives of the Paris Agreement. The circular economy addresses multiple unsustainable environmental impacts of economic activity. Regions and cities play a central role to drive the transition, including in energy supply, transformation and use; the transformation of mobility systems; and land-use practices. Many well-being gains from transition, such as improved health outcomes, accrue locally, and therefore can further motivate regions and cities to take action. The transition will unevenly affect citizens, regions and sectors. The diversity of conditions and potential impact on people, places, and industrial sectors needs to be acknowledged and incorporated into policy decisions.

Climate change, the loss of biodiversity, and unsustainable material consumption will pose unique challenges to urban and rural areas alike. Urban areas contribute substantially to climate change through their own GHG emissions and their materials consumption, and strongly feel its impact. Rural areas are vulnerable to environmental pressures because of their limited economic diversity, larger shares of vulnerable populations and larger dependence on natural resources in economic activity. The COVID-19 pandemic reveals the importance of preparedness and early, decisive action to mitigate risks to human-well-being and minimise economic costs. This involves systematic transformations of unprecedented depth and breadth. The COVID-19 pandemic illustrates some of the stakes and can galvanise citizens, economic agents and governments at all levels into action.

The workshop findings summarised in this report highlight that preparing regions and cities for the environmental and energy transition requires strong investment decisions, scaling-up and deploying sustainable technologies and practices. Accelerating innovation across electricity, transport, buildings, agriculture and other socio-economic systems is part of the answer. These technological and infrastructure shifts need to occur in the context of transformations in behaviour, knowledge, lifestyles and economic activity. A place-based approach to make sustainable use of local assets is central. The transition challenge for regions and cities becomes even more acute when considering the social justice issues surrounding equity, vulnerability, fairness, and legitimacy – despite the clear social co-benefits, such as displaced pollution and reduced climate change. With environmental and energy transition comes many economic and social opportunities and well-being benefits for regions and cities. However, it also presents risks and trade-offs. Regions and cities will reap the rewards and minimise risks and trade-offs if they promote early action, take a place-based perspective to human well-being and advance with a just transition to climate-neutral and circular economies.

Acknowledgements

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The report is the outcome of five high-level expert workshops organised in 2019 by the OECD and the European Commission at the OECD Headquarters in Paris as part of the project "Managing Environmental and Energy Transitions for Regions and Cities". The financial contribution by the Directorate-General for Regional and Urban Policy and the support, in particular by Peter Berkowitz, Sander Happaerts, Myriam Bovéda and Gergana Miladinova, are gratefully acknowledged.

The OECD Secretariat would like to thank the experts who wrote the background papers for each workshop: Harriet Bulkeley, Ralph Chapman, Paul Ekins, Greg Halseth, Martin Phillips, Alexis Robert, Dirk Schoenmaker, Willem Schramade, Seth Schultz, Diana Ürge-Vorsatz, and Anders Wijkman. The background papers are available in their entirety online. The OECD team would also like to thank the workshop participants for their perspectives that have contributed to informing this report.

The workshops and final publication were co-ordinated by Sandra Hannig under the supervision of Andrés Fuentes Hutfilter and Rüdiger Ahrend in the Economic Analysis, Statistics and Multi-level Governance Section in CFE, led by Rüdiger Ahrend. The chapters build on the background papers and the workshop discussions. Chapters 1, 2, 4, 5 and 6 were drafted by Sandra Hannig with input from Andrés Fuentes Hutfilter. Chapter 3 was co-authored by Sandra Hannig and Oriana Romano. Nikolina Jonsson supported the organisation of the five workshops for which Aimée Aguilar Jaber (Workshop 1), Tadashi Matsumoto (Workshop 2), Oriana Romano (Workshop 3), Chris McDonald (Workshop 4) and Dorothée Allain-Dupré (Workshop 5) were responsible. The report benefited from valuable additional comments and inputs from Jonathan Crook, Isabelle Chatry, Maria Varinia Michalun, Atsuhito Oshima, Louise Phung, Lisanne Raderschall, Andrés Sanabria and Raffaele Trapasso from the OECD. It also benefitted from comments from colleagues of several Directorates-General of the European Commission, including Benjamin Fairbrother, Merja Haapakka, Sander Happaerts, Michal Kubicki, Laura Liger, Federico Porra, Eleftherios Stavropoulos. Peter Takacs and Monika Zdaneviciute. Special thanks goes also to the Environment Directorate at the OECD for their participation in workshops and for their analysis on which the report draws.

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Executive summary

Regions and cities are vital to make the climate-neutral and circular economy a reality by 2050

Cities and regions can make the difference as pressures mount

Regional and local governments play a central role in managing the environmental and energy transition, which involves systemic transformations of unprecedented depth and breadth. Regions and cities often have jurisdiction over crucial sectors for climate action, including buildings, part of transportation, and other local infrastructure. They can also boost the circular economy, such as in waste management, and more generally are responsible for 55% of the public spending in sectors directly associated with climate change. Regional planning and regulation, for example on transport, can guide private investment in a way that is consistent with the transition. Last but not least, regions and cities are in close contact with citizens and local businesses, so are prime vectors for ensuring popular support of the required policy choices.

Recognise both the scale and urgency of needed action

Achieving the sustainability of human interactions with the natural environment is possibly the greatest challenge confronting regions and cities in the 21st century. Strong and rapid mitigation action is needed to meet the Paris agreement targets and avoid major risks to the foundations of human well-being. Despite success in halting and reversing the degradation of some ecosystems, environmental pressures are growing fast. Material extraction and processing contributes to 71% of GHG emissions (including fossil fuel use for energy supply, agriculture and industry) and accounts for substantial water, soil and air pollution. With current policies, the world's consumption of raw materials is set to nearly double by 2060 with corresponding intensifications in environmental pressures. While regional, urban and rural policy makers have taken some steps towards a climate-neutral and circular economy, the scale and speed of both action and investment are insufficient. Reaching net-zero emission and circularity objectives will require supplementary annual investment of around 1% to 1.5% of GDP annually. In addition, a large reorientation of investment flows away from fossil fuel is needed, beginning with the economic stimulus packages set up in connection with the COVID-19 pandemic.

Highlight the benefits to build support for action

Many of the well-being gains of the environment and energy transition, such as less air pollution, less traffic congestion, less water and soil pollution, access to green spaces and better health accrue locally. They motivate many regions and cities to take action and can largely offset the costs. Increasing green infrastructure generally offers multiple health and well-being benefits. Energy-efficient buildings, for example, not only mitigate GHG emissions and foster the circular economy, they also generate local employment, health and productivity benefits. Active mobility, such as walking and cycling, can contribute to achieving sustainable transport, building healthier and more sustainable communities and reducing traffic and pollution while freeing urban space.

Do no (more) harm, while protecting the vulnerable

Investment in assets that will become unproductive in the course of the environmental and energy transition, for example in fossil fuels, needs to be stopped. Delay only leads to both higher emissions and costs. Addressing these challenges requires overcoming barriers such as misaligned incentives, capacity gaps and political economy factors including employment in the fossil fuel industry, short time horizons and incumbent market interests. It also requires an inclusive approach to decision-making, protecting vulnerable households from income and employment risks as well as helping workers and firms adjust. In this context, coal mining and other carbon-intensive regions need support to achieve a just transition. The resilience of vulnerable households is also central for adapting to the local consequences of inevitable climate change. Regions and cities are needed to develop effective solutions in the context of national, international and supranational governance together with the citizens and businesses.

Both urban and rural areas need to pull their weight

Between 2015 and 2050, city populations are projected to increase from 3.5 to 5 billion. This creates pressures but also opportunities for more efficient resource use. City governments need to support the environmental and energy transition with urban planning, building and transport policies, and by providing financial, technical, and administrative support. A successful transition in rural areas requires overcoming challenges related to rural risk management, governance, and ensuring a just transition. Rural policy makers have a range of tools to manage the transition, notably with regard to the energy sector, rural mobility, sustainable land management and the bioeconomy. More generally, preparing rural regions for environmental and energy transition requires better linking transition objectives with rural development. Finally, regional and urban policy also plays an important role in enabling the transition to a circular economy. New circular business models, shared use, waste prevention, recycling, and similar measures can create savings and local jobs.

Embed the environmental priority in urban and regional policy

The environmental and energy transition needs to be integrated into all regional and urban policies. This requires effective co-ordination of cities and regions with national governments, strong investment decisions and deployment of novel technologies and practices. Unlocking the potential of the climate-neutral and circular economy in regions and cities also implies putting the necessary conditions in place to create incentives (legal, financial), stimulate innovation (technical, social, institutional) and generate information (data, knowledge, capacities). Urban, regional, and rural policy makers need to develop new skills and policymaking practices, embracing foresight, experimentation, evaluation and stakeholder interaction.

1 Managing environmental and energy transitions: A place-based approach

This introductory chapter presents a framework for managing the transition towards environmental and energy sustainability in regions and cities. It highlights the need for place-based public and private action and investment to bring about the broad economic, social and political transformations needed for a climate-neutral and circular economy.

Managing environmental and energy transitions for regions and cities

Regions and cities are pivotal actors in environmental and energy transitions, but need to step up ambitions and investment. Subnational governments – regions and municipalities – are responsible for almost 60% of public investment (OECD, 2018[1]) and are close to citizens. The environmental and energy transition (Box 1.1) requires multiple transformations, ranging from individual behaviours to policy makers that set effective incentive structures, from community projects to multilevel governance. While it is clear that such a shift requires systematic transformations at the local scale, it is not always clear how subnational policy makers can manage such transformations. The COVID-19 outbreak has further led to a context of radical uncertainty. Subnational governments face difficult trade-offs given the health, economic and social challenges the pandemic raises. At the same time, it provides an opportunity to build more sustainable and more resilient regions and cities. The scale and character of the sustainability challenges facing regions and cities differs depending on their geography, which calls for place-based responses. Embedding such a transition in broad and inclusive well-being objectives is also needed. Environmental action comes with important local well-being gains, including less air pollution, less traffic congestion, less water and soil pollution, access to green spaces and better health outcomes (OECD, 2019[2]). It requires both different and more investment. Since infrastructure is long-lived near-term action is cost-effective.

Box 1.1. The transition to environmental and energy sustainability in this report

This report uses the term environmental and energy transition to discuss policies that help regions and cities achieve long-term sustainability goals with respect to the natural environment, bearing in mind the central role of energy transformation and use. The report focuses on the transition to a climate-neutral and circular economy and discusses the opportunities and challenges of a systemic transition in important transition domains such as mobility, food, and housing.

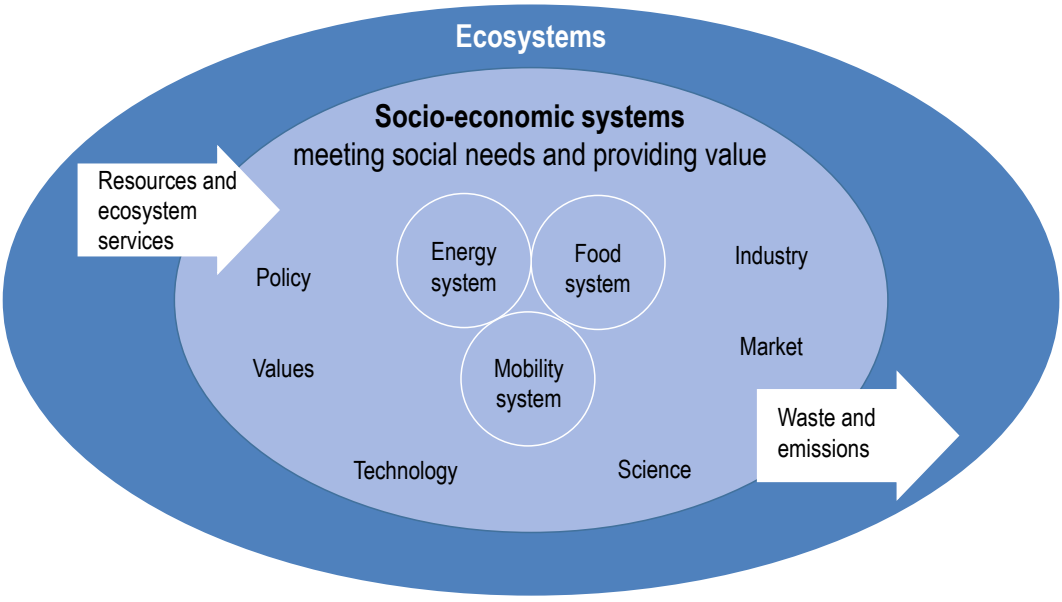
There is growing recognition that reaching a climate-neutral and circular economy will require a paradigm shift. Often called 'sustainability transitions', these recognise that global environmental challenges such as climate change or the environmental impacts of materials use are rooted in prevailing modes of production and consumption. Deep innovations and profound changes to the dominant structures, practices, technologies, policies, lifestyles, etc. are needed. This perspective is linked to the Sustainable Development Goals, which also encompass human well-being needs. Local and regional governments play an instrumental role in the environmental and energy transition given their important role in local transition domains (e.g. buildings), their levels of public investment, and closer connection to citizens.

Reducing environmental pressures requires unprecedented decoupling of economic activity from greenhouse gas emissions and the use of natural resources. GDP growth coinciding with absolute reductions in emissions or resource use is denoted as 'absolute decoupling'. This is in contrast to 'relative decoupling', where resource use or emissions increase less than GDP. While relative decoupling is frequent for material use as well as GHG emissions, examples of widespread absolute long-term decoupling of environmental pressures are rare. Several high-income countries, including the European Union as a whole, have decoupled GDP from production-based and from consumption-based CO2 emissions (Haberl et al., 2020[3]). In these countries, GDP generally grows less. The estimated amount of materials needed to meet final demand in the European Union (the “materials footprint”) has risen with GDP. Reaching net-zero greenhouse gas emissions by 2050 while ensuring economic high and growing economic activity requires sharp decoupling.

System transformation as a new policy rationale

Policies for the transition to environmental and energy sustainability should address entire socio-economic systems, such as energy, mobility and food. These systems are characterised by technologies (e.g. renewable energy technologies), as well as markets and functions (e.g. health, education, nutrition), and can be referred to as transformation domains (Anderson et al., 2019[4]). They lead to new or different ways to satisfy societal needs (nutrition, housing, communication, mobility, material supply, etc.). A systemic view of transformation domains attempts to capture the interrelationship of various factors. How we feed ourselves, travel or communicate is influenced by product offerings, infrastructure and technologies, market and power relations, societal norms, the temporal framework, etc. (Figure 1.1). These system elements are connected and mutually reinforcing.

Figure 1.1. An illustration of a socio-economic system



Source: EEA, (2020[5]), *The European Environment - State and Outlook 2020*, European Environment Agency, Stockholm, https://www.eea.europa.eu/soer/2015/europe/natural-capital-and-ecosystem-services/ecosystems-and-socio-economic-systems/view (accessed on 21 July 2020).

Long-term systematic policy frameworks are being developed at the European, national, and local levels. At the European level, strategic frameworks such as the European Green Deal and its more specific initiatives (e.g. the Circular Economy Action Plan) support the sustainability transition. At the national and subnational levels, many countries, regions, and cities have long-term targets for environmental and energy transitions. While still quite fragmented (Matsumoto et al., 2019[6]), these emerging frameworks are characterised by:

- the emergence of long-term strategies and objectives (e.g. 2050)
- a shift from sectors to systems, which implies recognising links between the economy, the environment and society and seeking greater policy coherence and alignment
- an emphasis on a transformation of the economy guided by mission-oriented objectives (e.g. the transition to a climate-neutral and circular economy)
- multi-dimensional goals (e.g. productivity and sustainability; maximising synergies and minimise trade-offs between conflicting goals)

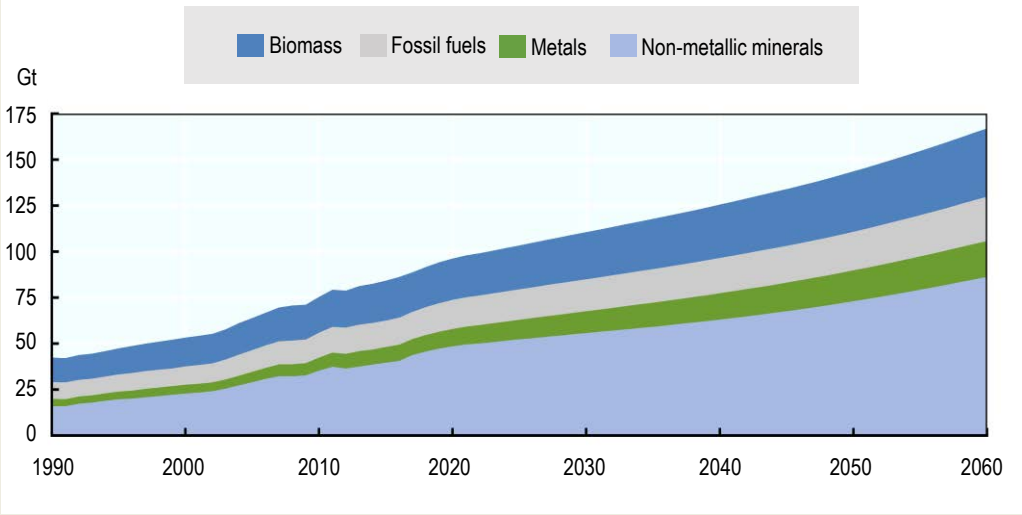
- recognising the relevance of diverse public and societal actors and the inclusion of stakeholders in local policy development
- more "transition thinking", including a particular emphasis on the role of innovation in different policy areas.

A shift towards framing policies in the context of transitions is taking place in different policy areas. System thinking can help identify and understand critical linkages, synergies and trade-offs between issues that are frequently treated separately, thereby reducing unintended consequences of policies (Hynes, Lees and Müller, 2020[7]). For example, responding to the COVID-19 pandemic requires a systemic approach focused on resilience, encompassing diverse policy areas including health, employment, urban planning and many others, with a strong place-based dimension. In science, technology and innovation (STI) policy, state intervention has shifted from using innovation policies to increase economic performance to improving sustainability (Machado, Qu and Cervantes, 2019[8]). This shift reflects a need to reorient innovation towards addressing societal challenges and achieving sustainability objectives. It also calls for engaging local actors in societal transformations, and significant public investment and policy support at the national and subnational level In environmental and energy transition, improving resource efficiency is essential to reduce the environmental impact of societal activity, reflecting the prominent role of the circular economy in providing environmental, economic, and social benefits (Box 1.2).

Box 1.2. A circular economy is essential to green growth

The world's consumption of raw materials, including biomass, fossil fuels, metals and non-metallic minerals, is set to nearly double by 2060 as the global economy expands and living standards rise. This will place twice as much pressure on the environment as today (Figure 1.2). Materials extraction and processing contributes 71% of GHG emissions (including fossil fuel use for energy supply, agriculture and industry) and accounts for substantial water, soil and air pollution. For example, plastics production and waste generation roughly doubled between 2000 and 2015, affecting the environment and ecosystems through higher energy use, pollution from landfill and incineration, and uncontrolled disposal, such as marine litter. Metals extraction and processing cause soil acidification, the degradation of water flows and have toxic effects on ecosystems and humans. The European Commission estimates that more than 90% of biodiversity loss and water stress comes from resource extraction and processing.

Figure 1.2. Raw material extraction is projected to increase



Note: Biomass is mostly for food and feed. Non-metallic minerals mostly for construction. Assumptions made on current policy trends.
Source: OECD (2019[9]), *Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264307452-en; OECD ENV-Linkages model.

Many regions and cities are implementing policies to stimulate the transition to circular economies, which aim at keeping products and materials in use (see Chapter 3). The circular economy is central to achieving climate-neutrality, as well as meeting the Sustainable Development Goals, especially those related to biodiversity, water, energy, and responsible production and consumption. Policies to move to a circular economy reduce materials use and related environmental impact by avoiding wasteful use, as well as by encouraging re-use, shared use, and recycling. Recycled and re-used materials have much less environmental impact than raw materials. For example, recycling plastics can largely avoid the impact associated with virgin plastics production. However, it faces substantial challenges, including low and volatile raw material prices and limited suitability of recycled materials (OECD, 2018[10]). New circular business models can reduce environmental impact, for example by sharing assets. One example of such an asset is the automobile: in the European Union, automobile use is estimated at 2%, which points to a large potential for sharing cars instead of owning them, lowering GHG emissions. Reducing materials consumption can also lower GHG emissions in heavy industry, which is otherwise difficult to decarbonise, by up to 60% by 2050, especially in plastics and steel, helping to achieve deep decarbonisation at the lowest cost.

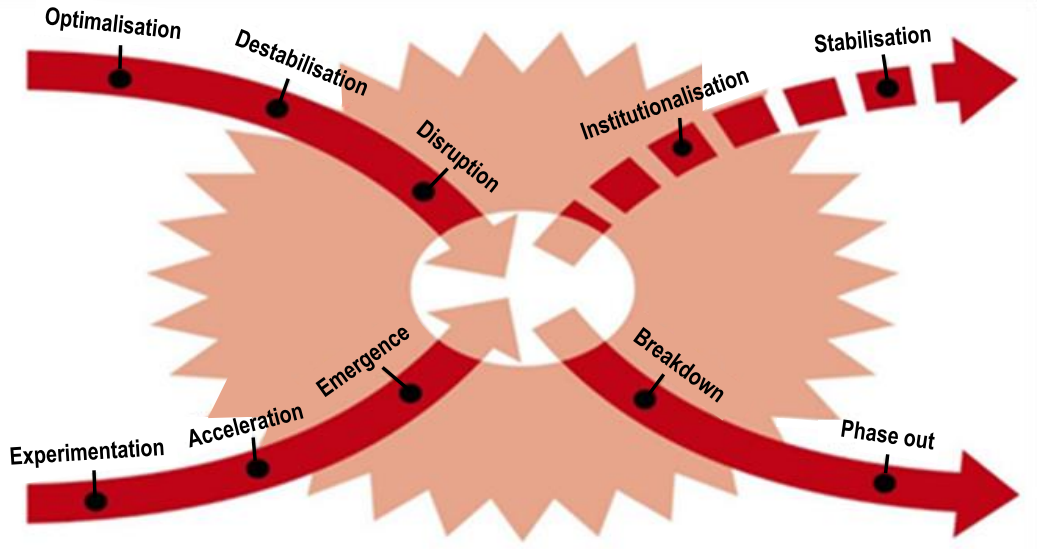
Sources: (European Commission, 2019[11]; European Commission, 2018[12]; Material Economics, 2018[13]; OECD, 2019[9]; OECD, 2018[10]).

Subnational transition management includes embracing new technologies, social practices and business models, and phasing-out of unsustainable structures

Managing sustainability transitions can expand participation and exchange among public and private stakeholders, triggering changes in markets, user practices, policies, technologies and cultural discourse (Loorbach, Frantzeskaki and Avelino, 2017[14]). Transition management is characterised by multiple and parallel changes in socio-ecological systems and by long-term processes over a 40-50 year period. Experiments are used to identify how successful a particular transition pathway could be (Bulkeley and Castán Broto, 2013[15]). Knowledge exchange and learning can take place at the national, regional, and local level. Stakeholders are invited to develop shared visions and goals, which are then tested for practicality with experimentation, learning and reflexivity.

Environmental and energy transitions are iterative processes of build-up and breakdown over a period of decades. In a transition model (Figure 1.3), change agents – for example pioneering regions and cities – start to experiment with ideas, technologies and practices towards a climate-neutral and circular economy. Over time, pressure to transform current socio-ecological systems (e.g. the current food system) builds up. Such pressure destabilises the current production and consumption system and creates space for alternatives to emerge, e.g. more sustainable food production systems. Change agents operate in parallel to so-called incumbents – actors (e.g. enterprises) that profit from the current, potentially unsustainable model. Incumbents can (and often do) prevent the successful emergence of new business models and institutional structures, such as renewable sources of electricity, cleaner fuels for mobility or more sustainable agricultural practices. During the process, elements of the old structure(s) that do not transform are broken down and phased out. The actual transition is chaotic and disruptive, and eventually leads to changed socio-economic systems, such as a sustainable food system or a sustainable energy system.

Figure 1.3. The x-curve of transition dynamics



Source: Schoenmaker, D. and W. Schramade, (2019[16]), "Financing environmental and energy transitions for regions and cities: Creating local solutions for global challenges". Background paper for an OECD/EC Workshop on 18 October 2019 within the workshop series "Managing environmental and energy transitions for regions and cities, OECD, Paris. Based on Loorbach (2010).

Transitions start with new technologies, social practices and business models. The bottom left and top right arrows in Figure 1.3 show the different stages of the transition process: Experimentation, Acceleration, Emergence, Institutionalisation; and Stabilisation. The early stages are the hardest and most unexpected. This is where government help and vision are needed (Mazzucato, 2018[17]). Government support can include financial assistance (e.g. grants or co-funding), or non-financial support, for example using convening power to bring together different stakeholders and interest groups.

Transitions also imply phasing out existing technologies, practices or business models that cannot adapt (the bottom right arrow in Figure 1.3). System transitions necessarily disrupt and challenge established investments, jobs, behaviours, knowledge and values in the destabilisation and disruption stages. All levels of government often want to help businesses that are in trouble and/or protect the jobs involved. However, it might be better to focus on helping workers transition (retraining and finding new employment) and supporting economic diversification.

History shows that transitions create conflict and generate resistance. Existing beliefs, behavioural patterns, institutions, investments and qualifications, as well as the allocation of resources, income and wealth are called into question. When new actors appear, power and distribution conflicts arise between the new and traditional, but also between different approaches to how a sustainable transition system should actually look like. Society, politicians and administrations often view the necessity, direction and speed of the transformation differently (Chapman, 2019[18]). Regional, urban, and rural policy makers and decision takers can facilitate the exchange among actors and approaches, and can communicate place-based visions for a climate-neutral and circular economy.

Towards a place-based approach to environmental and energy transitions

The ability to adapt to current environmental and resource vulnerabilities requires building on the specific resources, assets, and capacities of individual regions and cities. For instance, it is important to recognise that renewable energy systems emerge differently in cities, regions or countries, e.g. in terms of pace or scope, as well as in type of policies or technologies that are preferred or implemented. Food or

transport systems are also largely place-based and embedded in geographical areas due in part to ecological conditions. This place-based characteristic determines, to a large extent, the production system used, the commodities that can be produced, the habitats for biodiversity, and the specific transition challenges that can be expected. The COVID-19 pandemic also reveals that regional and local impacts of this current and future shocks to society are highly heterogeneous, with a strong territorial dimension and significant implications for crisis management and policy responses (Box 1.3).

Box 1.3. The COVID-19 pandemic reveals the importance of place-based responses to current and future shocks

The COVID-19 pandemic has lessons that can help regions and cities manage the environmental and energy transition. Both the COVID-19 pandemic as well as growing environmental pressures pose systemic risks to the foundations of human well-being. Human health risks are key. These risks also vary across regions and cities and require a place-based response. The participation of local and regional decision makers and multi-level governance has proven essential.

- The COVID-19 pandemic shows the importance of anticipation, preparedness and early action. They are also key to prevent and limit the well-being risks from climate change and to drive down emissions while extending economic prosperity.
- The COVID-19 pandemic shows that inclusiveness is key to resilience. Access of all households to adequate housing, social safety nets, including health services, water and sanitation, energy supply, income, communication and education improve the resilience of societies. This will also be key in the environmental and energy transition. The costs will also need to be shared fairly across households and firms.
- The COVID-19-related lockdowns have had temporary benefits for the environment, including on CO2 emissions, but at the expense of a major decline in economic activity. This illustrates how closely intertwined fossil fuels remain with economic activity. So far greenhouse gas emissions and other environmental impacts have risen with economic activity on a global scale. This link must be broken.
- It is key to identify factors that create resistance to early action. The COVID-19 pandemic illustrates the governance needs to integrate scientific advice, all levels of government, parliaments, and the public. Vested economic interests around fossil fuels have been a major source of resistance against climate policy. Clear, democratic, participative governance structures help to identify risks and actions to mitigate them.

Source: OECD, (2020[19]), "The territorial impact of COVID-19: Managing the crisis across levels of government", *OECD Policy Responses to Coronavirus (COVID-19)*, Updated 16 June 2020, http://www.oecd.org/coronavirus/policy-responses/the-territorial-impact-of-covid-19-managing-the-crisis-across-levels-of-government-d3e314e1/.

A place-based focus allows people to address the sustainability challenges and to be part of the transition in the making. Place is also relevant as the site of social interaction. It is where people can discuss the qualities of their local ecosystem, what they value, or how to build a place-based narrative for the future. This can lower resistance to change because it allows trusted relationships to develop among key stakeholders, which in turn provide a basis for more meaningful processes of knowledge transfer (Grenni, Horlings and Soini, 2020[20]).

This report contributes to a place-based approach to sustainability transitions by highlighting the role of regions and cities in transition management. This includes the specific actions that need to be undertaken by regional and city authorities, including needed investment. The report also discusses the

challenges that cities and regions might face (e.g. distributional impacts) and how these can be minimised and mitigated; as well as how to increase the synergies between climate and wider sustainability goals. Finally, it also reflects on whether transitions can 'travel' between places and across different scales, i.e. whether there is a flow of innovation, knowledge, technologies and so on beyond the places where they were initially conceived.

The report is structured as follows:

Chapter 2 discusses how regions and cities can manage **transition pathways towards climate-neutrality** and outlines several important climate governance considerations.

Chapter 3 focuses on the role of regions and cities in **managing the transition to a circular economy**. The chapter sheds lights on strategic approaches and tools that local and regional policy makers can use to support the circular economy in important circular sectors such as waste, construction and demolition and food.

Chapter 4 highlights the **role of cities** in managing environmental and energy transitions. City governments can enable transformations with urban planning, housing and transport policies as well as circular economy initiatives.

Chapter 5 explores how to manage environmental and energy transitions in **rural areas**. Successful transition in rural areas requires overcoming specific challenges related to rural risk management, governance, and achieving a just transition.

Chapter 6 features how cities and regions can **scale-up and finance** transition projects. It proposes a set of policy levers to meet investment needs and encourage private investment.

Recommendations for urban, regional, and rural decision makers

A series of high-level expert workshops jointly organised by the OECD and the European Commission in 2019 led to a set of recommendations for managing environmental and energy transitions for regions and cities. These recommendations are intended to support urban, regional, and rural decision makers in promoting, facilitating and enabling environmental and energy transitions (See box on Recommendations for urban, regional, and rural decision makers). They are suggested throughout this report to foster transitions in important local transition domains, including energy, mobility, and food.

Recommendations for managing environmental and energy transitions for regions and cities

Support the development of societal strategies and objectives for environmental and energy transitions

- Develop long-term visions and objectives for achieving a climate-neutral and circular economy.
- Define and implement near-term priority actions and measurable targets needed to reach long-term goals.
- Monitor and evaluate short-term action and its contribution to long-term goals on a regular basis and take more ambitious action, where necessary.

Systematically analyse transformation domains and identify pathways

- Collect information on transition domains, including synergies and potential trade-offs (e.g. can conflicts arise between renewable energy development and energy security?).

- Which policies promote/hinder the desired transformation? Is there path dependency or a danger of lock-in? What are future scenarios (to be determined e.g. by using transformation scenarios and back-casting)? Which pathways towards the long-term objectives should guide future policies?

Identify, evaluate, and address local societal needs

- Analyse current local change processes (e.g. digitalisation, urbanisation, lifestyle changes) and how they can be integrated to accelerate environmental and energy transitions.
- Identify how local well-being will be enhanced by moving to a climate-neutral and circular economy (e.g. lower air pollution, lower traffic congestion, less noise pollution) and integrate the benefits in policy design.

Phase out non-sustainable structures and practices

- Phase out technologies and business models that are inconsistent with reaching environmental sustainability objectives, such as by phasing out new coal power plants or fossil fuel vehicles. Identify and deploy sustainable infrastructure to avoid stranded assets.
- Address systematically unsustainable consumption patterns across transition domains.
- Build a just transition process by incorporating active dialogue with those most affected by change, supporting the adjustment of firms and workers and providing compensating measures to vulnerable citizens.

Ensure effective multi-level governance

- Reinforce multi-level governance systems to accelerate transitions, including by identifying policy inconsistencies, scaling-up and deploying local innovations, engaging citizens in local and regional decision making and integrating scientific advisory bodies.
- Seek out agents outside of environmental policy (e.g. educational actors, market intermediaries, health insurance companies, charities).
- Provide technical assistance to public authorities, non-governmental actors and other stakeholders to facilitate the transition, in particular in less developed regions.

Promote social and institutional innovation and experiments

- Identify upcoming, environmentally friendly, social technologies, business models and practices and analyse how they can be mainstreamed.
- Conduct regulatory experiments with a limited space and time (e.g. regulatory innovation zones, testbeds).

Scale-up and deploy finance for environmental and energy transitions

- Build subnational capacity to finance environmental projects, particularly in smaller administrations.
- Integrate environmental well-being gains in cost-benefit analysis, standardise project documentation and strengthen peer to-peer learning.
- Create clear signals for investors, such as minimum performance standards for energy efficiency in buildings or purchase subsidies for electricity storage, integrate the disclosure of climate-related risks in regional development policies.

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2 Managing the transition to a climate-neutral economy in regions and cities

Regions and cities play an important role in achieving climate-neutrality by the middle of the 21st century. This chapter discusses how regions and cities can manage transition pathways towards climate-neutrality. It also outlines several important climate governance considerations, notably long-term and strategic planning, and designing and implementing coherent policies across sectors and among levels of government.

In Brief

Regions and cities drive climate-neutrality, but need to step up work and investment

- **There is an urgency to act now**. Achieving the objective of the Paris Agreement to keep a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels requires net-zero GHG emissions by 2050. However, global greenhouse gas emissions show no signs of peaking. Although the COVID-19 crisis has led to a temporary drop in emissions, global GHG emissions have overall increased 1.5 fold since the 1990s. Global warming is likely to reach 1.5°C already between 2030 and 2052 if it continues to increase at the current rate.
- **While urban, regional and rural policy makers have been taking action towards reaching a climate-neutral economy, the pace and scale of work and investment are not sufficient**. Investments in assets, such as fossil fuels, which will become unproductive in the course of the transition, need to stop, and ambition towards climate-neutrality needs to rise sharply. Regions and cities provide critical emission reduction opportunities, as they often have jurisdiction over crucial sectors for climate action, including buildings and parts of transportation, and other local infrastructure. Regions and cities can also take action more rapidly than national-level government. Being centres of innovation, and testbeds for transition experiments and pilots, regions and cities are also pioneering some innovative policy approaches.
- **The impact of climate change manifests locally, and thus is place-specific**. There will be variations between and within countries, and different cities, regions and rural areas will feel the impact differently. Climate risk creates spatial inequality, as it may simultaneously benefit some regions while hurting others. The poorest communities and populations within cities, regions, and rural areas typically are the most vulnerable. Climate change is therefore likely to exacerbate social tensions. A just transition is thus key to counterbalance disproportionate impacts on the poor and the vulnerable.
- **Managing environmental and energy transition in regions and cities requires adjustments in wider energy, transport and food systems**. Policies often focus on single technological solutions, such as promoting renewable electricity or electric vehicles, potentially neglecting necessary complementary innovations and other changes such as relevant infrastructure development or coupling energy end-use to renewables. Transition policy should focus on whole systems rather than on single innovations and tackle production and consumption patterns. At the same time, it needs to recognise that the transition path differs for cities and rural and remote regions.
- **Regions and cities need to step up their capacity for transformative climate governance**. In light of the persistent failure to reduce emissions decisively, cities, regions, and rural areas need to build long-term resilience against climate change and other associated social, environmental and economic concerns. Different capacities are required to successfully address environmental and energy transition. These include long-term and strategic planning, including phasing-out investment that is inconsistent with transition objectives, designing and implementing coherent policies in support of transition, capitalising on well-being gains from environmental and energy transition, and co-ordinating stakeholder engagement.

Introduction

Climate change happens now, affecting urban and rural regions. After more than 10 000 years of relative climate stability, the earth's temperature is rising due to human activity. Since the start of the Industrial Revolution in the 1880s, the global average surface temperature has increased by around one degree Celsius (°C), driven mainly by higher atmospheric concentrations of greenhouse gas emissions from human activities (IPCC, 2018[1]). This temperature rise already brings with it many risks for urban and rural areas. For example, changes in rainfall reduce agricultural yields in many rural regions. Urban heat islands occurring on roofs and pavements can be up to 50°C hotter than the air temperature surrounding it. (Ürge-Vorsatz, Boza-Kiss and Chatterjee, 2019[2]). The disruption of the water cycle reduces the quality and quantity of the available water resources in all areas.

Regional, rural, and urban actors play a pivotal role in reaching climate-neutrality by 2050. In the Paris Agreement, parties agreed to the long-term goal of limiting climate change to well below 2°C and making efforts towards 1.5°C. In parallel, the 2030 Agenda on Sustainable Development (the Sustainable Development Goals, SDG) includes a dedicated goal on climate that seeks to "*take urgent action to combat climate change and its impacts*" (SDG 13). The European Green Deal, adopted by the European Commission in December 2019, aims to make the European Union climate-neutral by 2050. Several countries, including France and Spain, have already passed legislation to bring all greenhouse gas emissions to net-zero by 2050. Given the magnitude of the transformations required, the climate transition will entail profound transformations, which in their breadth are unrivalled in recent economic history over a relatively short period of time. It will unevenly affect citizens, regions and sectors. The transition to a climate-neutral economy needs to reflect the diversity of conditions and starting points between and within countries. It should also deliver broader well-being and sustainable development goals. While decarbonisation will come at a cost, it is likely to be small (around 1% to 1.5% to GDP, see also Chapter 6). The cost is possibly even negative in fossil-fuel importing regions once the key well-being benefits beyond climate, including from economic and health benefits from reduced air pollution, better thermal insulation, lower traffic congestion, and others are taken into account (UK Committee on Climate Change, 2019[3]). Regions and cities are well placed to develop effective solutions together with the private sector and citizens. Since many of the well-being benefits associated with climate accrue locally, a well-being perspective can also help foster local action. Still, support from and co-ordination with the national level is needed to manage this transition in a targeted and tailored manner.

This chapter discusses transition pathways and governance mechanisms available to regions and cities as they move towards climate-neutrality. The chapter starts with illustrating the climate urgency: actions and investment have to scale-up over the next decade. It then looks at how regions and cities can manage the transition in three critical transformation domains: energy, mobility, and food. Finally, the chapter discusses climate governance issues. The chapter builds on the OECD-EC seminar series on "Managing Environmental and Energy Transition for Regions and Cities" and in particular on the seminar entitled "Managing the Transition to a Climate-Neutral Economy". The main theoretical frameworks and regional case studies were identified in or inspired by the following publications:

- Chapter 1 of this publication, "Managing Environmental and Energy Transitions: A Place-Based Approach".
- Chapman (2019), "Managing the Transition to a Climate-Neutral Economy in Cities and Regions", Background paper for an OECD/EC Workshop on 17 May 2019 within the workshop series "Managing Environmental and Energy Transitions for Regions and Cities", OECD Paris.
- Ürge-Vorsatz (2019), "What Policies can Prepare Cities and Regions for the Transition to a Climate-Neutral Economy?" Background paper for an OECD/EC Workshop on 17 May 2019 within the workshop series "Managing Environmental and Energy Transitions for Regions and Cities", OECD Paris.

The transition to a climate-neutral economy: The urgency to act now

Global warming is likely to reach 1.5°C already between 2030 and 2052 if it continues to increase at the current rate. The IPCC has shown that a further increase in the global average surface temperature poses considerable physical and socio-economic risks to living conditions on earth. Already a 1.5°C rise provides a substantial threat to natural ecosystems and human well-being. Coral reefs in warm regions and the northern ecosystem already show significant damage. They could disappear completely with an increase of 1.5°C. Such an increase will also almost completely melt the Greenland ice sheet. The release of methane, which is bound in permafrost, would possibly further accelerate climate change (IPCC, 2018[1]). Given these climate impacts, it is imperative to limit the rise in global average surface temperature. Limiting global warming to 1.5°C is still feasible but requires rapid action (UNEP, 2019[4]) (IPCC, 2018[1]).

Not acting now means higher costs and systematic risks later. The longer emissions increase or plateau, the steeper reductions in the future must be because greenhouse gas emissions accumulate in the atmosphere. Delaying action means that the destruction of ecosystems, biodiversity loss, a collapse in global food production and falling labour productivity due to high temperatures are becoming increasingly acute. Delay leads to the "lock-in" of emissions-intensive infrastructure and related spending, which becomes obsolete when action is taken to cut emissions. Furthermore, rather than changing economic structures gradually, by delaying action eventually a sudden adjustment that could cause economic and social disruption will be required. “Lock-in” of emissions can also be the result of wrong choices in the near future, even if they have short term-gains (e.g. investments in natural gas to replace coal). Overcoming the challenges of “non-action” and “climate-inconsistent choices” requires overcoming institutional barriers (e.g. misaligned incentives and capacity gaps) as well as political economy factors (e.g. employment in the fossil fuel industry, short time horizons, incumbent market interests) (OECD/The World Bank/UN Environment, 2018[5]).

Climate change has direct consequences for human well-being. For example, extreme high air temperatures contribute directly to deaths from cardiovascular and respiratory disease, particularly among elderly people. Rising sea levels and increasingly extreme weather events will destroy homes, medical facilities and other essential services. More than half of the world's population lives within 60 km of the sea (WHO, 2018[6]). Climate change is, therefore, also one of the most significant challenges of health policy in the 21st century (OECD, 2019[7]). To help understand the magnitude of the climate challenge, Box 2.1 summarises the already present and growing risks from climate change.

Box 2.1. Six aspects of climate change risk stand out for regions and cities

The physical and human risk from a changing climate is already present and growing. Physical climate risks are:

- **Place-based**: The impact of climate change manifests locally, and thus is place-specific. There will be variations between and within countries, and different cities, regions and rural areas will feel the impact differently.
- **Increasing:** More disruptive climate change is likely to be locked in with global greenhouse gas emissions projected to increase if no ambitious climate action is taken. Such an increase would lead to melting glaciers and permafrost and drive sea-level rise. It would also worsen the intensity and frequency of extreme weather events, making it more difficult for people and ecosystems to adapt.
- **Systemic:** While the direct impact of climate change is place-based, it can have knock-on effects across regions and sectors through interconnected socio-economic and financial

systems. For example, trade and migration patterns can indirectly affect less exposed areas to climate change.

- **Non-linear**: Global warming accelerated over most of the twentieth century. Natural systems have "tipping points" beyond which damaging change such as species loss, groundwater depletion and land degradation become irreversible. Non-linear climate change underlines the urgency to act now to avoid reaching these tipping points.
- **Unequal**: Climate risk creates spatial inequality, as it may simultaneously benefit some regions while hurting others. The poorest communities and populations within cities, regions, and rural areas typically are the most vulnerable. Climate change is therefore likely to exacerbate social tensions. Heat waves that have office workers reaching for the air conditioning will have farmworkers facing heat strokes. Rising food prices will hit the poor more than the rich. A just transition is thus key to counterbalance disproportionate impacts on the poor and the vulnerable.
- **Underprepared**: While urban, regional and rural policy makers have been taking action towards reaching a climate-neutral economy, the pace and scale of work and investment are not sufficient. Investments in assets, such as fossil fuels, which will become unproductive in the course of the transition, need to stop, and ambition towards climate-neutrality needs to rise sharply.

Sources: IPCC (2018[1]), *Global Warming of 1.5 ºC*, The Intergovernmental Panel on Climate Change, www.ipcc.ch/sr15/ (accessed on 13 May 2020); European Commission (2018[8]), "A Clean Planet for all: A European strategic long term vision for a prosperous, modern, competitive and climate neutral economy", European Commission, Communication from the Commission COM(2018) 773 final, https://ec.europa.eu/knowledge4policy/publication/depth-analysis-support-com2018-773-clean-planet-all-european-strategic-long-term-vision_en; ILO (2019[9]), *Working on a Warmer Planet: The Impact of Heat Stress on Labour Productivity and Decent Work*, International Labour Organization, Geneva, www.ilo.org/global/publications/books/WCMS_711919/lang--en/index.htm (accessed on 17 July 2020).

Climate change poses unique challenges to both urban and rural areas

Urban areas are greatly affected by the impact of climate change while being significant contributors to greenhouse gas emissions. More than half of the world's population lives in urban areas. By 2050, around 55% of the world population is expected to live in cities (OECD/European Commission, 2020[10]). Many climate risks, such as sea-level rise, storm surges, and heatwaves, are challenging cities and threatening urban livelihoods. They risk affecting essential infrastructure systems such as water, energy supply, and transportation, particularly in places where infrastructure is ageing and in need of repair or replacement. If several of these systems are hit simultaneously, the risk of systemic collapse increases. There is a need for city-level climate action planning to address the threats and opportunities presented by climate change. Chapter 4 of this report presents several tools and instruments to support cities in this process.

Rural areas are vulnerable to climate change because of their larger dependence on natural resources in economic activity. Global warming, extreme weather events, and environmental change are already affecting the economies and social structures of rural areas. Rural areas may face in the future increased food market volatility, shifts and losses in plant and animal species and, depending on the region, increased water scarcity, flooding and coastal erosion, or wildfires. Changes in the timing of seasons, temperatures, and precipitation will also shift the locations where rural economic activities (like agriculture, forestry, and recreation) can thrive. Because many rural communities are less diverse than urban areas in their economic activities, a decline in one traditional sector will affect the community as a whole. Remoteness, lower incomes, an ageing population and weaker health and emergency response systems also increase the vulnerability of rural communities to climate change. Responding to climate change impacts will require significant adaptation within rural transportation and infrastructure systems. Climate change impacts will not be uniform or consistent across rural areas. While some communities lose, others

may benefit from climate change by being able to adapt agricultural production. Governments in rural communities need to build institutional capacity to respond to, plan for, and anticipate climate change impacts. Chapter 5 of this report presents several tools and instruments to support rural areas in this process.

Why we cannot just rely on adaptation measures

Adaptation will have to complement mitigation, it is not a substitute. Adaptation strategies are particularly necessary in the short and medium-term. Irrigation systems, higher dikes, coastal protection and more resilient infrastructure, are some examples. The effectiveness of these measures is difficult to assess, as the future consequences of climate change could undo adaptation efforts in the longer-term. For example, cities can cope with a 20 or 30 cm rise in sea level by building dams and other forms of protection. However, if the sea level rises by several meters, a dam no longer helps. Entire cities may then need to be relocated, which might not exist as an option for many megacities that lie by the sea. Plants such as rice, corn, or wheat, which are crucial for the world food supply, are unlikely to deliver sufficient yields if the global average surface temperature rises by more than 4 degrees (Reckien et al., 2018[11]).

City and regional government agencies and organisations have developed adaptation plans and policies. Examples include disaster risk management, infrastructure systems, agricultural adaptation and public health. Investments in “no-regret and low-regret options”, which have no or low trade-offs with other policy objectives, should be favoured where possible and relevant. Examples of such options can be found in the build environment (the insulation of buildings to cope with heatwaves), in land use and planning (reducing the risk of flooding by avoiding building in high-risk areas) and water (improving water efficiency). Adaptation efforts require co-operative private sector and governmental activities, but institutions face many barriers to implementing co-ordinated efforts. The efficiency and effectiveness of adaptation planning can be increased by integrating it with the relevant policy processes and decision cycles, for instance, regarding land use planning and resource management. Organisations like ICLEI, C40 and World Mayor Council on Climate Change play essential roles in supporting subnational policy makers to exchange and learn from one another to make the most of the resources invested in adaptation (OECD, 2015[12]).

We are not on track to reach climate-neutrality and action needs to be urgently scaled-up

The message of urgency cannot be overstated. To reduce emissions as cost-effectively as possible, the maximum of emissions globally needs to be reached by 2020, followed by a rapid decrease. The later the peak of emissions is reached, the more drastic the emission reductions necessary. Postponing climate action leads to higher costs, requires faster expansion of new technologies, is subject to greater susceptibility to errors and might be even more challenging to enforce politically. Excessive time pressure, which leaves little space to win necessary public support, could significantly reduce the chances of success for ambitious climate policy (Chapman, 2019[13]).

However, global greenhouse gas emissions show no sign of peaking. Increasing energy efficiency and the increased use of renewable energies have so far not been sufficient to stop an increase in emissions, let alone initiate a turnaround towards falling emissions. Although the COVID-19 crisis has led to a temporary drop in emissions, global GHG emissions have overall increased 1.5 fold since 1990, driven mainly by economic growth and rising fossil energy use in developing countries (OECD, 2020[14]). The IEA’s Stated Policies Scenario sees energy-related CO2 emissions constantly growing from 33 gigatonnes (Gt) to 35 Gt in 2040 (Table 2.1). In the Sustainable Development Scenario, energy sector CO2 emissions peak immediately at around 33 Gt and then fall to less than 10 Gt by 2050.

Table 2.1. World energy-related CO2 emissions by fuel and scenario (Mt)

			Stated Policies		Sustainable Development		Change 2018 -40	
	2000	2018	2030	2040	2030	2040	STEPS	SDS
Coal	8 946	14 664	14 343	13 891	8 281	3 424	- 773	-11 240
Oil	9 640	11 446	12 031	12 001	9 436	6 433	555	-5 102
Natural gas	4 551	7 134	8 486	9 697	7 464	6 032	2 563	-1 102
Total CO2	**23 137**	**33 243**	**34 860**	**35 589**	**25 181**	**15 796**	**2 345**	**-17 448**

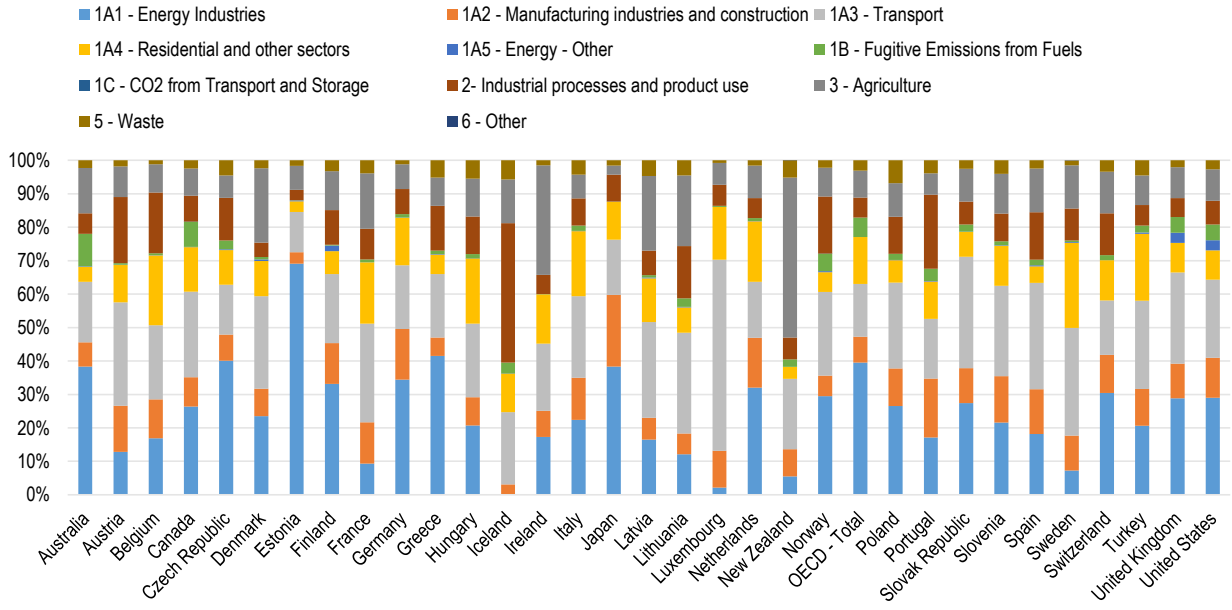
Notes: Mt = million tonnes; STEPS = Stated Policies Scenario; SDS = Sustainable Development Scenario. Total CO2 accounts for captured emissions from bioenergy with carbon capture, utilisation and storage (CCUS).
Source: IEA (2019[15]), *World Energy Outlook 2019*, IEA, Paris, https://www.iea.org/reports/world-energy-outlook-2019 (accessed on 3 April 2020).

For a long time, OECD countries were the largest emitters but have been overtaken by the BRIICS [Brazil, Russia, India, Indonesia, China (People's Republic of), South Africa] countries. For example, emissions in OECD countries remained practically unchanged from 1990-2014, while they more than doubled in Asia in the same period (OECD, 2020[14]). Nevertheless, the industrialised countries still have far higher per capita emissions than developing countries. Since the invention of the steam engine, they have also sent more CO2 emissions into the atmosphere than developing and emerging countries.

On average, energy industries are responsible for 29% of greenhouse gas emissions in OECD countries, followed by transport (24%), manufacturing industries (13%), agriculture, (9%), industrial processes (7%) and waste (3%). The share of emissions from energy industries has decreased since 2005. However, emissions from transport and agriculture increased, accounting for more than 30% in some countries in 2017, including Luxembourg, Slovenia, Sweden and Switzerland. Agriculture emits most emissions in Ireland and New Zealand (Figure 2.1). Progress in reducing greenhouse gas emissions has been uneven across countries, reflecting differences in levels of economic development, energy supply and demand, and energy prices (OECD, 2020[14]).

Figure 2.1. Greenhouse gas emissions by sector

Percentage, 2018



Source: OECD (2020[16]), *OECD Environment at a Glance Indicators*, OECD Publishing, Paris, https://doi.org/10.1787/ac4b8b89-en.

Managing the transition to climate-neutrality and responding to risks: Pathways and roles for regional and urban actors

Achieving net-zero greenhouse gas emissions by 2050 requires a deep transformation of societal systems of unprecedented breadth over the next decade. Pursuing such transformations will require deliberate long-term structural changes in resource use, infrastructure, institutions, technologies, and social relations, which have to happen in a relatively short time period (see Chapter 1 and Box 2.2). The transition puts energy centre stage, as energy is responsible for a large share of emissions. Better urban planning and strategic infrastructure investment, as well as a shift to more sustainable land use, are two other important pillars of the zero-net transition (New Climate Economy, 2019[17]). The transition also requires scaling-up of technological innovation in energy, construction, transport, industry and agriculture. Breakthroughs in digitalisation, information and communications, artificial intelligence and biotechnology can accelerate the transition further, but also pose risks, for example by increasing energy demand. The expansion of new systems and processes, with co-operation across sectors, is also required. A good example of a system-oriented approach is the circular economy, which aims to generate a sustainable economic system by fundamentally reducing resource consumption and waste. The transition will also require co-operation at different levels of government to maximise synergies and pool resources and knowledge.

Box 2.2. What is carbon-neutrality, and how can it be achieved by 2050?

To limit global warming to 1.5 degrees Celsius – a threshold the Intergovernmental Panel for Climate Change (IPCC) suggests is safe – carbon neutrality by the mid-21st century is essential.

Carbon neutrality is achieved when there is a balance between emitting carbon and absorbing carbon from the atmosphere in carbon sinks. Removing carbon dioxide from the atmosphere and then storing it is known as carbon sequestration. To achieve net-zero emissions, all worldwide greenhouse gas emissions will have to be counterbalanced by carbon sequestration.

A carbon sink is any system that absorbs more carbon than it emits. The main natural carbon sinks are oceans, soil, and forests. The carbon stored in natural sinks is released into the atmosphere through forest fires or changes in land use. To date, no artificial carbon sinks can remove carbon from the atmosphere on the necessary scale to fight global warming. This is why it is essential to systemically reduce carbon emissions to reach climate neutrality.

Source: OECD (2020[14]), *Environment at a Glance 2020*, OECD Publishing, Paris, https://dx.doi.org/10.1787/4ea7d35f-en.

Urban, regional, and rural actors drive the climate-neutral transition. Achieving climate-neutrality by the middle of the century requires systematic changes at the regional and local level. Many OECD member countries have expressed ambitious, long-term goals for sustainable growth, in particular concerning the climate-neutral economy and the circular economy. Cities and regions are well-positioned to contribute to these targets for several reasons:

- Cities and regions provide critical emission reduction opportunities, as they often have jurisdiction over crucial sectors for climate action, including buildings and parts of transportation, and other local infrastructure. Almost all decisions taken by local authorities affect GHG emissions directly or indirectly, such as local regulation on transport, building construction mandates, spatial planning, and economic policies.
- Cities and regions can take action towards a climate-neutral and circular economy more rapidly than national governments. Many cities and regions are also motivated to take action as many of the co-benefits of environment and energy transition, such as improved health outcomes, accrue locally.

- Since local governments are in close contact with citizens and local businesses, local governments can be in a better position to influence consumer and producer behaviour by implementing emission-reduction policies based on their knowledge of local conditions and capabilities.
- Cities and regions can set examples of progressive emission reduction and circularity targets. In a world in which the exact shape of climate change dynamism and disruption are not predictable and foreseeable, the capacity of cities and regions to generate, develop and implement technological and social innovations, from e-scooters to local housing strategies, support sustainability transitions (Chapman, 2019[13]).

Moving to a climate-neutral and circular economy comes with substantial non-climate benefits, which improve individual well-being in cities and regions. These benefits range from health and productivity benefits to reducing energy poverty. Urban and regional policy makers have an interest in supporting such well-being benefits because they often materialise locally. Some costs and well-being benefits can be quantified. Some are non-quantifiable well-being benefits. Overall, the state of understanding of co-benefits is inadequate and the IPCC has pointed out that societal well-being gains of climate-neutrality and a circular economy remain mostly unaccounted for (IPCC, 2018[1]).

Taking disruptive action and reconfiguring economic systems in regions and cities

Managing environmental and energy transition in regions and cities requires adjustments in wider electricity, transport and food systems (see Chapter 1 on sustainability transitions). Policies often focus on single technological solutions, such as promoting renewable electricity or electric vehicles, potentially neglecting necessary complementary innovations and other changes such as relevant infrastructure development or coupling energy end-use to renewables. Transition policy should focus on whole systems rather than on single innovations and tackle production and consumption patterns. At the same time, the transition path differs for cities and rural and remote regions. Chapter 4 on cities and Chapter 5 on rural areas provide more information on the city- and rural specific transition opportunities and challenges.

Connections between systems should also receive more attention, as deep changes in one system may require changes in other systems. For example, transitions in mobility patterns may require changes in land use and spatial planning. District heating systems can be coupled with renewables, leading to integrated systems in which thermal energy fulfils storage and back-up functions for intermittent electricity (Lund et al., 2014[18]). These interdependencies reinforce the point that policies should address entire transition systems and avoid displacing wider sustainability issues. The following section will provide an overview of how climate-neutrality can be achieved in three crucial local economic systems, energy, mobility, and food, and what urban, regional, and rural policy makers can do to support the transition.

The energy transition

The sustainable energy transition is a fundamental building block of climate-neutrality. A sustainable energy system aligns fully with the objectives of the Paris Agreement while also meeting targets related to universal energy access and cleaner air. It requires rapid and widespread change across all parts of the energy system (IEA, 2019[19]). The total share of renewable energy needs to rise from around 15% of the total primary energy supply in 2015 to roughly two-thirds by 2050 to meet climate targets, while the energy intensity of the global economy will need to fall by about two-thirds by 2050 (IRENA, 2020[20]). In light of the urgency and necessity for action, mobilising subnational authorities and exploring multi-level governance of energy systems is key to scale-up local climate and energy action. However, in practice, energy remains mostly a national responsibility. Also, policy efforts often tend to focus on single and often technological solutions, such as promoting renewable electricity or EVs, without taking into account the wider infrastructural and societal changes needed (Chapman, 2019[13]).

The energy transition provides important opportunities for cities and rural areas. Some renewable energy options like solar PV are relatively easy to integrate into an urban environment. Urban areas can even become energy-independent from larger networks through energy-saving urban planning and building refurbishment. Other options, like wind turbines and biomass plantations, are mostly realised with some distance from urban areas because they require geographical space. Particularly in rural areas, support from local communities, for example for large numbers of tall wind turbines does not come by itself. It has to be organised by creating awareness and developing a public interest. A wider public needs to be aware of the required transition and needs to be involved in future benefits (Chapman, 2019[13]). Although this is often a difficult process, this is also a chance for improving social coherence (see Chapter 4 on urban transitions and Chapter 5 on rural transitions).

The transformation of the energy system involves several transition areas, and cities and regions play essential roles in supporting them:

- **Changing energy behaviour** can lead to important savings in energy use. Behavioural issues matter in all aspects of the energy transition, from improving awareness of the benefits of energy efficiency and renewable energies, to making sure that technologies are easy to use, and that financial decisions can be taken in a well-informed manner. Behavioural change programmes can support households and industry in using less energy. They can include, for example, advertising campaigns, training plans for domestic appliances sales personnel, various forms of grants and subsidies or infrastructural provisions (e.g. thermostats and timer switches) (Hunkin and Krell, 2018[21]).
- **A sharp pick-up in efficiency improvements is the single most crucial element towards reaching climate-neutrality**. Improvements in the energy intensity of the global economy (the amount of energy used per unit of economic activity) are slowing. The increase in 2018 was 1.2%, which is about half the average rate seen since 2010. Following all economically viable opportunities for efficiency improvement can reduce global energy intensity by more than 3% each year (IEA, 2019[15]). This reflects a relative lack of new energy efficiency policies and efforts. Energy efficiency is particularly critical in the building sector, with a building renovation rate of just 1% per year of the existing building stock (see Chapter 4). In industry, embracing circular economy principles such as efficient design, use and recycling of materials such as steel, aluminium, cement and plastics would help reduce emission growth and provide rural and urban manufacturing with new business model opportunities (see Chapter 3).
- A pivotal piece of reaching climate-neutrality is **renewable electricity generation**. Extending renewable energy supply would require boosting manufacturing capacity of wind turbines and solar panels. Emerging technologies such as hydrogen, carbon capture, utilisation and storage also play an important role to reach a 1.5-degree pathway. Especially rural areas hope to benefit from the expansion of renewable energy by linking its development to sustainable rural development. Recent analysis has however pointed out that while there can indeed be rural development potential in renewable energies; rural areas have until now largely fallen short in unlocking this potential. More unambiguous evidence is needed on how renewable energy projects contribute to rural development beyond the causal relationship of revenues (Clausen and Rudolph, 2020[22]).
- To achieve net-zero emissions, policy makers will need to focus not only on new infrastructure but also on **reducing the emissions that are "locked-in" to existing systems**. That means addressing emissions from existing power plants, factories, and other capital-intensive infrastructure already in use. Stopping investment into infrastructure that is inconsistent with the net-zero emission transition is key to avoiding unnecessary costs. The longevity of the existing stock of coal-fired power plants accounts for 30% of all energy-related emissions today (IEA, 2019[15]). While new power plants are still being constructed, many European coal-fired power plants are more than 40 years old and are reaching the end of their planned lifespan (Rentier, Lelieveldt and Kramer, 2019[23]). Replacing those provides a window of opportunity for substantial change.

- Urban, regional, and rural policy makers and regulators will have to **move fast to keep up with technological change and the rising need for flexible operation of power systems**. Transforming the entire energy system will require progress across a much more comprehensive range of energy technologies and uses including market design, efficiency, carbon capture, utilisation and storage, hydrogen, and others. It will also require educating consumers about transition risks and opportunities.

Subnational authorities play an important role in the large-scale deployment of niche innovations such as passive houses and building retrofits. While those have diffused in some countries (e.g. the Netherlands, Austria, and Finland), they have not yet gained much attraction in many others (Ürge-Vorsatz, Boza-Kiss and Chatterjee, 2019[2]). Energy co-operatives and municipal energy have also only developed well in some countries, but not in others, depending on public policies and cultural contexts (Herbes et al., 2017[24]). The climate and energy model regions in Austria are an example of how national-scale policies are combined with regional renewable electricity initiatives to achieve a climate-neutral transition in the electricity sector (Box 2.3).

Box 2.3. Climate and energy model regions, Austria

In Austria, national energy targets are implemented at the regional level through the *climate and energy model* (CEM) regions. They aim to scale up renewable energy deployment and to stimulate local socioeconomic development by attracting public and private finance into the deployment of renewable energy technologies. The idea behind the CEM regions is to support regions on their way to becoming independent of fossil fuels by 2050. The goal should be reached by expanding renewables, increasing energy efficiency, and supporting a climate-neutral transition in economic sectors that can be targeted at the regional level, such as agriculture, housing and mobility. This goal is realised with the help of a local implementation concept and the installation of a CEM manager, funded through the Austrian Climate and Energy Fund. As of 2019, 95 regions participated in the CEM program – covering more than 800 communities in Austria, most of them rural and structurally weak.

The CEM process reflects a mixed modus of governance. The Climate and Energy Fund together with several Austrian national ministries, administers the process at the national level. Regional development agencies and the provincial government are responsible for the implementation of the CEM process. At the local level, the CEM manager is responsible for the design and implementation of concrete energy transition measures. Representatives of different municipalities as well as, in some CEMs, energy groups help engaging citizens and interested stakeholders into local decision-making processes (Komendantova, 2018[25]).

An evaluation of the programme has shown that it led to an increase in networking and exchange around climate transition between local communities. The programme has also promoted (inter)municipal learning processes and has raised awareness of climate action among political decision makers. It has also led to increased diffusion of climate-efficient technologies (Schüle et al., n.d.[26]). (Schinko et al., 2020[27]) points out that large-scale renewable deployment is not only environmentally effective in terms of reducing GHG emissions from fossil fuel combustion, but can also become macro-economically efficient in the long-term if the focus of renewable strategies is on economically competitive technologies. In particular, their analysis illustrates that policy costs are much lower for solar photovoltaics, small-scale hydro and wind than they are for biomass and biogas, leading to net welfare gain on the national scale if these "new" renewables are used. The positive macroeconomic effects could potentially be even more significant if a level playing field with conventional fossil fuel-based technologies can be achieved, e.g. by internalising external costs with a CO2 tax.

The mobility transition

Moving towards climate-neutrality requires a paradigm shift in mobility. Historically, the policy direction in transport has been expressed in terms of supporting mobility for economic growth, sometimes with social progress (including health), but often with externalities such as climate change seen as a lower priority consideration. That order of priorities is not consistent with reaching a net-zero transition. The solution is to redesign mobility systems around accessibility to ensure that people can reach their jobs, opportunities, services, goods, and amenities. This means that priority is given to sustainable transport modes such as walking, cycling, public transport and other forms of shared mobility, particularly in cities (OECD, 2019[7]).

A sustainable mobility transition in regions, cities, and rural areas needs to advance electrification of vehicles while also making sure that the dominance of the automobile over railway, bus, e-rollers, cycling and walking is reduced. To decarbonise, this sector would need to shift rapidly to zero-carbon sources of energy. Cities and regions are supporting vehicle electrification through several policy levers, including by setting policy targets for market shares for EVs by a given date (i.e. 30% by 2030) and the installation of public charging stations or subsidies for EV purchasing (see Chapters 4 and 5). Although electrification is vital in achieving climate-neutrality, it needs to be complemented by additional measures, which also address other well-being challenges and urban quality-of-life issues, such as pollution, congestion, accidents, noise as well as active mobility and its health benefits. Important measures are:

- **Encouraging behavioural change:** Promoting mobility behaviour change for inspiring more walking, cycling, and public transport and minimising car use can be done through behavioural change campaigns in regions and cities. Typically this will involve either 'hard' measures within regional and urban transport (e.g. new footpaths or bike lanes, safer crossings, or investment in more comfortable public space) or 'soft' measures like information and communication campaigns, organising services and co-ordinating activities of different partners (Partnership for Urban Mobility, 2019[28]).
- **Discouraging private vehicle use**: Cities and regions can help to reduce the overall mileage driven by personal vehicles through policies that discourage individual vehicle use. This includes banning cars in city centres, taxing vehicles on a per-mile-travelled basis, and encouraging the use of public transport.
- **Making use of digital-based ride sharing**: Shared mobility, thus replacing individual car rides by rides in shared taxis or minibuses, can improve equality of access to jobs, health services, education and other opportunities. Extensions of the model from the core city to a broader metropolitan area have shown that shared services can also complement existing metro and commuter rail lines and help increase their ridership (ITF, 2018[29]).
- **Supporting a modal shift from cars to railways, bus and active mobility**: The integration of walking, cycling bus, e-rollers, subway and railway regimes into an intermodal transport system could also make such a modal shift more attractive, as happened in London, where car use declined by 25-35 % between 1995 and 2015 (Cass and Faulconbridge, 2016[30]).
- **Reducing trip lengths by changing spatial planning**: This includes, for example, compact cities or transit-oriented development, which aims to mix residential, business and leisure space within walking distance of public transport (OECD, 2012[31]).

The food transition

The current food system does not meet the food and nutrition security needs of a growing global population and creates high environmental and health costs. Modern agricultural methods have depleted carbon in the soil, and agriculture remains a net emitter of carbon dioxide despite some absorption through crops and plants (OECD, 2019[32]). A food system transformation requires several transitions, including sustainable supply chains, a healthier diet, and higher production efficiency. These transitions imply a fundamental change in the way food is produced, treated and consumed. Food system transformation targets agro-industrial operations as well as the practices of more than 500 million smallholder farmers around the world (OECD, 2019[7]). Delivering the emissions reduction needed to reach a 1.5-degree pathway sustainably requires several actions at the same time, to which urban, regional, and rural policy makers need to contribute:

- **Encouraging behavioural change**: Food systems and the way they are set up are a key driver of malnutrition in all its forms (undernutrition and overweight and obesity). At the same time, food systems are also responsible for one-third of global GHG emissions (OECD, 2019[7]). To provide better access to affordable and healthy diets, food systems need to be transformed, particularly to address the rising burden of overweight, obesity and diet-related diseases. Healthier diets would also reduce emission-insensitive meat and dairy production. Regions and cities can invest in consumer education and awareness, create clear dietary guidelines and leverage public channels to deliver healthier products (e.g. school canteens).
- **Repurposing public investment and policies**: By realigning incentives in the policy and regulatory environment and by using public-sector investments, local, regional, and national governments can change the behaviour that drives companies, investors, and farms. For example, fertiliser subsidies should be removed as they can lead to overuse, which causes water pollution from fertiliser run-offs and an increase in GHG emissions from chemicals. Governments could also set prices on natural resources to address negative externalities associated with food systems (e.g. a higher price on water) (OECD, 2019[32]). Local agency procurement can play an important role in what type of food is being purchased, provided and distributed. By mandating and encouraging specific requirements, these policies can help drive demand for and improve the availability of healthy and sustainable foods. Box 2.4 provides several examples of how cities and regions can support a food system transformation.
- **Fostering business-model innovation**: Companies can redesign business models towards greater climate compatibility. Many companies are recognising that their future competitiveness will depend on their commitment to helping solve society's problems. To mainstream and scale business model innovation, urban, regional, and rural policy makers can help local companies with technical assistance, funding and capacity building to address key barriers such as innovation risk, economic return and corporate culture challenges (OECD, 2019[33]).
- **Reducing waste**: About one-third of global food output is currently lost in production or wasted in consumption. Curbing waste would reduce both the emissions associated with growing, transporting, and refrigerating food that is ultimately wasted and the methane released as the organic material in wasted food decomposes.

Box 2.4. Engaging cities and regions in the transformation of food systems

Cities and regions are performing a central and growing role in achieving sustainable development. Promising examples exist of systematic approaches to food, nutrition and agriculture in urban and regional areas:

- **Integrated approaches to municipal food system governance**: The food strategy in **Vancouver**, Canada, covers food production, processing, distribution, access and waste. A systemic approach to urban food planning and regulations was adopted, resulting in social, economic, environmental and health outcomes and documented results. In Belgium, **Ghent** was one of the first European countries to have a food policy council in which the city gathered stakeholders to engage with civil society organisations and the private sector. Together with these stakeholders and in collaboration across city departments, the food council set multiple targets for food system interventions, including for climate change mitigation and adaptation, health, poverty, employment, health and food waste.
- **Urban-rural linkages for food systems: Ljubljana**, Slovenia has a "City Rural Development" plan to support more than 800 farms in the city boundaries. The program focuses on short supply chains, preservation of farmland, financial support for farmers, training of suppliers, retailers, chefs and food service professionals. The programme's targets are resilience to climate change, decrease of food waste, increase of jobs and promotion of sustainable diets. In France, the city of **Bordeaux** brought together 28 different governmental bodies to collaborate on comprehensive food system development in what is called a "territorial social food system". Planning, finance, land and markets are dimensions of this cross-jurisdictional collaboration and outputs are tracked for social and economic equity, improved health and more robust regional markets.
- **Partnerships and alliances among diverse stakeholders in food policy and practice**: In Denmark, **Copenhagen**'s Organic Conversion Project has succeeded in reaching a 90% organic food procurement target for all 900 municipal kitchens. The City Green Belt surrounding **Valencia**, Spain has received municipal support and significant civil society mobilisation to provide a constant source of food for the city. Participatory methods, a territorial approach and an interactive knowledge platform were the essential ingredients to a partnership between the city and civil society.

Source: FAO (2018[34]), *The role of Cities in the Transformation of Food Systems: Sharing Lessons from Milan Pact Cities*, Food and Agriculture Organization of the United Nations, Rome, http://www.milanurbanfoodpolicypact.org/wp-content/uploads/2018/10/CA0912EN.pdf.

Governing climate-neutral pathways for regions and cities

Regions and cities need to step up their capacity for transformative climate governance. In light of the persistent failure to reduce emissions decisively, cities, regions, and rural areas need to build long-term resilience against climate change and other associated social, environmental and economic concerns. Different capacities are required to successfully address environmental and energy transition. These include long-term and strategic planning, including phasing-out investment that is inconsistent with transition objectives, designing and implementing coherent policies in support of transition, capitalising on well-being gains from environmental and energy transition, and co-ordinating stakeholder engagement.

The role of multi-level governance in zero-emission transitions

Urban, regional and rural sustainability transitions take place in a context of multi-level governance. Policy makers at the international, national, and local level all define visions and targets for the transition, such as setting stringent building codes for retrofitting or supporting zero-emission vehicles. National governments and supranational institutions, such as the European Union, are responsible for investment and legislation. At the same time, much of the implementation, innovation and learning that advances the transition occurs at regional and local levels. This means that regional and local administrations must have the resources and ability to implement transition initiatives. They are also likely to have a much better understanding of local needs, skills, barriers, knowledge and capacities. Policy makers at different levels of government must be clear in their role and responsibilities with respect to sustainability transitions. Ensuring that the governance approaches and policy choices of these different actors are aligned and mutually supportive rather than at odds is at once the challenge and the requirement of an effective multi-level governance system (OECD, 2019[35]).

Effective multi-level governance is a pre-condition to achieving a climate-neutral and circular economy, but there are barriers. Ensuring that the objectives, priorities and targets for transition are aligned and coherent is fundamental but often challenged by co-ordination failures across sectors or among different levels of government. There are positive examples. For example, the European Union's Strategy for Low-Emission Mobility emphasises that regions and cities will be major actors in delivering low-emission mobility solutions (European Commission, 2016[36]). Other cases are less favourable. (Ohlhorst, 2015[37]) analyses the multi-level governance of Germany's energy transition policy, concluding that experimentation at the subnational level of the Länder advances the energy transition, but the German Laender risk increased inefficiencies and macroeconomic cost if they focus on an inwardly directed policy, arguing therefore for enhanced co-ordination efforts. Other multi-level governance challenges arise when national governments hinder the spread of local initiatives by withdrawing crucial national-level funding, as occurred in the United Kingdom when it significantly cut government subsidies for local and community energy installations (Armstrong, 2015[38]). However, such influences are dynamic, and positions can change over time.

There are a number of practical ways to overcome barriers associated with multi-level governance, among these are:

- **Identifying policy inconsistencies**: A mapping of actors and potential policy inconsistencies can help identify misalignment among stakeholder priorities and needs with respect to sustainability issues. This includes identifying who can influence environmental and energy transition in different policy fields such as energy, mobility or agriculture and at different levels and fostering the integration of national and subnational policies and strategies (OECD, 2019[39]). Where implementation responsibilities may be too large for any one municipality or region to tackle on their own, co-operative agreements may be helpful (OECD, 2017[40]).
- **Scaling-up and deploying local innovations in governance**: The heterogeneity of local contexts can enable local administrations to experiment with options that may not be politically feasible at higher levels of government (see Chapter 4). Where such experiments are replicated or adapted at higher levels, they may help promote coherence and create space for greater ambition at the national level. For example, local-level actors are an active part of Denmark's renewable energy processes, and support a progressive agenda on climate and renewable energy expansion (Jänicke and Quitzow, 2017[41]).
- **Strengthening resource and knowledge flows and dialogue among levels of government**: Platforms for knowledge sharing among local and regional governments and levels of government provide an opportunity to empower local actors. Networks such as the Covenant of Mayors for Climate and Energy and the ICLEI GreenClimateCities Programme help identify and share best practices, standardising local climate and energy policy plans in line with national and EU/OECD policies.

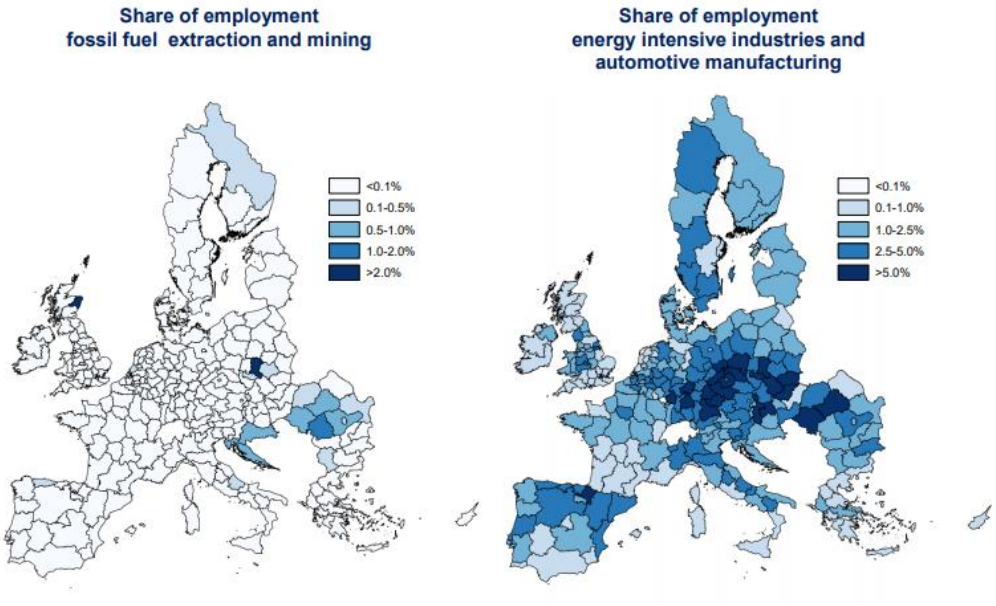
- **Integrating scientific advisory bodies**. National and regional scientific climate advisory bodies provide independent advice to the government on setting and meeting greenhouse gas emission targets. These bodies should be integrated into dialogue opportunities among levels of government as they promote an integrated policy approach to environmental and energy transitions.

How regional, rural and urban actors can promote a just transition

Most climate change mitigation policies have the potential to generate positive as well as negative well-being impacts. The extent and direction of these co-impacts depend on contextual factors, policy design and implementation, and action that is taken to mitigate the potentially harmful outcomes (Markkanen and Anger-Kraavi, 2019[42]). Positive outcomes for economic equality emerge when policies reduce expenditure (e.g. on fuels) or raise productivity (e.g. by reducing traffic congestion) or improve opportunities for economic participation among poorer households, regions or countries. Negative outcomes for economic inequality, on the other hand, are associated with policies that have regressive distributional impacts, increase the cost of basic consumer goods reduce or remove employment opportunities or limit people's access to natural resources (Ekins et al., 2019[43]) (Marcu and Vangenechten, 2018[44]) (ILO, 2015[45]).

The transition towards climate-neutrality will likely lead to changes within and between economic sectors, affecting different places in different ways. Whereas the number of jobs is projected to increase in some sectors, such as renewable energy, for other sectors the transition can be difficult. Particularly affected could be the regions whose economies depend on activities that either are expected to decline or will have to transform in the future (OECD, 2019[39]). Areas with high regional employment in coal mining, oil and gas exploration are likely to be affected (Figure 2.2). Regions, which depend economically on these sectors, will be challenged. Many of those are located in Central and Eastern Europe and lower-income European Union countries. Energy-intensive sectors such as steel, cement and chemicals as well as car manufacturers, will see a shift to new production processes with new skills required (European Commission, 2018[8]). Other existing jobs will have to be transformed and adapted to the new economy. Managing this change requires taking into account place-based challenges. Mainly rural areas will face difficulties to adapt as they are less economically diversified, have older populations and weaker skills to adapt.

Figure 2.2. Regional employment in fossil fuel extraction and energy-intensive industries (NUTS2 level)



Source: European Commission (2018[8]), "A Clean Planet for all: A European strategic long term vision for a prosperous, modern, competitive and climate neutral economy", European Commission, Communication from the Commission COM(2018) 773 final, https://ec.europa.eu/knowledge4policy/publication/depth-analysis-support-com2018-773-clean-planet-all-european-strategic-long-term-vision_en.

A just transition involves an explicit focus on using policies to benefit disadvantaged groups and on taking active measures to address economic inequalities and mitigate regressive outcomes. The pathway to positive equality outcomes involves carefully considering who might be impacted by a given policy and involving these groups or communities in the decision-making process and policy implementation through means such as community consultation (Chapman, 2019[13]). Policy measures with potentially negative impacts on household income or livelihoods must be accompanied by corresponding mitigating measures, such as exemptions, subsidies, compensation for losses and concrete support to help affected individuals and communities (see Box 2.5). This also supports transition acceptance. In policy and programme implementation, socioeconomic benefits can be achieved by utilising the local workforce where possible, while also seeking to ensure equitable distribution of benefits at the local level. This can happen for example through locating large-scale renewable energy projects in areas of high unemployment, by training local unemployed people to fill the new jobs, and by ensuring that new employment opportunities do not exacerbate existing inequalities (Ürge-Vorsatz, Boza-Kiss and Chatterjee, 2019[2]).

Box 2.5. The EU Just Transition Mechanism

The Just Transition Mechanism was announced by the European Commission in January 2020. It will provide targeted support to regions and sectors that are most vulnerable to the transition towards the green economy in terms of job or income risks and ensure a just and fair transition that leaves no one behind. It will mobilise at least EUR 150 billion over the period 2021-27 in the most affected regions, to alleviate the socio-economic impact of the transition.

The EU Just Transition Mechanism rests on three pillars: The Just Transition Fund is the first pillar and will provide EUR 40 billion to support economic diversification and reconversion. The dedicated InvestEU scheme is the second pillar, providing support in a wider range of projects, such as energy and transport infrastructure, including gas infrastructure and district heating, but also decarbonisation projects, economic diversification and social infrastructure. It is complemented by a new loan facility leveraged by the European Investment Bank, which is the third pillar of the Just Transition Mechanism.

Support will be available to all European Union member countries, focused on regions that are the most carbon-intensive or with the most people working in fossil fuel extraction. Member countries can get access by preparing territorial just transition plans that cover the period up to 2030, identifying the territories that should get the most support. The plans should set out ways to best address social, economic and environmental challenges.

Source: European Commission (2020[46]), "Just Transition funding sources", *The Just Transition Mechanism*, https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/just-transition-mechanism/just-transition-funding-sources_en (accessed on 13 September 2020).

The role of long-term and strategic planning in transition management

Cities and regions need strategic long-term planning in order to manage environmental and energy transitions and integrate it in current decision making. Strategic planning includes determining the cities or regions mission, vision and overarching strategy when it comes to the transition to a climate-neutral and circular economy. Long-term planning is about setting the process by which the strategic plan will be achieved and allocating resources accordingly. Decisions taken today, particularly for infrastructure assets with long lifecycles, can either contribute to or hinder efforts to achieve the transition (OECD/The World Bank/UN Environment, 2018[5]) (see also Chapter 6). Long-term planning needs to inform new courses of action in the present, as well as planning in the near- and medium-term. This requires aligning different time horizons and different levels of government. Several countries have started to develop governance platforms to co-ordinate transport and land-use development between national, regional and local co-operation. Examples are the Norwegian urban growth agreement and the Swedish Urban Environmental Agreements (Westskog et al., 2020[47]).

Long-term strategic planning can enhance the effectiveness of policies in different urban and regional contexts. For example, land-use zoning policies that encourage higher densities can reduce trip distances and frequency in the transport sector. Natural resource policies to increase vegetation and green space can reduce the impacts of heat extremes and flooding. Such local efforts can be complemented with tailored building standards and energy retrofit projects that take into account climate objectives (Ürge-Vorsatz, Boza-Kiss and Chatterjee, 2019[2]).

Vision-led scenario planning can help cities and regions in long-term strategic planning. Tools such as scenario planning can encourage urban, regional, and rural policy makers to envisage and design more sustainable futures (OECD/The World Bank/UN Environment, 2018[5]). The IPCC also supports the contribution of a vision-led path: '*Pathways that encompass joint, iterative planning and transformative visions, for instance… in urban contexts, show potential for liveable and sustainable futures*' (IPCC,

2018[1]). While vision-led scenario planning can be less feasible at higher levels (for political reasons, for example), it can work well at the local community and the city level. In addition to local government, businesses, households, NGOs, and unions can all play valuable roles, responding creatively to the vision and goals of sustainability transitions. The Helsinki-Uusimaa region in Finland managed to successfully create a shared vision and long-term planning towards achieving climate-neutrality by 2035 (see Box 2.6).

Box 2.6. Achieving climate-neutrality by 2035 in the Helsinki-Uusimaa Region

The development vision of the Helsinki-Uusimaa region for 2050 foresees climate-neutrality by 2035. Three strategic priorities are used to fulfil the vision. Choices are made, and actions are taken to create a climate-aware and diverse region offering competence and well-being for its inhabitants and to host successful and responsible businesses. The strategic priorities for 2018–2021 are:

- Human Well-being and Competence.
- Successful and Responsible Business.
- Climate-aware and Diverse Region.

Critical sectors targeted across municipalities are the energy sector, transport, and land use planning. Local energy companies are in a vital position to drive the transition, which rests on biofuels and emission reduction in district heating. With regard to transport, experimentation takes place with large scale (regional) transport projects such as electric or gas-powered buses or driver-free public transport. Preserving the remaining greenhouse gas sinks of forest areas and limiting the use of virgin lands/areas in construction supports the goal of sustainability in land use planning.

A Regional Implementation Programme provides a steering instrument for regional development and the allocation of local resources. The programme is the result of active co-operation between the Helsinki-Uusimaa Regional Council and the Centre for Economic Development, Transport and the Environment for Uusimaa (ELY), along with municipalities, businesses, universities, research institutes and organisations. Possible carbon-neutrality strategies vary considerably between municipalities because of their differences in size and nature.

The Implementation Plan is drawn up annually. The plan outlines the actors for individual projects and preliminary project budgets stated in the Regional Programme. The plan is continuously updated in a consultation process involving the key stakeholders in the region, and the partners responsible for each project.

Source: City of Helsinki (2019), "From theory to practice: What policies can prepare cities and regions for the transition to a climate-neutral economy?",. PowerPoint Presentation for the high-level expert workshop on managing environmental and energy transition, 17 May 2019, Paris, France (unpublished).

Making use of well-being gains maximises synergies and minimises trade-offs between policies

Successful transition management integrates well-being gains. Cities and regions need to recognise that increasingly one-dimensional outcome measures (such as economic growth) are replaced by a richer set of objectives, including addressing inequality and enhancing resilience and sustainability, as embodied in the UN's Sustainable Development Goals (SDGs). Systematically placing people's well-being at the centre of decision making is necessary to increase the political and social support for more ambitious mitigation action and to overcome the barriers to change. Adopting a well-being lens means ensuring that decisions aim to deliver simultaneously on multiple well-being objectives, including environmental and energy transitions (see Box 2.7).

Box 2.7. Climate mitigation through a well-being lens

Climate change mitigation has the potential to deliver wider well-being benefits. The potential trade-offs between climate policy and other goals such as affordability, competitiveness and employment constrain the ambition of climate action. Using a well-being lens helps make these synergies and trade-offs visible, allowing decision makers to increase a “two-way alignment” between climate change mitigation and broader well-being objectives.

The objective of applying a well-being lens to key sectors is to limit climate change for regions and cities while securing substantial well-being improvements. The OECD report on "Accelerating Climate Action" examines five economic sectors (electricity, heavy industry, residential, surface transport, and the food system), which together represent over 60% of global GHG emissions. It explains how reassessing policy priorities and adapting the set of indicators used to track progress and guide decisions in each sector can support governments in creating a “two-way alignment” between climate and a number of other well-being benefits, such as public health and safety, affordability, reliability, natural resource management, and new employment opportunities. It also discusses how climate policies in these sectors can be implemented, designed and evaluated while taking into account potential synergies and trade-offs.

Source: OECD (2019[7]), *Accelerating Climate Action: Refocusing Policies through a Well-being Lens*, OECD Publishing, Paris, https://dx.doi.org/10.1787/2f4c8c9a-en.

Regions and cities can and should take action to maximise locally arising well-being gains and to minimise trade-offs. Quantifying and mapping, to the extent possible, regional and metropolitan non-climate well-being gains from climate mitigation policies (e.g., how much air pollution would improve with ambitious climate policy) can help judge where well-being gains arise and where losses occur. Maximising well-being gains and minimising losses requires policy makers to look for multiple synergies between policies that eliminate greenhouse gas emissions, have local well-being gains and improve productivity and employment. Cities and regions are well-placed to seek such synergies. For example, where cities invest in energy-efficient buildings, they not only support greenhouse gas emission reduction, but they also provide several wider benefits to local citizens such as health benefits, productivity benefits, local employment generation. Green urban infrastructure does not only uptake carbon, but also it improves domestic thermal comfort by reducing surface and air temperature. By reducing car usage, air pollution can be mitigated to a significant level (Ürge-Vorsatz, Boza-Kiss and Chatterjee, 2019[2]). Understanding and profiling co-benefits and equity-enhancing dimensions of policies are necessary to support change makers' ability to receive political support for a coherent mitigation strategy. The Welsh Government introduced a low carbon prosperity strategy that seeks to combine climate-action with a more comprehensive well-being framework (see Box 2.8).

Box 2.8. Combining well-being with climate action: The low carbon prosperity strategy of Wales

Wales has strengthened its legislative framework to reduce greenhouse gas emissions through the Environment (Wales) Act 2016. The Act requires the Welsh Government to develop carbon budgets for Wales and sets a legal target for reducing emissions by a minimum of 80% by 2050. The Act requires a system of five-yearly carbon budgets and interim targets. These serve as stepping-stones and ensure that regular progress is made towards this long-term target. Interim emission targets are set for 2020, 2030 and 2040.

The first carbon budget is 2016-20 and subsequent budgets will run until 2050. Carbon budgets provide long-term economic predictability to encourage investment and act as a stimulus for green growth. All sectors across Wales contribute to reducing emissions and transitioning to a low carbon economy. This is a considerable challenge, since a small number of industrial sites (e.g. Tata steel, Port Talbot and Aberthaw power station) produce over 50% of emissions.

The Welsh Government is currently developing a matrix to use as part of their well-being appraisal process to ensure that their Low Carbon Delivery Plan is framed within the Well-being of Future Generations Act at the start of policy development. Financial budget cycles will be aligned with carbon budgets, which means that decisions about where the money is spent can have a greater focus on achieving carbon reduction targets. This alignment also reflects efforts of the government not only to consider cost-effective pathways for emission reduction but also the wider opportunities to improve well-being.

Source: Wales's commitment to tackling climate change, https://gov.wales/sites/default/files/publications/2019-05/our-commitment-to-tackling-climate-change-infographic.pdf.

A successful transition requires coherence across policy areas

Crosscutting policies such as innovation policy, tax policy, educational policy, and regional/industrial policy influence policies towards climate-neutrality. However, because sectoral policies are often prepared by different departments with different objectives and expertise, misalignments and contradictions between policies can occur (Ürge-Vorsatz, Boza-Kiss and Chatterjee, 2019[2]). In addition, inconsistent policy instruments can be counterproductive to reaching specific policy goals. For example, policy makers may promote renewables to replace fossil fuel generation to reduce emissions, while at the same time providing subsidies to the fossil fuel industry to protect employment in these sectors, which delays the climate-neutral transition (Janipour et al., 2020[48]). Similarly, subsidies for animal farming to support the economy in rural areas are likely to slow down the introduction of non-meat diets, even if the alternatives receive subsidies as well (see Chapter 5). While these challenges are not unique to environmental and energy transition, they are particularly important in a context, where cities and regions need to take large-scale and rapid action that requires persistent and long-term efforts.

Co-ordination and integration are needed to promote policy alignment. Co-ordination refers to horizontal and vertical alignment of policy areas. Integration seeks coherence by integrating specific objectives (such as environmental sustainability) into other domains such as transport, housing and finance (Matsumoto et al., 2019[49]). Urban, regional and local policy makers can promote both. For co-ordination purposes, it can be helpful to appoint a national, regional, or local body (depending on where policy responsibility lies) or platform that can bring together different policy areas (e.g. energy, climate, and transport policy). Inter-departmental committees can support dialogue and facilitate more informed policy making to minimise policy misalignments and trade-offs. Appointing individual civil servants at the

cross-section of two or more city or regional departments can also help in information exchange. The United Kingdom's Climate Change Act (CCA) is a good example of a high-level policy for the climate-neutral transition that promotes co-ordination and directionality, although it does not explicitly include local levels (Gillard, 2016[50]). The Netherlands' National Environmental Policy has a long tradition of integrating transition perspectives into other policy areas (e.g. industry, innovation, education, transport, energy, food) through its policy plans. In the Dutch case, different ministries were in charge of implementing their transition of energy, mobility, agriculture and health, with the environment ministry playing an overall co-ordinating role. Recent analysis on food and climate change policies in the Netherlands emphasised an essential role for science in advocating changes of the dominant policy framing toward strengthened integration (Biesbroek and Candel, 2020[51]).

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3 Managing the transition to a circular economy in regions and cities

This chapter discusses the role of regions and cities in managing the transition to a circular economy. While the circular economy is gaining momentum in regions and cities as a means to drive environmental, economic, and social sustainability, more investments and more effective governance are needed to upscale promising innovations. The chapter sheds light on some of the key drivers and barriers to the circular economy transition in regions and cities. It also identifies strategic approaches and tools that local and regional policy makers can use in transition domains crucial to the circular economy such as waste management, construction and demolition, land use and spatial planning, and food systems.

In Brief

While regions and cities go increasingly circular, more investment and more effective governance are needed to upscale promising innovations

- **The circular economy is gaining momentum as a means to combat climate change and contribute to environmental sustainability by tackling waste as a resource**. Increasingly, with pressing megatrends such as demographic growth and urbanisation, regions and cities make also an economic and social case for the circular economy. New circular business models, based on waste prevention and resource efficiency create cost savings, increase turnover and create local jobs in various sectors. National and supranational strategies are also proving important impetus, as do global agendas such as the 2030 Agenda for Sustainable Development.
- **There is a distinctive role for urban, regional, and rural policy makers in the circular economy**. Regions and cities can be promoters, facilitators and enablers of the transition to a circular economy. The transition to a circular and climate-neutral economy requires a system change across decision-takers and levels of governments. Co-ordination is needed to update regulation, allocate funds efficiently and develop information systems.
- **A number of circular economy policy initiatives are taking place in regions and cities**. These are often linked to broader agendas related to green growth and regional development. Ongoing initiatives include strategies and long-term visions (e.g. Amsterdam, NL or Paris, France), roadmaps (e.g. Valladolid, Spain), programmes (e.g. Rotterdam, NL), and circular economy objectives as part of a broader set of policies on sustainability issues (e.g. Lisbon, Portugal and Flanders, Belgium). In addition, private sector and civil society initiatives help foster the transition to a circular economy.
- **Accelerating the transition to a circular economy and scaling it up requires removing several barriers**. At the level of regions and cities, the challenges towards building a circular economy are less of technical nature but more related to economic and governance factors. These include building a holistic vision of the circular economy, and introducing a conducive legal framework and an aligned (multi-level) governance framework. For businesses, a lack of clear pricing signals and poorly developed markets of secondary materials are amongst the main issues.
- **Policy plays an important role in enabling or constraining the transition to a circular economy**. The use of regulatory instruments has been central to waste disposal and pollution policies. Fiscal instruments have also been widely used when it comes to prolonging the lifecycle of materials in the economy. Green public procurement is widely recommended as an effective policy for providing a market for products and services with high environmental performance, but its potential remains underexploited. Innovation support schemes and collaboration platforms for the circular economy have been created and diffused by national and regional governments in many locations.
- **Monitoring approaches to follow the development of the circular economy still lags behind**. Complex dynamics and multiple stakeholders make it difficult to monitor the transition appropriately and holistic monitoring frameworks at the level of regions and cities are not yet well developed.

Introduction

The circular economy is a new socio-economic paradigm whereby resources and products are used for as long as possible and waste is minimised. It is one of the European Union's key priorities as outlined in the European Green Deal (2019), setting an ambitious roadmap towards a climate-neutral and circular economy, raising opportunities and providing investment directions for a wide range of economic sectors. The new Circular Economy Action Plan (March 2020) has announced a comprehensive set of actions to accelerate the transition in Europe. Moreover, the circular economy has become central to the achievement of the SDGs and the Paris Agreement. In contrast to a linear economic system, the circular economy implies a transformational change in consumption and production, by designing out waste and pollution, preventing waste, putting resources back into environmental and economic systems, and postponing material losses through re-using goods and products for as long as possible. In recent years, the circular economy has increasingly gained popularity at both national and subnational levels and an increasing number of regions and cities are implementing initiatives that aim to turn them into sustainable circular systems.

Regions and cities are well-positioned to support and steer the transition to the circular economy. Regions and cities have responsibilities over policies directly linked to a circular economy, such as waste management, zoning and urban and regional planning. Moreover, they have the ability to create markets for circular products and services through public procurement, favourable framework conditions for industrial symbiosis, and can facilitate networks and hubs and enable local circular economy experiments and innovations. At the same time, they can empower citizens to help reducing waste by promoting sustainable consumption. With the support of public policies, a circular economy can become a new driver for economic, social and environmental sustainability in regions and cities. New circular business models, waste prevention, recycling, eco-design and similar measures create savings, increase turnover and create local jobs in various sectors. For example, London benefits from circular approaches applied to the built environment, food, textiles, electronic appliances and plastics are estimated at GBP 7 billion every year by 2036 (LWARB, n.d.[1]). In the Île-de-France, about 50 000 jobs linked to the circular economy are estimated to be created by 2030 (Mairie de Paris, 2017[2]).

The transition to a circular economy also presents challenges. Such challenges are, for example, linked to the uptake of new business models, adequate standards and laws, financial incentives, innovation, behavioural change, improved waste management, knowhow and administrative capacity, among others. The market for secondary material is poorly developed, while the cost of virgin material does not account for environmental costs (OECD, 2019[3]). Many instruments like carbon price, environmental tax and the polluter pay principle are still not widely and effectively implemented. In addition, the potential of green public procurement is not yet exploited and there are important cultural barriers, whereby society at large is very much oriented towards ownership rather than renting or sharing. Unlocking the potential of circular economy in regions and cities implies putting the necessary conditions in place to create incentives (legal, financial), stimulate innovation (technical, social, institutional) and generate information (data, knowledge, capacities) (OECD, 2020[4]).

The chapter draws from the OECD seminar series on "Managing Environmental and Energy Transition for Regions and Cities", and in particular from the seminar entitled "Managing the Transition to a Circular Economy". The chapter equally draws from the results of the OECD report on the Circular Economy in Cities and Regions. The main theoretical frameworks and regional case studies were identified in or inspired by the following publications:

- Chapter 1 of this publication: "Managing Environmental and Energy Transition: A place-based Approach".
- OECD (2020), *The Circular Economy in Cities and Regions: Synthesis Report*.

- Ekins (2019), "The Circular Economy: What, Why, How and Where", Background Report for an OECD/EC Workshop Series on Managing Environmental and Energy Transitions for Regions and Cities, OECD, Paris, 5 July 2019.
- Wijkman (2019), "Circular Economy in Cities requires a System Approach", Background Report for an OECD/EC Workshop Series on Managing Environmental and Energy Transitions for Regions and Cities, OECD, Paris, 5 July 2019.

The circular economy in regions and cities

The circular economy is not a new concept. It was introduced in the economic literature in the sixties. The circular economy is a means of slowing depletion of natural resources, reducing environmental damage from the extraction and processing of virgin materials, and reducing pollution from the processing, use and end-of-life of materials (Ekins et al., 2019[5]). The main rationale behind the circular economy is the development of systems that go beyond linear "take-make-dispose" economic models. The circular economy aims at closed loops of materials and energy that maintain the value of resources in the economy while minimising waste. According to the 2019 Circularity Gap Report, less than 10% of the world is circular (Circle Economy, 2020[6]). However, awareness from citizenship, academia, science and policy makers has considerably increased and it has now become part of the political agenda, especially in the European Union (EU), a global leader in this area.

Cities provide important opportunities for a circular economy system due to their proximity of citizens, producers, retailers, and service providers and high human capital. More than half of the world population (54%) lives in metropolitan areas, which contain cities and their commuting zones (OECD/European Commission, 2020[7]). Between 2015-50 city populations are projected to grow by 50%, creating further pressures but also opportunities for more efficient resource use. Cities are responsible today for 70% of consumption-based emissions and about around two-thirds of global energy demand (IEA, 2016[8]). At the same time, around 90% of city dwellers in Europe are exposed to harmful levels of air pollution (EEA, 2019[9]). Congestion costs, mostly in cities, are estimated to be around 2-5% of global GDP annually. More than 90% of privately owned cars are parked most of the time and when on the road, only between one and two of five seats are used (Ellen MacArthur Foundation, 2015[10]). Waste management costs make up to 20% of municipal budgets (Wijkman et al., 2019[11]). Several urban policy levers such as urban planning, public procurement, and legislation and regulation have been identified to support the circular economy in cities. Examples of circular economy opportunities in core urban transition systems are buildings (e.g. designing buildings for resource efficiency and deconstruction), mobility (e.g. ride-sharing and reduced transport needs), and food (e.g. diet transition and food waste reduction). These approaches are discussed further below in this chapter and in Chapter 4 on managing environmental and energy transitions for cities.

Rural regions play an important role in the transition to a circular economy because they specialise in resource-based economic activity such as agriculture, forestry, fisheries, mining, and energy. Rural regions are connected to cities through flows of people, goods and services. 20% of the total OECD population lives in rural regions close to cities, which are defined as territories less than 60 minutes of driving time from urban centres. 6% live in remote rural regions (OECD, 2019[12]). Global primary materials use is projected to almost double in 2060 and the need to address unsustainable land-use practices is growing. Fossil fuel use and the production and use of iron and steel and construction materials lead to large energy-related emissions of greenhouse gases and air pollutants. Metals extraction and use have a wide range of environmental consequences, including toxic effects on biodiversity systems (OECD, 2019[3]). Rural households and firms also depend more on carbon-intensive road transport (Chapman, 2019[13]). The circular economy presents an opportunity for rural regions to overcome the challenges of reversing biodiversity declines and mitigating climate change, while producing sufficient food at the same time. By providing new jobs and income in rural areas, it can also foster economic development and fight

rural depopulation. Examples of circular economy opportunities in rural areas are agro-food systems, moving towards a circular bioeconomy, and applying circularity in rural industries such as mining and forestry. These approaches are discussed below in this chapter and in Chapter 5 on managing environmental and energy transitions for rural areas.

What is meant by the transition to a circular economy?

The transition to a circular economy requires changes for businesses, consumers, and society at large. The adoption of more sustainable and cleaner production structures entails changes in companies in the way of doing their business. Such changes can include improvements in the design of products as well as of equipment and production processes, adoption of new technologies, product modifications (e.g. product life extension), or internal and external waste management (OECD, 2019[14]). Within society the transition to a circular economy may require new infrastructures and new consumption models and access to services, based on the collaborative and sharing economy. The introduction of new sustainable products and business models also implies changes in consumer behaviours.

The introduction of new sustainable products and services is leading to competition with the existing products and services. For example in the last years, in the market, more sustainable products that meet particular environmental criteria are complementing conventional products. However, new technologies and business models on their own might not replace the linear economic production and consumption systems and structures with circular and reproductive materials and energy flow systems (Korhonen, Honkasalo and Seppälä, 2018[15]). This is because the technologies and business models that have achieved their leading position first will not adopt other new technologies or models. Businesses tend to hold their ground and rather continue the old way of doing things than venture into unknown futures. These dynamics show that sustainability transitions are complex processes and the path towards the goal of a circular economy could require considerable time and effort on the part of regions and cities.

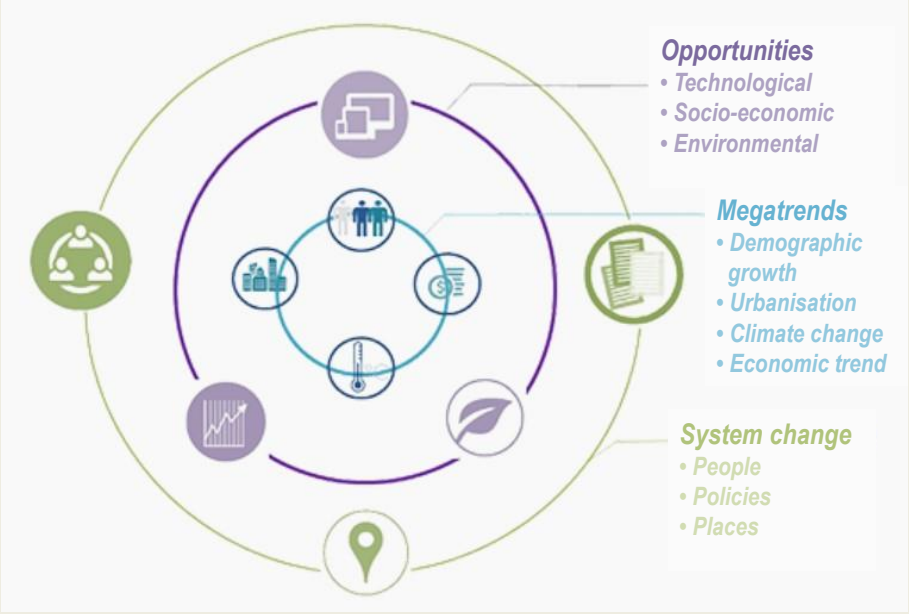
Because the circular economy still lacks a universally accepted definition, policies associated with the transition to a circular economy can also differ substantially. A recent study counted over 100 definitions of the circular economy (Kirchherr, Reike and Hekkert, 2017[16]). OECD work on the circular economy emphasises that achieving circularity means *closing resource loops* to minimise extraction of raw materials, *slowing loops* through re-use, repair and remanufacturing services, and *narrowing resource flows* through more efficient use of materials and products such as cars or phones in current consumption systems (OECD, 2019[14]). Not having a clear definition is one reason why there are no comprehensive parameters and indicators in place yet that can capture all the aspects of a circular economy. This makes a standardised comparison of how regions and cities perform on the circular economy and what effects it has on the environment, economy, and employment still difficult (Kirchherr, Reike and Hekkert, 2017[16]).

The OECD has developed a conceptual framework for the circular economy in regions and cities to support the transition to a circular economy and to facilitate comparison of different circular economy strategies and initiatives (Box 3.1). Cities, regions and rural areas can make use of the circular economy in the provision of *services* (such as water, waste and energy) to increase the efficient use of resources and to optimise re-use. They can also carry out *economic activities* (e.g. in the food sector) in a way that closes, slows, and narrows loops across value chains. Finally, *infrastructure* can be designed to avoid linear lock-ins, for example by turning the construction sector more circular through minimising waste production and maximising waste re-use (OECD, 2020[4]).

Box 3.1. A conceptual framework for the circular economy in regions and cities

Within its program on the circular economy in cities and regions, the OECD has developed a conceptual framework that focuses on 3Ps: People, Policies, and Places:

Figure 3.1. The circular economy framework for cities and regions



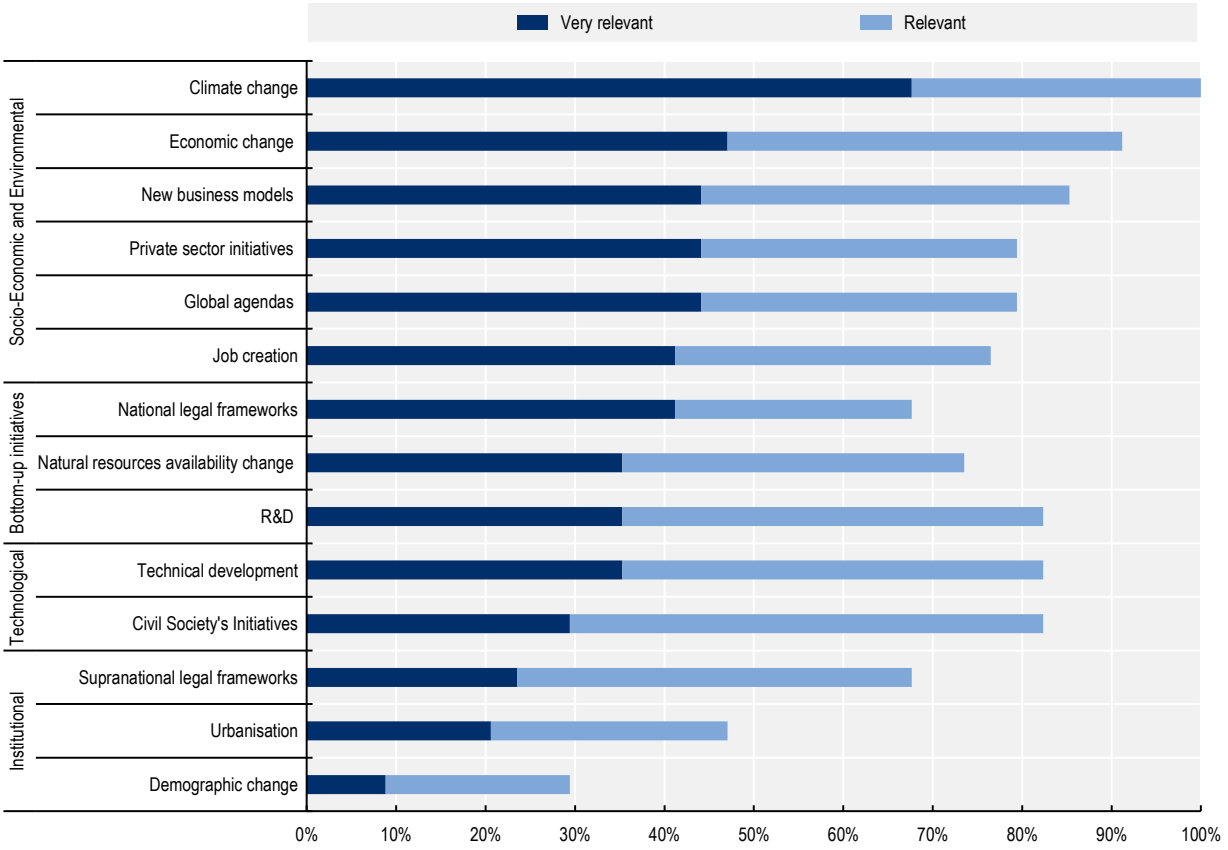
- **People**: The circular economy is a shared responsibility across levels of government and stakeholders. The business sector can determine the shift towards new business models (e.g. using secondary material, recycling, sharing, etc.). People, on the other hand, make constant consumption choices and can influence production. The circular economy is transformative and implies a behavioural and cultural shift towards different production and consumption pathways, new business and governance models.
- **Policies**: The circular economy requires a holistic and systematic approach that cuts across sectoral policies. As somebody's waste can be a resource for somebody else, the circular economy provides the opportunity to foster complementarities across policies. As such, environmental, regional development, agricultural and industrial policies should provide complementary approaches to enhance planning, e.g. for the use of water and energy in the built environment or the re-use of food waste for agriculture purposes. The variety of actors, sectors and goals makes the circular economy systemic by nature. It implies a wide policy focus through integration across often siloed policies. When interactions and complementarities are overlooked, the lack of a systemic approach might lead to the implementation of fragmented projects over the short-medium run, rather than sustainable policies in the long run.
- **Places**: Cities and regions are not isolated ecosystems, but spaces for inflows and outflows of materials, resources and products, in connection with surrounding areas and beyond. Therefore, adopting a functional approach going beyond the administrative boundaries of cities is important for resource management and economic development. Linkages across urban and rural areas (e.g. related to bio-economy, agriculture and forest) are key to promote local production and recycling of organic residuals to be used in proximity of where they are produced, to avoid negative externalities due to transport. At the regional level, loops related to a series of economic activities (e.g. to the bio-economy) can be closed and slowed.

Source: OECD (2020[4]), *The Circular Economy in Cities and Regions: Synthesis Report*, OECD Urban Studies, OECD Publishing, Paris, https://doi.org/10.1787/10ac6ae4-en.

Drivers of the circular economy in regions and cities

The circular economy in regions and cities is mainly driven by concerns about climate change, economic uncertainties, and opportunities for new business models. According to an OECD Survey on the Circular Economy in Cities and Regions,[1] climate change (68%), evolving economic conditions (47%) and the search for new business opportunities (44%) are major drivers of the circular transition in regions and cities. Among the top five drivers are also private sector initiatives, and changes in global agendas (both 44%) (See Figure 3.2). The following section unpacks these drivers and how they relate to the circular economy.

Figure 3.2. Drivers of the circular economy in regions and cities



Source: OECD (2019), OECD Survey on Circular Economy and Cities and Regions.

- **The circular economy plays an important role in fighting climate change.** Systemic change of energy and industrial systems, land management, buildings, and infrastructure will be needed to put the global economy on track to reach net-zero emissions by 2050 and therefore limit global warming to 1.5˚C with no or limited overshoot. While the supply of energy, and its consumption in buildings and transport, together generate 55% of global GHG emissions, the remaining 45% are directly linked to the production of goods and the management of land (Ellen MacArthur Foundation, 2019[17]). Potential synergies between circular material use, climate change mitigation and the halting of biodiversity loss are recognised in an increasing number of studies. According to a recent study from the Ellen MacArthur Foundation (ibid), applying circular economy principles to transform the way goods and materials are produced and used in the economy would offer significant potential to reduce GHG emissions. For example, a circular economy approach could

reduce global CO2 emissions from key industry materials by 40% or 3.7 billion tonnes in 2050. Another study looked at the potential of circular strategies within the car manufacturing and building sectors, including extensive car-sharing systems and electrification (Material Economics, 2018[18]). They calculated that a radical shift to circular business models and low-carbon technology would allow the EU to reduce its industrial emissions by 56%, by 2050, more than half of what is necessary to achieve net-zero emissions. Such a shift requires significant effort from producers, consumers and public policy.

- **The circular economy can stimulate economic growth and revive local and national economies**. The Ellen MacArthur Foundation and McKinsey have demonstrated that by implementing the principles the circular economy increases resource efficiency and the material costs of production in the European Union can be reduced by 10-25% (up to USD 600 billion or 3% of EU GDP (Ellen MacArthur Foundation, 2015[10]). Circular economy technology and the expertise required for implementation can become a growth market globally in the context of increasingly scarce resources. According to the European Environment Agency (EEA), savings of EUR 600 billion can be generated within the EU-27 by 2030 through enhanced resource productivity and material re-use alone (European Environment Energy, 2016[19]). At the level of regions and cities, an example from the city of Amsterdam shows that material re-use strategies can generate annual savings of EUR 85 million in the construction sector and EUR 150 million with more efficient organic residual streams (Amsterdam Smart City, n.d.[20]).
- **The labour market consequences of a transition to a circular economy are likely positive**. According to a recent OECD review of the quantitative literature on the macroeconomic impacts of the resource efficiency and circular economy the transition is likely to lead to a net improvement in employment rates, albeit small and ranging between 0 and 2% (Laubinger, Lanzi and Chateau, 2020[21]). The UK Waste & Resources Action Plan (WRAP) has published a study showing that expansion of the Circular Economy could create up to 3 million extra jobs in the European Union by 2030 (WRAP, 2015[22]).
- **The circular economy in regions and cities offers opportunities for new business models and product and process innovations.** The transition to a more circular economy in regions and cities can be operationalised through circular business models. Available data suggest that circular business models are increasingly adopted. One in four companies for which information is available report that they have changed their product design to improve re-use, repair or maintenance (European Environment Agency, 2019[23]). Recent OECD work has identified five key business models that can provide a business case for the different circular activities (OECD, 2019[14]). Material and technological innovation is a core enabler for fast-tracking transformation from a linear into a circular economy, and businesses can innovate by changing the efficiency of production processes or by introducing alternative materials. Regions and cities play an important role in scaling circular business models. The agglomeration of people, material and skills means that regions and cities provide testbeds and experimentation spaces that can enhance the impact of the circular economy transition. For example, when looking at some of the impacts of new business models, a range of benefits emerge. Refurbishing a thousand tons of electronics would create 13 times more jobs than recycling the same amounts. Switching outdoor US lighting to led lighting would have the same impact on carbon emission reduction equivalent to taking 8.5 million cars off the road. The Airport of Amsterdam in the Netherlands purchases light as a service rather than buying light bulbs. This new model incentivises the manufacturer to make items last for as long as possible. Accessing clothing via rental model could result in a 14 times reduction of garments produced or disposed of (Ellen MacArthur Foundation, 2019[24]).
- **Private sector and civil society initiatives help foster the transition to a circular economy.** The business sector and civil society can promote bottom-up initiatives towards more sustainable production and consumption processes. Regions and cities can provide the enabling conditions for such initiatives to be scaled up or for creating new opportunities for collaboration. For example, in

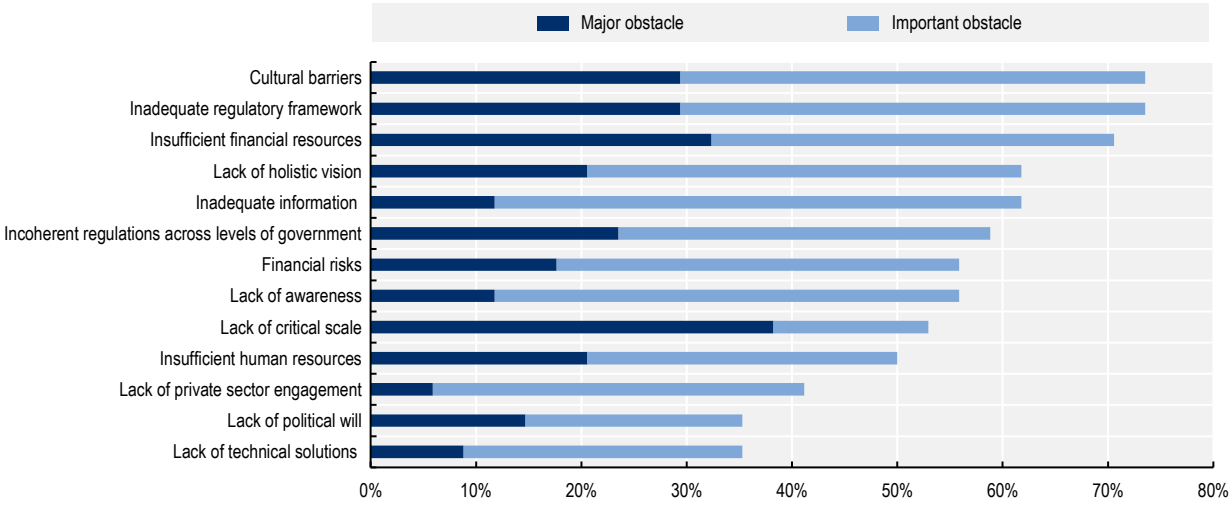
the Region of Lapland (Finland), the business sector began to support the circular economy in 2012 and sought subsequent support from public authorities to improve the re-use of by-products and residues. The request was well received by the local authorities, which started to support the development of the circular economy with technical assistance and promoting collaborations (Region of Lapland, 2020[25]; OECD, 2020[4]).

- **National and supranational strategies are proving important impetus towards a circular economy in regions and cities**. Several initiatives of the European Union, and notably the Circular Economy Action Plan, express this clearly (see Box 3.3). Many countries worldwide are also establishing policy agendas in favour of the move to a circular economy in order to further support the transition to sustainable development and to meet the targets of global sustainable development agenda by 2030. Regions and cities are encouraged to apply innovative strategies for implementing circularity at the regional and urban scale (OECD, 2020[4]).
- **Global agendas are also driving the transition to the circular economy**. The circular economy is central to the achievement of Sustainable Development Goal (SDG) 12 on sustainable production and consumption. It is further a horizontal approach supporting progress towards several other SDGs, such as SDG 6 on water, SDG 7 on energy, SDG 11 on sustainable cities, SDG 13 on climate change, SDG 15 on sustainable use of natural resources. The circular economy also offers mitigation solutions towards fulfilling the objectives of the Paris Agreement since it provides an increased focus on low-carbon materials and has the potential to drive low-carbon behavioural change in society. Finally, the circular economy is a crucial pillar of the European Green Deal, and it represents an opportunity for implementing the New Urban Agenda, and G20 initiatives on resource efficiency (OECD, 2020[4]).
- **An increasing number of international organisations, umbrella organisations and foundations are supporting regions and cities with their transition to the circular economy**. The Ellen MacArthur Foundation, the leading institution in the field, launched in March 2019 a dedicated website on the circular economy in cities, containing examples from several cities all around the world and guidance for circular cities. The C40 collaborated with Climate KIC in 2019, to collect circular economy-related practices. The ICLEI and the Eurocities network are also supporting their members by raising awareness and promoting networking on the circular economy. The European Investment Bank (EIB) dedicated works on funding solutions for cities within the EU Urban Partnership on the Circular Economy (OECD, 2020[4]; Wijkman et al., 2019[11]). The African Circular Economy Network (ACEN), a non-profit organisation formed by professionals working on the circular economy field, organises networking events and shares knowledge through newsletters, blog posts and academic research aiming to promote a restorative circular economy in Africa.

Obstacles of the circular economy in regions and cities

The transition to the circular economy faces governance challenges. Challenges towards building a circular economy are not related to the lack of technical solutions. Instead, lack of critical scale, cultural barriers, inadequate regulatory frameworks, and a lack of financial resources has been signalled as “major” obstacles by more than one-third of the interviewed governments in the OECD Survey (Figure 3.3). Three critical priorities that have been addressed in the survey as future priorities to overcome these barriers are: (i) increasing the environmental quality and resource efficiency in regions and cities; (ii) adapting, updating and making sure that policy and regulation are conducive to the transformation from linear to circular; and (iii) behavioural shifts and awareness-raising (OECD, 2020[4]).

Figure 3.3. Obstacles to the circular economy in regions and cities



Source: OECD (2019), OECD Survey on Circular Economy in Cities and Regions.

A related challenge is a lack of mutual understanding of what a circular city or region is or aims to achieve. Although environmental objectives, such as reduced material use to reduce GHG emissions, have thus far dominated the agenda when it comes to promoting the implementation of the circular economy, regions and cities are increasingly paying attention to the social and the economic components as drivers for this transition. However, there is still a need to better understand the connections and mutual implications between the different building blocks of the circular economy in cities. Many of existing measures can be labelled as incremental while 'major investments' to transform baseline linear systems are largely absent (Wijkman et al., 2019[11]).

Regions and cities need to be ambitious in their CE strategies. Lock-in mechanisms and path dependence patterns might keep regions and cities from promoting circular investment opportunities and production models. They may lead to a situation in which less preferable CE strategies such as recycling maintain a leading position compared to more ambitious strategies such as prevention and re-use, repair and remanufacturing. Moving from an incremental approach to the circular economy towards transformative change requires ambitious action and investment at the level of political decision makers. At the same, awareness of local circular economy opportunities needs to be raised. Regional and city governments can engage with multiple stakeholders from across sectors and catalyse action. This is key to the emergence of circular economy opportunities, which require understanding, collaboration, and action within and between sectors (Ekins et al., 2019[5]).

One of the barriers to the development of the circular economy is that producers and consumers do not yet perceive the benefits so evident. This makes the adoption of the circular economy difficult at the level of companies, where it often entails the adoption of cleaner production processes. Studies also point out that in the business world, the CE concept is still unknown or mainly related to the management of waste and recycling option (Stewart and Niero, 2018[26]). As a result, fostering and boosting the CE in the whole economic system (and in particular in small-medium enterprises) requires policy interventions that enhance the culture and knowledge towards CE, provide financial support to CE-related investments by the companies and provide legislative support to the closure of the loops within the companies.

A range of external company barriers persists, too. Amongst the external barriers that companies might face, 'inconsistent policies and messages', and 'lack of clear pricing signals', are problems whose resolution would require the intervention of policy makers. Other barriers such as 'supply chain constraints', and 'thresholds in technologies and infrastructure capacity', may more directly concern interactions with

other companies; however, the role of policy in co-ordinating actors and supporting technological innovation may still be significant (Ekins et al., 2019[5]).

Internal company barriers mainly relate to questions of mindset and culture. A recent study on the CE shows that one of the most relevant barriers to the CE implementation is a "hesitant company culture" that limits the discussion about the CE to environmental departments disregarding operative or financial departments (Kirchherr et al., 2018[27]). Financial barriers such as 'high upfront costs', 'low returns on investment', and constrained 'access to capital', could also be improved by policy measures, for example, to provide low-cost financing, or to reduce the cost of commercial financing by providing clear and stable long-term policies.

Governance and policy of the circular economy in regions and cities

Policy plays an important role in enabling or constraining the transition to a circular economy. Policy approaches for the circular economy may be broadly separated into five categories of policies. The first three are: (i) market-based policies (alerting economic incentives); (ii) regulatory policies (i.e. setting requirements or prohibitions); and (iii) information policies (i.e. raising awareness in society). While these categories are important tools to address traditional market failures, they are insufficient to stimulate radical innovation and transformation instruments. (iv) Public procurement and infrastructure; and (v) innovation support schemes and collaboration platforms are therefore proposed as additional categories of instruments. Table 3.1 provides an overview of these different types of policies. Although designed primarily for national policy makers, the framework is applicable to policy makers at all levels, from municipal to supranational.

Table 3.1. Five categories of policy intervention

Policy Intervention Category	Examples
Regulatory Frameworks	Strategies and targets for resource efficiency/productivity; product regulations (e.g. material requirements, product warranties); waste regulation (e.g. landfill bans, recycling requirements, Extended Producer Responsibility).
Fiscal Frameworks	Material use taxes, waste or landfill taxes and charges, subsidies or tax reduction for resource-efficient or circular products or activities.
Education, Information and Awareness	Communication and information campaigns, requirements or resources targeted at businesses or the public.
Public Procurement and Infrastructure	Inclusion of resource efficiency elements in public procurement criteria, investment in enabling infrastructure.

Source: Ekins, P. et al. (2019[5]), "The Circular Economy: What, Why, How and Where", Background paper for an OECD/EC Workshop on 5 July 2019 within the workshop series "Managing environmental and energy transitions for regions and cities", OECD, Paris.

The use of regulatory instruments has been central to circular economy policy making to date, particularly concerning waste disposal and pollution. For example, many countries and jurisdictions around the world have instituted bans on disposing of different types of waste streams into landfills, requiring instead alternative disposal, treatment or material re-use. A range of countries and jurisdictions has also employed outright bans on the manufacture, sale or use of certain products or materials, particularly single-use plastic bags to increase material use and prevent pollution.

Fiscal instruments have also been widely used when it comes to prolonging the lifecycle of materials in the economy, again with a substantial focus on waste disposal and pollution. Landfill taxes to incentivise the diversion of waste streams have become widespread across the EU and other OECD countries in recent years (OECD, 2015[28]), often in combination with landfill bans. When it comes to education and awareness-raising, research shows that between 1970 and 2012, 544 environmental

labelling and information schemes (ELIS) were introduced across 197 countries. Around 40% are related to natural resources and waste. The vast majority of these are voluntary schemes, operated by private or non-governmental organisations at national levels, and generally concern the processes and methods of production (Gruère, 2013[29]).

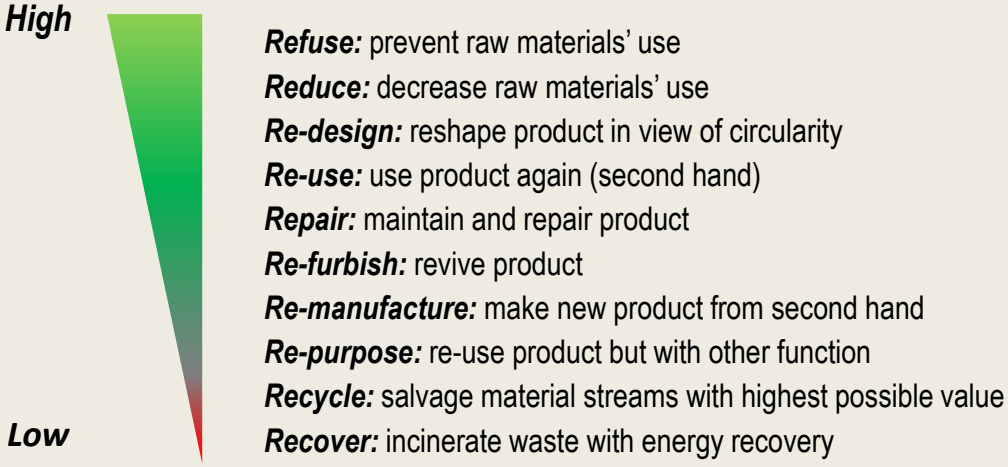
Green public procurement is widely recommended as an effective policy for providing a market for products and services with high environmental performance. Public procurement accounts for around 12% of GDP and one-third of public expenditures in OECD countries. In 2016, 84% of OECD countries had green public procurement policies at the central government level. However, few include resource efficiency considerations (OECD, 2019[3]) and the evidence for such schemes achieving their objectives, both in terms of direct environmental benefits and stimulating innovation, remains limited (albeit largely positive). In 2015, the Amsterdam Metropolitan Area has initiated a circular economy programme focusing amongst others on green public procurement (Box 3.2).

Innovation support schemes and collaboration platforms for the circular economy have been created and diffused by national and regional governments in many locations. Although innovation support schemes have been created in many places, tracking the provided innovation support to improvements in circularity remains difficult because the impact of such activities is often not measured (Prendeville, Cherim and Bocken, 2018[30]).

Box 3.2. Implementing the circular economy: The case of the Amsterdam Metropolitan Area

The Amsterdam Metropolitan Area is a comparatively densely populated region with 2.33 million inhabitants. Large amounts of products and material circulate within the region, and it is home to many innovative and sustainable entrepreneurs. The Amsterdam Economic Board has initiated a circular economy programme at regional level in January 2015 in close co-operation with the Regional Board of Local Governments, businesses, knowledge institutes, and citizens. Within the programme, 32 municipalities and two regions were engaged in communities of practice. To stretch the circular ambition of the programme, the aim was to set up activities that focus on the highest possible steps on the ladder of circularity as depicted in Figure 3.4.

Figure 3.4. Order of priority: 10Rs



Based on the ladder of circularity, the strategic choice of the programme in 2015-18 was to focus on two major strategies:

- Circular procurement: The strategy aims to stimulate circular products through circular procurement executed by local governments and other contractors (for example businesses and knowledge institutes). Three communities of practice were set up successively; with a total of 31 representatives of procurement or sustainability division. Each community of practice consisted of 6 sessions, in which the participants learned from each other and acquired the necessary expertise to implement circular procurement within their organisations.
- Closing the loop of resource streams: The aim of this strategy was to create ecosystems in which resource streams are recycled and if possible re-used and redesigned. The Board selected nice resource streams, designed, and adopted a generic approach to generate and select the most promising options for closing the loop of each resource stream. A key lesson from this exercise has been that the approach of material streams has to be tailor-made for different types of materials.

Key results were EUR 150 million were invested in circular procurement. Moreover, the participating 32 municipalities and the two provinces of the region signed a manifesto, which committed them to realise 10% circular procurement by 2022, 50% in 2025 and 100% as soon as possible. High-value recycling and product re-design and re-use of 20 resource streams were additional positive impacts.

The main lesson learned was that success depends on a number of main drivers. First, there should be one or a limited number of initiators that act as inspiring 'transition brokers'. Second, co-operation across the product chain (including end-users) is key, including trust and mutual respect. A combined effort on the part of innovative companies and forward-thinking universities, plus a government to stimulate, facilitate and connect them, is crucial, as together they know more, and can achieve more. Third, new financial and organisational arrangements are important to create a convincing business case. Finally, tailor-made incentives need to be designed for specific product or waste streams. One of the main incentives is circular procurement.

Source: Amsterdam Economic Board (2019), The evolution of implementing circular economy: The case of the Amsterdam Metropolitan Area. PowerPoint Presentation for the high-level expert workshop on "Managing the Transition to a Circular Economy", OECD, Paris, 5 July 2019, unpublished.

Policy initiatives related to the circular economy in regions and cities

Regions and cities have put in place a number of initiatives to promote, facilitate and enable the circular economy. Amsterdam (Netherlands), Paris (France) developed dedicated Strategies based on a long-term vision. The Circular Economy Strategy of the Greater Paris (France) has been developed by 240 stakeholders from over 120 different organisations. They were divided into working groups and defined 65 proposals. Nantes Metropolitan Area (France) and Valladolid (Spain) developed Roadmaps that indicates steps for sectors and business to shift towards the circular economy. At the regional level, strategies are often embedded in carbon neutral and or sustainable strategies. This is the case of the Region of Västerbotten, Sweden, and the Autonomous Region of Andalusia, which approved the "Strategy for Sustainable Development" (OECD, 2020[4]).

Table 3.2. Selected circular economy initiatives

City	Country	Initiative
Amsterdam	Netherlands	"Amsterdam Circular 2020-2025" (2019)
Barcelona Metropolitan Area	Spain	Circular economy promotion programme AMB circular (2019)
Nantes	France	Circular Economy Roadmap Nantes (2018)
Paris	France	Circular Economy Plan 2017-20 (2017)
Rotterdam	Netherlands	Rotterdam Circularity Programme 2019-23
Tilburg	Netherlands	Tilburg Circular Agenda 2019
Valladolid	Spain	Valladolid Circular Economy Roadmap (2017-18)

Source: OECD, (2019), OECD Survey on Circular Economy in Cities and Regions.

The circular economy plays an important role in a whole range of sectors. The EU circular economy action plan (see Box 3.3) identifies five priority sectors intending to accelerate the transition to the circular economy along its value chain: plastics, food waste, critical raw materials, construction and demolition, biomass and bio-based materials. According to the OECD (2019[31]), 78% of regions and cities surveyed referred to waste as the core sector of the circular economy, followed by construction and demolition (66%), land use and spatial planning, and food production (52%). In addition, manufacturing (45%), water and textiles (42%), energy (39%), biomass (36%), and finally agriculture and mobility (33%) were also highlighted as potentially "circular" sectors (OECD, 2019[31]).

Box 3.3. The European Union Circular Economy Action Plan

The European Commission adopted in 2020 a new Circular Economy Action Plan as one of the main blocks of the European Green Deal, Europe's new growth agenda. The new Action Plan announces initiatives along the entire life cycle of products, targeting for example their design, promoting circular economy processes, fostering sustainable consumption, and aiming to ensure that the resources used are kept in the EU economy for as long as possible.

The European Commission launched a first Circular Economy Action Plan in 2015. All 54 actions under the plan and focusing on five priority areas (plastics, food waste, critical raw materials, construction and demolition, and biomass and bio-based products) have been delivered or are being implemented. According to the EC, the implementation of the Circular Economy Action Plan has accelerated the transition to a circular economy in Europe and its recognition across all levels of government and within the private sector.

Amongst others, relevant developments in the EU are:

- Increase of 6% of the circular employment between 2012 and 2016.
- New business opportunities and development of new markets, as in 2017, circular activities (e.g. repair, re-use or recycling) generated around 155 EUR billion in value-added in the EU-28, 17% higher than in 2011.
- Increased recycling of municipal waste during the period 2008-16.

The implementation of circular economy initiatives is further supported through the European Circular Economy Stakeholder Platform, a virtual open space that facilitates policy dialogue among stakeholders and provides information on ongoing circular economy initiatives within the EU.

The below section will look deeper at the regional dimension of some critical circular sectors as identified by the OECD survey and which are also part of the EU Circular Economy Action Plan amongst others:

Waste

Waste production is growing, driven by rapid urbanisation and growing populations. The world is expected to generate 3.4 billion tons of waste annually by 2050, increasing drastically from today's 2.01 billion tons (Kaza et al., 2018[32]). High-income countries - although they only account for 16% of the world's population – are generating more than one-third (34%) of the world's waste. Plastics are especially problematic. Plastic production has harmful impacts on the environment and climate. Estimates put the contribution of plastic production and plastic waste incineration globally at 400 million tonnes of carbon dioxides equivalents (CO2e) annually. Based on increasing demand, plastic production reached 348 million tonnes in 2017, of which almost one fifth was produced in Europe. However, only 31.1% of plastic waste was recovered in Europe in 2017 (European Environment Agency, 2019[33]).

Cities and municipalities are increasingly recognising the potential of the circular economy in waste collection and recycling. Improved waste collection can be a first step towards a circular economy. However, many regions and cities are also striving for increased producer responsibility or high-quality recycling and biological waste treatment (e.g. organic processing, composting or fermentation). Local and regional authorities play an important role when it comes to initiating and accelerating the transition to a circular economy. For example, Groningen, in the Netherlands, plans to launch a circular hub to promote the recycling of circular materials such as textiles, wood and plastics. The Greater Porto Intermunicipal Waste Management Service (LIPOR, Portugal) has developed a range of measures to support the circular economy in waste production, including limiting the use of plastics, and stimulating a market for recycled plastics (OECD, 2020[4]). Going forward, a new conditionality in EU cohesion policy funding for the period 2021-27 will require the adoption of Waste Management Plans, with a strong regional dimension in some EU Member States.

Construction and demolition

Circular principles can reduce the environmental impact of buildings significantly. Construction and demolition (C&D) waste makes up just over one-third of total waste generation in the EU within total 374 million tonnes generated in the EU in 2016 (European Environment Agency, 2020[34]). It is also defined as a priority area in the EU circular economy action plan for closing the loop and the revised Waste Framework Directive (WFD 2008/98/EC, amended 2018/851) sets a mandatory target of 70% for its recovery by 2020. Many EU countries have succeeded in establishing markets for recovered C&D materials.

Regions and cities are implementing various actions towards more circular buildings, in order to reduce the use of new material, increase recycling, while reducing CO2 emissions. These actions consist of designing for disassembly and promoting modular buildings that can adapt to changes in economic activities; increasing the use of buildings through smart repurposing; increasing durable design and material. For example, the city of Amsterdam applies smart design to make buildings more suitable for the repurposing and re-use of materials and to improve efficiency in the dismantling and separation of waste streams (Amsterdam Smart City, n.d.[35])). The Flemish Public Waste Agency (OVAM, Flanders, Belgium) together with the Public Service of Wallonia (SPW) and Brussels Environment Agency (Bruxelles Environnement – Leefmilieu Brussel) developed an online open-access tool called "Tool to Optimise the Total Environmental impact of Materials" (TOTEM). The TOTEM helps architects, designers and builders to assess the environmental impact of building materials to increase the material and energy performance of buildings (TOTEM, 2020[36]; OECD, 2020[4]).

Land use and spatial planning

Land use and spatial planning can strongly facilitate the take-up of the circular economy. The spatial planning of residential and/or industrial areas can lay the foundation for future circular material flows and resource independence. If circular economy principles are incorporated early on in the urban development process, planners can ensure that the physical structure of the city and its infrastructure supports the effective re-use, collection and redistribution of resources such as industrial by-products, and components (Ellen MacArthur Foundation, 2019[17]).

Cities have different tools at their disposal to foster circular urban planning, including circular land tenders, land use regulation and urban planning. Amsterdam is the first city in the world that issued a Roadmap Circular tendering for constructing sites. The roadmap offers practical information on how to design a circular tender and provides information on how to define and measure circularity in buildings (Amsterdam Smart City, n.d.[20]). Urban planning for compact city development helps circularity because it reduces a city's resource and energy requirements and improves the provision and use of infrastructure. Land use regulation and urban planning for compact cities is an integral part of the circular economy strategy of Flanders, Belgium (OECD, 2020[4]).

Food

A circular economy for food mimics natural regeneration systems so that there is no waste, but raw material for another cycle. A complete circular system for food includes local production of food, local consumption, and organic waste management. The transformed waste could then serve again as raw materials for food protection or as bio-gas for other users (e.g. fuel for buses). Roughly one-third of the food produced is lost, the bulk of which comes from consumption in developed countries (61%), followed by production, handling and storage (WRI, 2018[37]). The reduction of food loss and waste can be enabled by improving local waste management at every stage of the food chain from production to final consumption. Where food loss cannot be avoided, it may be re-integrated into natural nutrition cycles. This enables new business models based on urban agriculture, local production and new interactions with producers in peri-urban and rural environments.

Urban and rural areas already are moving towards circular food systems. According to (OECD, 2020[4]), there are already some initiatives to reduce food waste (Groningen, Umeå, Ljubljana, Porto), promote urban agriculture (Paris, Brussels, Guelph) and support local food production (Umeå). Some of these initiatives provide for improved co-ordination between urban and rural areas (Valladolid), and explicitly include restaurants and hospitality in current strategies (Amsterdam, Valladolid, Umeå) (OECD, 2020[4]). The EU Farm to Fork strategy highlights the circular bio-based economy as having a still largely untapped potential for farmers and their cooperatives. It also envisages to scale-up and promote circular business models in food processing and retail, including specifically for SMEs ((European Commission, 2020[38]).

Measuring the circular economy in regions and cities

Measuring approaches to follow the development of the circular economy still lag behind. Complex dynamics and multiple stakeholders make it difficult to monitor the transition appropriately. The complexity and system perspective of the circular economy and its approach of addressing economic, environmental, and social concerns at the same time further call for a broad approach to monitoring. A first challenge for monitoring the circular economy is the lack of an agreed precise definition of a circular economy. In addition, data gaps and inconsistency in statistical reporting is a problem, especially as some of the dimensions of the CE have not historically been reflected in statistical databases. A second challenge is a lack of alignment of local, regional, and national CE strategies and monitoring systems. Third, and related to the above, there is still a limited understanding of the rebound effects of circular economy strategies.

For example, a recent study (Haupt, Vadenbo and Hellweg, 2017[39]) found that commonly used indicators for circularity such as collection rate and recycling rate may give a misleading indication of progress, as recycling rates indicate inputs into the recycling processes rather than an indication of the efficiency of recycling processes (OECD, 2020[4]).

Supporting the transition to a circular economy for regions and cities requires making better use of existing data as well as designing new approaches to data and indicators. In New York, the Circular City program is a first-of-its-kind experiment to test whether collaboration between the public and private sectors. It consists of collecting and use a wide range of real data that can be used by organisations and start-ups to solve urban problems, such as mobility. Within the New Lab, three start-ups working on waste collection and mobility and three city agencies working on the same fields took part in a pilot project. The challenge was to create an incentive system whereby city agencies could access data that start-ups collected. One of the start-ups was able to produce a technologically advanced micro-level mapping of transportation by taxis and of garbage collection through real-time data. These data can inform policy makers. As such, even outside of the monetisation framework, it is possible to build value and collaborate with start-ups.

Several subnational governments have taken efforts towards measuring the circular economy. As part of their circular economy strategies, many municipalities have developed monitoring frameworks or systems of metrics at the urban level. In many cases, they focus on specific aspects such as recycling of construction and demolition (C&D) waste and food waste while others also include aspects such as jobs and private investments. An increasing number of cities have adopted circular economy strategies and corresponding monitoring frameworks (see Box 3.4). From the city perspective, metrics can help motive the transition to the circular economy, measuring carbon neutrality targets, the number of jobs created and the increase in the sharing economy and the positive impacts on material flows. Existing measurement frameworks take into account the following dimensions: Material flows, accounting for the amount of waste recycled, incinerated or sent to landfills; material streams, including food, plastic and textile; recycled material vs virgin material used in products; the extent to which procuring products could be replaced by procuring services; the existence of new business models and sharing platforms. The OECD developed the OECD scoreboard on the governance of the circular economy to support regions and cities to self-assess the existence and level of functioning of governance conditions, as enablers of circular economy systems (OECD, 2020[4]).

Box 3.4. Measuring the circular economy at local and regional level: Some examples

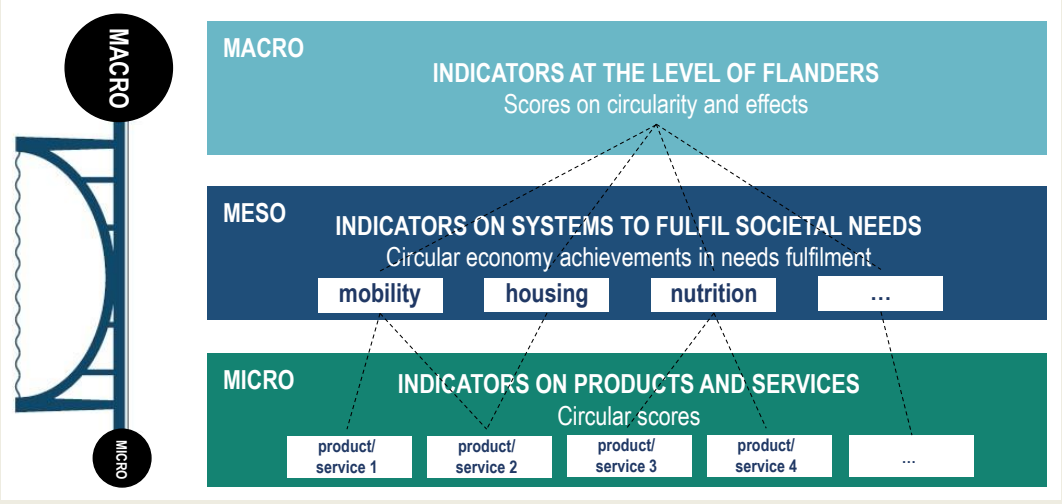
The City of Paris (France) proposes one performance indicator for each of the 15 actions included in the 1st Roadmap Paris Circular Economy Plan. The first roadmap addresses themes considered to be priorities and structural for the city: planning and construction; waste reduction, re-use. re-use, re-use or repair; support for local actors; public procurement; and responsible consumption. In the second roadmap, there are two indicators for each of the 15 established actions (one achievement indicator and one impact indicator).

In Peterborough (United Kingdom), the local circular economy initiative presents eight indicators that report on the waste (% household waste and % non-household waste recycled) energy (CO2 emissions per capita and amount of renewable electricity available to each household), and socio-economic dimensions (number of shares in a local platform and % of adults cycling and walking, % circular jobs and % circular business). On the "Measuring the Circular Economy - Developing an indicator set for Opportunity Peterborough" report, the set of indicators are designed to: i) allow individuals and organisations to measure the level of circularity of the City of Peterborough (United Kingdom); ii) capture specific characteristics of the changing system; and iii) evaluate the progress made on the circular economy objective.

The "Making Things Last: A Circular Economy Strategy for Scotland" report aims at better understanding the flow of materials in Scotland through supply chains to consumers and onwards to other uses. The report gathers three waste-related indicators: the total amount of waste produced by sectors (household; commerce and industry; and construction and demolition); the amount of waste produced by sectors per unit of GVA (Gross Value Added); and the carbon impact of waste (the whole-life impacts of waste including the benefits of prevention and recycling). The aim of the current indicators and those to be created is to contribute to building an evidence base to help identify specific circular economy opportunities.

The region of Flanders currently builds up a circular economy monitoring system (Figure 3.5). The proposed system works with macro-, meso- and micro-level indicators. The macro-level indicators would look at circularity levels and related impacts. The meso-level would focus on system indicators that fulfil societal needs and allow introducing a sustainability transition perspective into the monitoring process. The micro-level indicators would measure products and services.

Figure 3.5. Monitoring the circular economy in Flanders



Sources: (Ekins et al., 2019[5]; Ellen MacArthur Foundation, 2019[40]; Mairie de Paris, 2017[41]); OVAM Flanders (2019, unpublished), Flanders Strategy towards a circular, low carbon economy. PowerPoint Presentation for the high-level expert workshop on "Managing the transition to a circular economy", 5 July 2019, OECD Paris.

Monitoring progress can give a good indication of whether the transition is on its way or whether additional measures are needed. The report *Single-Use Plastics: A Roadmap for Sustainability* (UNEP, 2018[42]) provides a good example. It shows that introducing a single-use ban on plastic bags has resulted in sharp reductions in plastic pollutions only in 30% of registered cases. In the countries that have reported a small or non-existent impact, the main issues seem to be a lack of enforcement and a lack of affordable alternatives. The (OECD, 2020[4])defined a Scoreboard to measure the level of advancement towards the circular economy, distinguishing across "newcomer", "in progress" and "advanced" regions and cities, based on ten governance indicators that can allow a self-assessment.

Digital technologies open up new possibilities for monitoring the circular economy. Digital technologies can support the upscaling of the circular economy and improve its monitoring. The Internet of Things, blockchain, artificial intelligence, and interactive platforms change how materials and interactions are managed across the value chain and how services are provided. The recent explosion in big data sources should be further harvested for their potential to learn about changing societal structures and consumer behaviours. Tracking consumer choices and behaviours might provide new information that can be used to influence these choices towards a circular way of thinking. New ways of thinking might also lead to price signals moving away from a linear to a circular economy.

Key factors towards the transition to the circular economy

A number of lessons can be learnt from existing circular economy practices in regions and cities:

- **Address consumption patterns**: Regions and cities can support circular consumption patterns of re-using, re-storing and re-pairing rather than buying new products, especially for electrical and electronic devices. They can also provide education and information for consumers so as to make more sustainable and responsible choices regarding appliances' energy efficiency and reparability potential.
- **Enhance co-ordination across levels of government**: Having a common understanding of how strategies and objectives can be aligned is key to boost the circular economy at local and regional level. Ambitious policies can be delivered through technological innovation, funding, and investment, which require co-ordination across levels of governments, according to respective roles and responsibilities. Regions and cities can play an important role in making material use more effective. However, in some cases, regulation changes are the responsibility of national governments. Dialogue is needed to identify challenges in this respect and overcome them.
- **Align the circular economy with wider well-being gains.** The circular economy not only has environmental and health benefits such as reducing the risk of resource depletion, lowering air pollution and curbing GHG emissions, it also can contribute to new employment opportunities and new business models for cities, regions, and rural areas. Policy makers need therefore to re-assess policy priorities and align the circular economy with objectives to generate wider well-being gains.
- **Move from waste to resources**: Waste definition, collection, and treatment are complex for public and private actors. New technologies allow more efficient recycling and transformation of waste, which cannot be reduced, into secondary material. However, first, strategic planning is needed for regions and cities to move from waste management to material strategies; second, a market for secondary products is still poorly developed.

- **Reinforce capacity**: Inside public administration and within companies, capacity should be built on the challenges and opportunities of the circular economy towards more sustainable production and consumption patterns. Educational campaigns can help build awareness among private households to reduce consumption, too. Managing transition and transition managers are needed.
- **Connect cities and rural regions with businesses**: there is a variety of circular economy business model applicable at the city and regional level. For this to happen, cities as well as local communities in rural areas should connect with companies, create collaborations, share data, boost digitalisation in sectors such as waste collection, shared mobility, food chains.
- **Support experimentation and networking**: Regions and cities are important places for the circular economy to emerge and unfold through experimentation and innovation. They can experiment with projects before they are rolled out more widely and test initiatives such as energy-efficient buildings, bike-sharing systems and behavioural change campaigns. Networks facilitate experimentation and help raise the level of ambition to learn from and compete with each other.
- **Strive for systematic change beyond experimentation**: Setting local targets for circular economy initiatives is useful for experimentation and for creating momentum. Mainstreaming circular economy initiatives requires however effective co-ordination with regional and national governments, strong investment decisions, and scaling-up of existing technologies and practices.
- **Increase the uptake of Green Public Procurement**: Green public procurement has huge potential in cities and rural regions to drive production and consumption of sustainable patterns. Regions and cities can lead by example by introducing circular economy principles in public tenders, from mobility to food to furniture.
- **Improve data and metrics**: international organisations and institutions should support regions and cities in measuring their level of circularity to improve where need be. Most of the framework indicators are related to the waste sector. However, the complexity of the circular economy as a system should take into account environmental, social and economic dimensions.

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Note

[1] Within the OECD programme on the circular economy in cities and regions, a survey has been carried out between April and June 2019 among 31 cities and 3 regions located in Europe (26) Americas (5), Oceania (2) and Asia (1) The survey aimed at gathering data and information on current practices of the circular economy in cities and regions, main implementation tools (including regulatory frameworks and economic instruments), as well as obstacles and good practices available to date. Update results, collecting data form 50+ cities and regions will be available in the OECD report on the Circular Economy in Cities and Regions (OECD, 2020[4]).

4 Managing environmental and energy transitions in cities

This chapter discusses the role of cities in managing environmental and energy transitions. It argues that cities are important places for environmental and energy transitions to emerge and unfold. City governments can enable the transition with urban planning, housing and transport policies as well as circular economy initiatives and by providing financial, technical, and administrative support. While existing experimentation and innovation with local transition projects remains useful, effective co-ordination with regional and national governments, strong investment decisions, and scaling-up and deployment of innovative technologies and practices is needed.

In Brief

Cities commitments to reaching a climate-neutral and circular economy are rising, their ability to implement action remains however unequal across cities

- **Cities are contributing to and can mitigate environmental pressures such as climate change and the sustainable use of natural resources**. Cities are responsible today for 70% of consumption-based energy-related CO2 emissions, and about around two-thirds of global energy demand. More than half of the world population (54%) lives in metropolitan areas, which contain cities and their commuting zones. Between 2015-2050, city populations are projected to grow by 50%, creating further pressures but also opportunities for more efficient resource use. Cities produce 50% of global waste and it is estimated that by 2050, global levels of municipal solid waste will double.
- Cities are important places for environmental and energy transitions to emerge and unfold because of their **large contribution to emissions in critical infrastructure such as energy, water, waste and transport**. In addition, the potential for local wellbeing benefits from climate policy is large for cities, notably through less air pollution and congestion.
- **Cities matter for the circular economy**. Cities are global hubs of production and consumption and this pattern will increase with urbanisation. In high-income countries, the emissions and materials footprint of consumption is likely to exceed locally generated emissions and material use. Transforming urban consumption and production would reduce emissions and the environmental impact of materials use substantially. Cities can apply different approaches and use various policy instruments to support the circular economy.
- **Cities present several advantages for managing environmental and energy transitions in terms of governance, stakeholder relationships, and institutional support mechanisms**. However, environmental and energy transitions hold challenges for cities: Cities have over decades locked in a pattern of energy-, building- and transport-related carbon emissions that needs to be undone. Citizen and stakeholder engagement does not mean that urban initiatives are consensual and conflict-free. Lessons from individual initiatives often remain with local participants if dedicated learning and sharing are not stimulated.
- **City size is a critical factor as larger cities often benefit from conditions, which facilitate innovation and deployment**. Disparities can be reduced by making more resources available for the aggregation and circulation of knowledge. Learning is also a central mechanism in supporting the diffusion and up scaling of urban sustainability initiatives.
- A **just transition approach in cities** involves an explicit focus on how a policy could be used to benefit the poorest persons and take measures to address existing and potentially worsening economic inequalities. Well-designed just transition strategies ensure local employment benefits for disadvantaged areas and population groups. Just transition strategies in cities need to consider who may be negatively impacted by a given policy as well as why and how this happens.

Introduction

Cities, confronted with challenges such as climate change and the sustainable use of natural resources, are increasingly at the centre of the debate and action related to environmental and energy transitions. Reaching the objective of the Paris Agreement to limit global warming to well below 2 °C above pre-industrial levels and to pursue efforts to limit the increase to 1.5 °C requires transformative and co-ordinated action by all levels of government. The important role of cities in sustainability transitions is also mentioned in the Sustainable Development Goal 11. It aims to "make cities inclusive, safe, resilient and sustainable". The United Nations has adopted a 'New Urban Agenda' (United Nations, 2016[1]). In the European Union, the 2016 Pact of Amsterdam created the Urban Agenda implemented through a new multi-level governance working method to address societal challenges in cities and better include the urban dimension in policies at various levels (European Union, 2016[2]). The EU's European Green Deal makes explicit reference to cities to reach the EU's climate-neutral and circular transition objectives.

Cities are contributing to and can mitigate environmental pressures such as climate change and the sustainable use of natural resources. More than half of the world population (54%) lives in metropolitan areas, which contain cities and their commuting zones (OECD/European Commission, 2020[3]). Between 2015-2050, city populations are projected to grow by 50%, creating further pressures but also opportunities for more efficient resource use. Cities are responsible today for 70% of consumption-based (see also Box 4.1 on consumption-based vs. production-based city emissions) energy-related CO2 emissions, and about around two-thirds of global energy demand (IEA, 2016[4])They are major innovation hubs, provide great opportunities for learning and networks and offer the possibility of achieving whole system transformation at local scale. On the path towards 2050, when many countries aim at reaching net-zero greenhouse gas emissions, cities will play a key role in transforming their building stock, mobility systems, enterprises and industries, and urban infrastructure. This will require significant investments, but could also lead to many positive impacts, in addition to urban sustainability. These include business opportunities locally, better well-being, including substantial health benefits, accessibility, improved public services, and increased growth for all.

Box 4.1. Consumption-based greenhouse gas emissions in cities

Consumption-based GHG emissions in cities are often substantially higher than production-based emissions. In Bristol for example, (Millward-Hopkins et al., 2017[5])the city's consumption-based emissions are three times the production-based emissions, largely due to the impacts of imported food and drink. In other United Kingdom (UK) cities they may be twice as high (Sudmant et al., 2018[6]).

Consumption-based emissions inventories differ from the territorial (or "sector-based") approach typically used to calculate urban GHG emissions, because they include emissions generated outside city borders to produce goods and services for urban residents. Consumption-based emissions rise more strongly with city per capita income and population density than production-based emissions (Sudmant et al., 2018[6]). If income rises and density falls, local consumption gives rise to emissions outside a city's border, reinforcing the case for monitoring consumption-based emissions and making cities more compact.

Calculating consumption-based emissions provides additional opportunities for reducing emissions and supporting a more circular economy. This can help accelerate the transition, while requiring a lower level of investment. In Bristol, low-carbon investments of circa GBP 3 billion could reduce production-based emissions by 25% in 2035, equal to the mitigation achievable by eliminating the city's current levels of food waste at little cost (Millward-Hopkins et al., 2017[5]).

Urban transitions are critical to address the intertwined issues of climate change, biodiversity loss, and sustainable development. The circular economy is gaining momentum as a means to combat climate change and contribute to environmental sustainability by tackling waste as a resource. Yet, the potential and limitations of urban actions towards environmental and energy transitions have only recently received extensive and critical scrutiny. More work needs to be done on translating sustainability ambitions into concrete policies and actions for cities. This chapter, therefore, provides insights into why cities matter for sustainability transitions and explores how cities can manage environmental and energy transition in different domains such as urban planning, buildings, transport, and energy. The chapter draws from the OECD seminar series on "Managing environmental and energy transition for regions and cities", and in particular from the seminar entitled "Managing environmental and energy transitions in cities". The main theoretical frameworks and regional case studies were identified in or inspired by the following publications:

- Chapter 1 of this publication, "Managing Environmental and Energy Transitions: A Place-Based Approach".
- Bulkeley (2019), "Managing Environmental and Energy Transitions in Cities: State of the Art & Emerging Perspectives", Background Report for an OECD/EC Workshop Series on Environmental and Energy Transitions for Regions and Cities, OECD, Paris, 7 June 2019.
- Schultz (2019), "A New Global Research Agenda on Cities and Climate Change: Innovate4Cities", Background Report for an OECD/EC Workshop Series on Managing Environmental and Energy Transitions for Regions and Cities, OECD, Paris, 7 June 2019.

The role of cities in environmental and energy transitions

Cities are important places for sustainability transitions (see Chapter 1) to emerge and unfold because of their large contribution to emissions in critical infrastructure such as energy, water, waste and transport. In addition, the potential for local wellbeing benefits from climate policy is large for cities, notably through less air pollution and congestion as well as increasing green infrastructure (Chapter 2). At the same time, cities depend on national governments in important areas of climate and environmental change such as energy supply, transport, buildings and waste legislation. Such dependence on co-ordination across levels of government calls for an integrated approach towards environmental and energy transition (Matsumoto et al., 2019[7]). A large number of cities have made commitments to sustainability transitions, some of them with even more ambitious local targets and policies than European Union (EU) or national pledges (Box 4.2).

Box 4.2. Examples of city engagement with environmental and energy transitions

Many cities and regions around the world have set carbon emission and circular-economy targets, often more ambitious in scope and time horizon than their national equivalents. The following list provides some examples:

- Copenhagen (Denmark) aims to be the world's first carbon-neutral capital city by 2025. The population of Copenhagen is expected to grow by 20 % in the next decade. This opens an opportunity to combine infrastructural changes with green growth toward carbon neutrality in 2025. The Copenhagen climate plan 2025 is based on four pillars: energy use, energy production, mobility, and municipal initiatives. An evaluation of the implementation phase 2017-20 and preparations for the next implementation phase 2021-2025 are currently ongoing.
- The city of Adelaide (Australia) adopted its Carbon Neutral Strategy 2015-2025, which includes targets for the City of Adelaide to have zero net carbon emissions by 2025, and 50% renewables

by 2025. The Carbon Neutral Adelaide Action Plan 2016-2021 outlines that the City of Adelaide supports energy efficiency and the uptake of renewable energy technologies in public buildings. It also provides an incentive scheme for the uptake of sustainable energy and water technologies in households and firms. Vulnerable population groups can receive flexible finance arrangements for solar PV energy systems.

- The city of Amsterdam (Netherlands) aims to halve the use of new raw materials by 2030 and to achieve a fully circular city by 2050. The Amsterdam Circular Strategy 2020-2025 focuses on three core value chains: 1) food and organic waste streams; 2) consumer goods; and 3) the built environment. The first Circular Economy Monitor for Amsterdam, carried out in 2018), concludes that a lack of data prevents some important insights into the transition to a circular economy and recommends collecting more data and building universal indicators to measure progress towards circularity.
- Oslo (Norway), Los Angeles (United States), Stockholm (Sweden), Beijing [China (People's Republic of)], London (United Kingdom), and the San Francisco Bay Area (United States) have announced their ambitions to become electric vehicle capitals or leaders. London, for example, has the target of 70 000 ultra-low emission vehicles sold by 2020; and 250 000 by 2025, Los Angeles aim to electrify 10% of vehicle stock by 2025 and 25% by 2035.

Sources: https://www.carbonneutraladelaide.com.au/; https://www.amsterdam.nl/en/policy/sustainability/circular-economy/; https://theicct.org/sites/default/files/publications/World-EV-capitals_ICCT-Briefing_08112017_vF.pdf.

The contribution of cities to environmental and energy transitions

Cities present several advantages for managing environmental and energy transitions in terms of governance, stakeholder relationships, and institutional support mechanisms.

First, cities are important places for environmental and energy transitions to emerge and unfold through urban experimentation and innovation (Frantzeskaki et al., 2017[8]). One case in point is the proliferation of Urban Living Labs (ULL), which are urban sites devised to design, test and learn from social and technical innovation in real-time (Marvin et al., 2018[9]). Cities can also experiment with projects before they are rolled out more widely in other cities. For example, the Parisian bike-sharing Vélib started with about 7 000 bikes and gradually expanded to over 20 000 bikes in the city and suburbs (DeMaio, 2009[10]) as well as to other cities.

Second, city agglomerations provide a favourable context for social and technological innovations because they are associated with connectivity, creativity, and innovation. Since cities are in close contact with users, citizens and local businesses, they are in a better position to influence consumer and producer behaviour and to provide opportunities for these groups to engage in the implementation, learning and adjustment. Comparative research on the four cities Budapest, Genk, Stockholm and Dresden has found that multi-stakeholder spaces help cities make sense of urban sustainability transitions and examine how innovative urban solutions help foster the transition (Frantzeskaki and Rok, 2018[11]).

Third, cities have significant procurement powers in areas such as public real estate, school buildings, land allocation tenders. Cities can use public procurement to encourage the circular economy, for example by subjecting land allocation tenders to circular criteria. They can also opt for re-used or re-usable products and develop recycling streams, for example for electronics or office furniture. The Amsterdam Metropolitan Area, for example, has set a target of 50% circular procurement by 2025 (Amsterdam Smart City, n.d.[12]) The Circular Economy partnership of the Urban Agenda for the EU recognises public procurement at city level as an important policy lever to foster the circular economy.

Fourth, cities can support social innovation and local grassroots initiatives. They can provide institutional support, such as political commitment and risk reduction and access to unused urban space. Some cities are actively supporting sustainable heating (e.g. renewable energy in district heating), transport programmes (e.g. through providing charging points for electric vehicles) and green infrastructure (e.g. green roofs, urban trees). Other cities are supporting more sustainable food systems, for example, the marketing of healthier food, produced locally and with less pollution (Ellen MacArthur Foundation, 2019[13]) or to support urban farming and gardening (Gernert, El Bilali and Strassner, 2018[14]).

Challenges for environmental and energy transitions

While environmental and energy transition comes with numerous opportunities, it also holds challenges:

- **New investment needs to avoid lock-ins**. Cities have over decades locked in a pattern of energy-, building- and transport-related carbon emissions that needs to be undone. The long service life of buildings, transport systems and other infrastructure means delays result in higher costs, as new investment that is inconsistent with energy and environment transition targets will need replacement for the end of its economically useful life.
- **Cities are complex**. Environmental and energy transitions require coherence across all policy domains and sectoral and administrative boundaries. Strategies have to be congruent with a wider set of objectives. Doing may offer important benefits beyond climate, for health and economic performance. However, negative impacts on vulnerable populations also need to be minimised.
- **Transition can lead to conflict**. Citizen and stakeholder engagement does not mean that urban initiatives are consensual and conflict-free. A recent study of two projects in Copenhagen revealed that contestation and conflicting interests, can lead to failure and abandonment (Madsen and Hansen, 2019[15]). In addition, transforming urban infrastructure in order to promote renewable energy development and a more circular economy, for example by installing PV cells on rooftops, often leads to refusal on aesthetic grounds. The identification and handling of conflicts should therefore be an important dimension of managing environmental and energy transition in cities. They do not imply abandoning transition projects, but anticipating conflicting interests.
- **The state of understanding of local well-being gains is still inadequate.** Urban and regional policy makers have an interest in supporting well-being gains from environmental and energy transition on health and productivity because they often accumulate in regions and cities taking action. There is, however, a lack of knowledge on how to account for well-being gains and how to emphasise them in policy.
- **Lack of knowledge sharing.** Lessons from individual initiatives often remain with local participants if dedicated learning and sharing are not stimulated. Cities need to compare experiences and circulate and aggregate best practices. Learning should lead to portfolios of best practices that take account of structural, cultural and geographical differences across cities.

Strengthening co-ordination between cities, neighbouring jurisdictions and other levels of government

Subnational governments often depend on some form of external support from higher levels of government. Central governments can for example earmark subnational funds for environmental and energy projects and provide leadership on climate policy. At the EU level, a number of funding mechanisms are available to support urban environmental and energy transitions. One important instrument is the European Union's Cohesion policy, which supports integrated urban development strategies.

Cities have numerous functional relationships with their urban hinterland, particularly with regard to energy, mobility and food systems. Cities are interdependent in designing, implementing environmental, and energy transitions. New forms of administrative co-operation and multilevel

governance are important. Functional Urban Areas (FUAs) reflect this relationship by encompassing the economic and functional extent of cities based on daily people's movements (Dijkstra, Poelman and Veneri, 2019[16]). FUAs often constitute an appropriate level of intervention for many challenges, including through Cohesion policy funding for sustainable urban development.

Multilevel governance presents a challenge for managing environmental and energy transition because of the complexity of transition and the large number of actors involved. Policy actions at different levels of government need to reinforce each other, for example, linking local government agendas to EU and national-level targets, without preventing them from going further. In some instances, national-level action can hinder the spread of local initiatives by withdrawing funding or blocking progress (OECD, 2019[17]). A useful starting point to make complex policy schemes more coherent involves mapping responsible actors for various policy decisions and potential inconsistencies between policies at different governance levels.

National and regional scientific climate or environmental sustainability policy advisory committees can help with co-ordination. Examples are such as the Finnish climate change panel, the Environment and Nature Council of Flanders, and the German Advisory Council on the Environment. They aim to provide policy makers and authorities with independent expert advice. To various degrees, they are integrated with relevant actors, typically at the national or regional level, to align policy with scientific evidence. For example, in the United Kingdom, the 2008 Climate Act established the Committee on Climate Change, which provides independent advice to the government on setting and meeting greenhouse gas (GHG) emission targets. It also reports on progress to parliament and makes its assessments public. Providing an integrated approach to environmental and energy transitions would require including cities and their policies in higher-level climate policy frameworks.

Instruments and tools to manage environmental and energy transitions for cities

Cities can have significant influence in urban and land use planning, transport, buildings, and waste management. Importantly, the environmental and energy transition is not only meant to address the carbon intensity of urban systems, but also extends to consumption patterns (e.g. food production and sharing), sustainable living, urban water security, climate resilience and biodiversity. The main policy instruments used by local governments can be broken down into four key categories:

- *Direct investment and procurement*, which include environment-friendly purchases and direct investments in related technologies and materials by city governments, as well as municipal support for investment in environmentally friendly infrastructure in urban areas.
- *Enabling policies*, which can help to improve the environment in which citizens and businesses operate and support social and grassroots innovations. This can mean to facilitate the emergence of new business models such as solar leasing, where you enter in an agreement with a solar leasing company that owns and maintains your solar panel system and entitles you to the benefits of the system (i.e., the energy that the solar panels generate) for the term of the contract. It can also refer to community projects such as urban farming or ride-sharing. Cities can also enact policies to reduce administrative and regulatory barriers to investment.
- *Mandates and obligations*, such as in waste management or building codes, which can be stricter than national-level regulations. A growing number of cities around the world are using mandates and building codes for both new and existing building stock to support environmental and energy transition.
- *Fiscal and financial incentives*, which include grants and tax exemptions to encourage specific behaviours (as well as fees and levies to discourage) and investment choices in cities that have at least some control over taxation. Different policies ideally reinforce each other and therefore have a higher impact together than without each other or cost less to achieve the same impact. The following section will provide examples of policies and instruments in different domains.

Urban design and spatial planning

Good urban design enables access to jobs and facilities in a way that is consistent with the objective of zero net emissions and circular economy principles while fostering urban economic development. Climate-neutral and circular mobility systems as well as building sectors make use of co-location of employment, mixed-building use residential and commercial densification, and the supply of mobility options, including non-motorised mobility. For instance, walkable, mixed neighbourhoods with close proximity of employment and commercial options improve connectivity and accessibility, while saving on energy and material intensive mobility. They also save space that is otherwise needed to store vehicles and other goods.

Climate-neutral and circular urban strategy development and implementation requires a strong regional and sub-regional urban planning framework. Spatial planning occurs at multiple geographic scales: (i) regions and metropolitan areas; (ii) sub-regions, districts, and corridors; and (iii) neighbourhoods, streets and blocks. All three scales of spatial planning strategies rely on multiple policy instruments and levers. Some instruments intervene in markets, aimed at correcting market failures such as negative externalities through government regulations (e.g. land regulation) or government incentives (e.g. targeted biking and walking infrastructure). Others work with markets, aimed at shaping behaviours through price signals (e.g. congestion charges) or public-private partnerships. Policy mixes to support sustainable land-use and transportation need to be adapted to the unique political, institutional, and cultural landscape of the cities in which they are applied. Successful implementation requires institutional capacity and political willingness to align the right policy instruments to specific spatial planning strategies. It also requires strategic investment in transport, energy, water and waste infrastructure (Seto K.C. and D.B. Müller, 2014[18]).

In addition to urban design, mitigating heat islands and developing green infrastructure are also important policies for cities and regions to achieve environmental and energy transition. Heat islands can cause surface temperature differences between built-up and tree-covered urban surfaces of as high as 30 degrees Celsius. In order to mitigate urban heat islands, cities can

- promote green infrastructure, especially trees with foliage that actively cool through evapotranspiration and serve as shading for paved and other isolated man-made urban surfaces
- “cool” surfaces for all man-made isolated surfaces in urban neighbourhoods with higher infrastructure densities
- discourage mechanical cooling in high-density neighbourhoods and encourage passive cooling techniques in order to avoid the burdening of such neighbourhoods with further heat loads by the waste heat of air conditioning
- ensure that the built urban infrastructure allows for air movements that can reduce local warming through urban heat islands.

Improving energy efficiency in buildings

The building sector is not on track when it comes to reducing emissions and neither for going circular. The buildings and construction sector accounted for 36% of final energy use and 39% of energy and process-related carbon dioxide (CO2) emissions across the world in 2018, 11% of which resulted from manufacturing building materials and products (IEA, 2019[19]). Buildings in urban areas account for over half of a total city’s emissions on average (C40, 2015[20]). To meet the goals of the Paris Climate Agreement, which aims to limit global temperature rise to 1.5 degrees Celsius, the built environment’s energy intensity—a measure of how much energy buildings use—will have to improve by 30% by 2030 (UN Environment and International Energy Agency, 2017[21]). Yet, the sector is off track regarding the level of investment and action necessary towards a zero-emission, energy-efficient and circular building sector. On the contrary, $_{\text{final}}$ energy demand in buildings has risen (IEA, 2019[19]).

Retrofits and deep renovations will be a crucial part of decarbonisation: up to 85% of existing buildings in the EU will still be in use in 2050 (BPIE, 2018[22]) **and not even 1% of buildings are net-zero** carbon today (World Resources Institute, 2019[23]). The main challenge for policy in high-income countries therefore is the decarbonisation of existing building stock. Deep retrofits (here defined as achieving close to the Passivhaus level of energy performance without counting building-integrated energy production, i.e. the use of up to 15kWh/m2/yr for heating and cooling) are extremely rare still, and the majority of building retrofits do not save more than 20 – 40% energy (Ürge-Vorsatz, Boza-Kiss and Chatterjee, 2019[24]).

Sustainable building designs and construction concepts such as passive houses, and net-zero or energy plus buildings are available, but remain underused. A "passive house" sets a standard of efficiency for space heating and cooling, saving 70 – 95% of thermal energy demand. A net-zero carbon building produces as much power as it consumes over the year and it uses power from renewable sources on site or nearby. The IPCC Fifth Assessment Report in 2014 shows the feasibility of retrofits to passive house levels. Passive house levels are still extremely rare, mostly demonstration projects or heavily subsided (Ürge-Vorsatz, Boza-Kiss and Chatterjee, 2019[24]).

Recent analysis shows that a pathway consistent with limiting global warming to 1.5°C requires deep renovation rates of 5% in OECD countries per year. This stands in stark contrast to existing renovation efforts in the EU and other developed regions. Retrofits also need to be deep enough to be zero carbon consistent. Making all new buildings zero-carbon consistently saves costs (Climate Action Tracker, 2016[25]).

Energy-efficient buildings do not only mitigate GHG emissions and foster the circular economy; they also provide several wider benefits such as health benefits, productivity benefits, and local employment generation. Recent estimates point out that in Europe, on average 4.5 sick days/person per annum can be avoided with deep retrofits, to reach passive house level as defined above (Chatterjee and Ürge-Vorsatz, 2018[26]). Workers in energy-efficient buildings are 1-16% more productive, due to an improved working environment and lower rates of illness. In addition, by investing in upgrading existing buildings and raising the energy efficiency of new buildings in OECD cities, 2 million net jobs could be generated annually in the period to 2050. The same amount of investments in non-OECD cities could result in creating between 2-16 million net jobs annually in the same period (Gouldson et al., 2018[27]).

City policies in many OECD and EU countries support green building transitions by introducing or improving building codes, subsidy schemes, or other incentives at various government levels. An increasing number of cities adopt energy-efficiency approaches in the built environment. The City of New York is an example of a place that has taken action to support retrofitting of existing buildings (Box 4.3).

Box 4.3. The Climate Mobilisation Act of New York City

New York City has passed its Climate Mobilization Act in April 2019, requiring buildings above 25 000 ft2 to reduce their emissions by 40% by 2030 as compared to 2005 levels, and by 80% by 2050. The city requires buildings larger than 25 000 square feet (applies to 50 000 buildings across New York City) to meet greenhouse gas emissions caps, beginning in 2024. This bill is the first to require buildings to cap their emissions. New York has already been mandating the disclosure of energy demand of its buildings over 10 000 ft2.

The Climate Mobilization Act is expected to reduce New York City's overall emissions by 10% by 2030, to eliminate 6 million tons of greenhouse gas emissions by 2030, to create 26 700 green jobs by 2030 and to prevent 50 to 130 premature deaths annually by 2030.

In order to help building owners comply with the Climate Mobilisation Act, the City has introduced the "Retrofit Accelerator". It offers free, personalised advisory services to identify energy-saving opportunities The adoption of the Climate Mobilisation Act is also interesting because it is a regulation-based instrument instead of a market incentive. While carbon pricing could have been adopted (and in fact there will be limited trading for compliance flexibility under the law), the judgement appears to be that presenting building owners with a clear regulatory limit and timeframe will be more effective than a price on carbon emissions (or a price on fossil energy use).

Source: New York City (2020[28]), New York City Climate Mobilization Act, http://on.nyc.gov/benchmarkingmap (accessed on 25 March 2020).

Progress is insufficient. A diverse set of barriers can hold back sustainable building construction. These include, but are not limited to, misplaced incentives, a lack of awareness and information, long payback times, and fragmented market structures. The main barriers can be summarised as follows:

- **Risk of lock-in into shallow retrofits**: Many cities in OECD countries have instruments and policies in place to promote energy-efficient retrofits. However, a high number of building renovations results in modest energy savings, resulting in "shallow retrofits". While these only save 20 – 30% heating energy, best practice retrofits can save 80-90% of heating energy and even 100% or higher savings are possible. The difference between the two, i.e. the 50 – 80% energy saving potential remains locked in. Once a building envelope is built or retrofitted, it is extremely expensive, or sometimes even physically impossible, to revisit it and capture this remaining locked-in potential for several decades. Avoiding such shallow retrofits requires a clear policy for deep whole-of-building retrofits. Cities and regions can promote deep retrofits by suggesting step-by-step retrofits that allow for smaller steps, which are sequenced to arrive at deep retrofits cost-effectively. One-stop-shops in cities providing information and taking care of necessary arrangements can greatly reduce transaction costs and complexity of deep retrofits (Ürge-Vorsatz, Boza-Kiss and Chatterjee, 2019[29]).
- **Change in business models**: The dominant energy business model is still based on selling and purchasing electricity and heat. Alternative business models can provide smart energy management. Enabled by increased digitalisation and servitisation, new business models can offer building maintenance with energy efficiency improvements at the core, integrating the provision of new technology through energy services and the use of data to improve energy management (Brown, Sorrell and Kivimaa, 2019[30]). Cities and regions can help district heating related companies in the transition towards lower energy buildings, for example by incentivising them to take a new role in the provision of deep retrofits.
- **High upfront costs for private households and investors**: Governments will need to provide targeted support to households with low income and wealth and address credit constraints.

Mobilising private sector financing to finance small-scale projects is possible, but often imply high transaction costs for institutional investors (see also Chapter 5 on financing). An innovative business model has emerged with the Dutch initiative Energieprong: a mix of funding from national and EU sources as well as local authorities and industry partners has supported the creation of a market for net-zero energy homes. Renovations were carried out by an intermediary organisation and financed through loans taken by the housing associations with the objective to renovate overall 111 000 housing association properties. It was agreed that individual households would pay higher rent to the housing association to enable them to pay back the loan. The amount of additional rent equals what they would have paid in higher energy bills without the renovation, resulting therefore in gross rent-neutral retrofits (Brown, Kivimaa and Sorrell, 2018[31]).

- **Lack of adequate information and fragmented market structures**: Although the private benefits of deep energy efficiency typically pay for investment over time through saved fuel costs and better indoor ambient quality, widespread market failures such as long pay-back periods, split landlord-tenant incentives and incomplete information may hold homeowners and investors back. Individual cities could accelerate the enforcement of building codes for those most in need (commercial or residential) through public funding or subsidised loans. This may well deliver the biggest gains in energy efficiency and be inclusive, as housing inhabited by low-income households may be relatively poorly insulated. Box 4.4 provides two examples of financing deep refurbishment schemes from Innsbruck and Bolzano. These deep refurbishing schemes do not only save costs but help inclusivity by providing improved health, thermal comfort, living conditions and productivity of residents, especially for residents of relatively lower socio-economic standing.

Box 4.4. The EU SINFONIA project in Innsbruck and Bolzano

The Smart Initiative of cities project (SINFONIA) supports deep refurbishment initiatives. The project deploys large-scale, integrated and scalable energy solutions in mid-sized European cities such as the city of Innsbruck, Austria, and the city of Bolzano, Italy. The main objective of this project is to achieve at least 40% to 50% primary energy savings and increase the share of renewables at least by 20% in these two cities. Energy savings and increases in the share of renewables can be achieved by implementing several measures, such as deep retrofitting of more than 100 000m² of living surface, optimisation of the electricity grid, and solutions for district heating and cooling.

Under this project, the city of Innsbruck, Austria, has provided support for all new social housing to meet at least passivhaus standards. The city subsidises the extra cost that such a construction entails, and the lower utility costs benefit the poor occupying these buildings. In addition, the city supports energy upgrades only if they meet the requirements of systematic deep retrofits. Even where full deep retrofits are not available, for example through a lack of finance, the partial retrofits need to enable – rather than lockout - the systemic, deep retrofit at a later stage. For instance, windows need to be replaced in a way that complies with passivhaus standards. Similar to Innsbruck, the city of Bolzano has developed an ambitious investment plan to implement large-scale deep refurbishments within the city. This refurbishment initiative takes place in collaboration with both public and private investment. The investment plan also includes the city's infrastructural development of renewable energy generation process. The goal of this initiative is to achieve 40% to 50% primary energy savings and to increase the share of renewables in the district of Bolzano South West by 20%.

Source: http://www.sinfonia-smartcities.eu/en/.

Local assessments need to determine what type and extent of retrofit acceleration makes sense in a given area based on local characteristics and policy goals (Ürge-Vorsatz, Boza-Kiss and Chatterjee, 2019[24]). For example, it needs to be carefully assessed whether still functioning building components should be put out of use rather than refurbished to reach a good compromise for reaching climate neutrality and circularity targets. All cities can accelerate the adoption of passive house buildings through clear policy ambitions such as:

- **City role model function**: Cities play an important role model for achieving energy efficiency targets in buildings. The city of Vancouver, for example, has renovated public buildings in accordance with passive house standards, thereby providing private developers with a blueprint. In addition, removal of regulatory barriers, city staff training, incentives, leader dialogues, and tours and trainings provided by city partner organisations have led to a rise in voluntary adoption of passive house certified buildings (NAPHN, 2019[32]).
- **Support for front-runners and knowledge dissemination**: Front-runners need support during initial phases of development to overcome barriers that arise for the first time. This can entail financial support and the provision of technical expertise. For example, the New York State Energy Research and Development Authority (NYSERDA) initiated a subsidised training and development program to promote skills and services related to improving building energy efficiency. The training program has generated a significant momentum to help drive early passive house adoption in New York City (NAPHN, 2019[32]).

Addressing environmental and energy transition in the building sector is not just a matter of energy efficiency. It also depends on changes in existing construction practices and business models. This is also where transportation comes into play as the "what and where of construction". Avoiding urban sprawl and fostering dense buildings also saves energy as well as infrastructure material needs and costs, and building amenities such as on-site bike storage integrates policy response across domains. Several institutions have published guidebooks to help regions and cities re-use space and buildings, as for example the sustainable and circular re-use of spaces and buildings guidebook from the Urban Agenda (Urban Agenda, 2019[33]).

Sustainable urban mobility

An increasing share of CO2 emissions is associated with road transport in and around cities, driven by urbanisation, population growth and rising incomes in middle-income countries. Transport emits around 23% of energy-related CO2 emissions, mostly road transport. Around half of passenger transport takes place in urban areas and urban transport accounts estimated 40% of transport energy use (IEA, 2016[4]) . It is the sector with the highest growth rate of GHGs (ITF, 2019[34]). Without immediate action, its share could reach 40% by 2030, as demand for transport may continue to grow.

Transport systems often present problems for environment and health, including climate change, local air pollution, noise and accidents (EEA, 2019[35]). Congestion and land used with transport infrastructure raise economic costs and threaten biodiversity (Goodwin, 2004[36]). There are also several notable social problems associated with transport, as congestion and sprawl reduce access to basic services in some regions (Marozzi and Bolzan, 2018[37]). However, transport is crucial for economic competitiveness as well as for commercial and cultural exchanges (Mullen and Marsden, 2015[38]). Furthermore, the automotive industry is among the largest manufacturing sector in the world and is one of the major generators of wealth and employment in the EU (European Commission, 2020[39]).

The problem for society – and policy – is therefore how to retain the social and economic benefits associated with accessibility and connectivity while reducing the negative environmental, economic and social impacts from transport. Meeting the demand for access to jobs and facilities while minimising environmental and public health impacts will require finding solutions that reduce greenhouse gas emissions, congestion, local air pollution, and improve energy efficiency. Steps to meet these needs

with fewer vehicle kilometres will be particularly effective in reducing all of these impacts at the same time. By reducing the material input required in energy infrastructure and vehicle construction, they also advance the circular economy agenda.

Urban policy solutions to tackle these persistent problems have focused on improving technologies and (to some extent) encouraging modal shift. These have done little to address the growth in mobility and emissions. A transition with radical systemic innovation in road transport is therefore necessary (Frantzeskaki et al., 2017[8]). Such a transition will require both technological and institutional changes (e.g., electric vehicles, customised mobility, teleworking, zoning policies).

Cities and their hinterlands play a crucial role in supporting sustainable mobility systems. Cities need to support urban mobility in several ways:

- **Active mobility, such as walking, cycling and public transport provide green mobility options and have multiple implications for health by changing the exposure to certain health** determinants like physical activity, traffic incidents, air pollution, and noise. Public transport is an essential component of any sustainable urban transport system. Walking and cycling can make a considerable contribution to sustainable transport goals, building healthier and more sustainable communities and contributing to traffic and pollution reduction. Research indicates that the reach of the existing public transport system can be extended significantly simply by making walking to and from hubs and stops easier, less prone to barriers and more pleasant by creating attractive urban spaces that are well connected to public transport infrastructure (EEA, 2019[35]). Cycling is another transformative option. Various cities in Europe have shown commuting by bicycle can become the dominant mode of transport to and from work. Policymakers should encourage modal shifts towards cycling and walking, including through infrastructures such as mixed-zone developments. However, realising this potential requires an in-depth understanding of the different options, their strengths and weaknesses, and how they affect the mobility system as a whole.
- **Shared mobility solutions, such as digital-based ride-sharing, can lower CO2 emissions sharply**. They also deliver substantial reductions of congestion, while improving connectivity and accessibility, provided they replace individual car use. It improves connectivity and accessibility especially for low-income households, who are often less well connected to public transport. In such ride-sharing models, individual private car rides, ideally all rides in an entire metropolitan area are replaced by rides in shared taxis or minibuses. These services are modelled to be available on-demand, at the doorstep or the next street corner. Supply and demand of on-demand services are co-ordinated by a digital platform, which optimises routing (Box 4.5).

Box 4.5. Shared mobility solutions for cities: digital-based ride sharing

Recent modelling for the metropolitan area Dublin, Ireland, based on its daily mobility patterns, suggests that the number of vehicles, traffic, CO2 emissions and congestion would be reduced by up to 98%, 38%, 31%, and 37% respectively. Broadly similar results have been obtained for other cities, such as Lyon, Auckland, Helsinki and Lisbon. Ride-sharing could also reduce the delivery cost of public transport. Further benefits would include substantially lower pollution and freeing up space occupied by parked cars. Emission reductions are larger if the shared electric vehicle fleet is electric.

The modelling results suggest that shared rides could be cheaper to provide than what users pay for bus and taxi rides and would not require subsidy. Shared rides could substitute inefficient bus lines and provide feeder service to rail. Survey results from recent modelling for Lyon suggests that most citizens are willing to use shared modes for direct trips or to access high capacity public transport. The majority of current public transport users are willing to pay a higher ticket price for the new service and most car users expect shared mobility fares to be lower than the current cost of using a private car.

Survey results suggest that 20% of car drivers would be willing to switch to shared rides, although this share could be substantially higher if more information about the ride-sharing system or incentives to switch are provided. If only 20% of private car trips were replaced with shared modes, shared services could still be provided at a cost sufficiently low to ensure uptake. Traffic would fall 23%, emissions by 22% and congestion by 7%.

Electric vehicle fleets can be used in more densely populated sub-regions where they can cover more trips within their available range. Relying on on-demand ride-sharing also reduces the cost of electrifying transport. By reducing the number of vehicles and using them more intensively, ride-sharing would take advantage of the lower operating costs of electric vehicles, while limiting electricity demand and related infrastructure needs. At the same time, more intensive vehicle use results in more frequent renewal and therefore quicker technology diffusion. However, since ride-sharing would improve connectivity and reduce mobility costs for many, its widespread use could encourage sprawl. It, therefore, needs to be accompanied by appropriate pricing and urban planning.

Source: ITF (2020[40]), "Shared Mobility Simulations for Lyon", International Transport Forum Policy Papers, No. 74, OECD Publishing, Paris, https://dx.doi.org/10.1787/031951c3-en; ITF (2018[41]), "Shared Mobility Simulations for Dublin", International Transport Forum Policy Papers, No. 58, OECD Publishing, Paris, https://dx.doi.org/10.1787/e7b26d59-en.

- **Another potential strategy for sustainable urban mobility is the electrification of car use and investment in related infrastructure**. Electric car deployment has grown rapidly over the past ten years, with the global stock of electric passenger cars passing 5 million in 2018, an increase of 63% from the previous year. While the majority of electric cars on the road in 2018 were in People's Republic of China (hereafter 'China') with 45%, Europe accounted for 24% of the global fleet, and the United States for 22% (IEA, 2019[42]). Many cities support the widespread uptake of electric vehicles. Some cities also have announced specific goals for electric vehicles, as shown in Table 4.1.

Table 4.1. Electric vehicle goals announced by selected major cities

City	Target
Amsterdam (NL)	Zero-emissions transport within the city by 2025
London (UK)	70 000 ultra-low emission vehicles sold by 2020; 250 000 by 2025
Los Angeles (US)	10% of vehicle stock electric by 2025; 25% electric by 2035
New York City (US)	20% electric vehicle sales share by 2025
Oslo (NO)	Zero-emissions transport within the city by 2030
Shenzen (CN)	120 000 new energy vehicles sold by 2020
Tianjin (CN)	30 000 new energy vehicles sold by 2020

Source: Hall, D., H. Cui and N. Lutsey (2017[43]), *Electric vehicle capitals of the world: What markets are leading the transition to electric?*, The International Council of Clean Transportation, http://www.theicct.org/EV-capitals-of-the-world (accessed on 22 May 2020).

Little is known if and how local policies and or strategies affect EV usage and its supporting infrastructure (Roelich et al., 2015[44]) and some studies even consider cities efforts as paying "lip-service mentioning EVs in their climate change mitigation strategies" (Heidrich et al., 2017[45]). Cities need therefore to encourage the uptake of EVs more actively and to improve the infrastructure required for the use of EV. One successful policy has been to invest in public charging infrastructure, which is highly visible and easily accessible for drivers. Cities in the Netherlands (Amsterdam, Rotterdam-Utrecht, Norway (Oslo) and China (Beijing, Shanghai) have the highest concentration of public charging points (Hall, Cui and Lutsey, 2017[43]). The need for public charging varies based on housing stock, private charging availability, and commuting patterns. Electrification of car use will need to come with the adoption of car use charges in order to complement falling fuel taxation (Atkinson, 2019[46]). This will also lower excess driving demand and shift mobility to other modes of transport, reducing overall CO2 emissions (OECD/ITF, 2019[47]). Cities will have an important role to play in setting car use charges.

The development of location-based connectivity and accessibility indicators for all residential areas helps to guide cost-effective investment decisions. It ensures that people are easily able to reach jobs or every-day public services with sustainable transport modes, such as walking, cycling or public transport. This can include, for example, steps to make pedestrian and cycling access to public transport hubs quicker and safer. Transport-oriented development requires integrated accessibility and connectivity for commercial and residential development (OECD, 2019[48]).

Moving towards a circular economy

Cities matter for the circular economy. Cities are global hubs of production and consumption and this pattern will increase with urbanisation. In high-income countries, the emissions and materials footprint of consumption is likely to exceed locally generated emissions and material use. Driven by rapid urbanisation and growing populations, the world is expected to generate 3.40 billion tons of waste annually by 2050, increasing drastically from today's 2.01 billion tons (Kaza et al., 2018[49]). High-income countries - although they only account for 16% of the world's population – are generating more than one-third (34%) of the world's waste. Continuing on a business as usual trajectory, the consumption and production habits of urban citizens alone put a significant strain on ambitious environmental and energy transition. Transforming urban consumption and production would reduce emissions and the environmental impact of materials use substantially. The City of Lahti in Finland is an example of a mid-sized city that has managed to become environmental-friendly and aims to curb over-consumption (Box 4.6).

Box 4.6. The environmental city of Lahti, Finland

The city of Lahti in Finland with a population of 120 000 inhabitants about 100 km north of Helsinki has set targets of being carbon neutral by 2025 and a zero-waste city and curbing over-consumption by 2040. Lahti has a strong tradition of environmental research and pioneering sustainable development. Starting in the mid-1970s, Lake Vesijärvi has become a famous freshwater restoration project. During the 90s, Lahti experienced great progress in recycling and created a special regional waste sorting and treatment culture. Today, the circular economy has become a specific focal theme in the Lahti Region.

In 2019, the city was the first to launch a carbon trade programme for citizens' personal carbon emissions. The share of sustainable urban mobility in Lahti was 51% in 2012 (buses, walking, cycling), compared to 49% private vehicles. Municipal solid waste is recycled to 50% (up from 25% in 2007), landfilled (3%) and used for energy recovery (47%). Eight different types of waste are collected from households and treated differently in order to promote a circular business approach among local businesses and citizens.

A success factor of the circular economy approach in Lahti is that the perspectives of residents is systematically included in the general development of the city as well as in overall land-use planning. For example, the city funds projects thought up by its citizens with a budget of EUR 40 000. It will fund projects that support circular economy activities or events that promote sustainable mobility. Businesses and universities take part, turning environmental know-how into growth-oriented businesses.

Source: City of Lahti (2019, unpublished), LAHTI YOUR ENVIRONMENTAL CITY; PowerPoint Presentation for the high-level expert workshop on managing environmental and energy transition in cities, 7 June 2019, Paris, France.

Cities and municipalities are increasingly recognizing the potential of the circular economy in waste collection and recycling, which are two of the tasks most commonly associated with the municipal level. Cities across the world have implemented local production, repair and re-use initiatives, such as re-use centres with associated repair workshops, repair cafés, urban mining schemes, circular shopping centres or online market place and support initiatives. However, significant potential to further reduce waste exists. Following the "waste hierarchy", the environmental impact of materials use, including greenhouse gas emissions, is generally most effectively reduced with waste prevention, followed by re-use, recycling and composting, and energy or material recovery. Cities can work with the private sector and academic community to develop innovative economic models to make the environmental impact of materials use sustainable.

Cities can apply different approaches and use various policy instruments to support the circular economy (see also Chapter 3 on the circular economy). To this end, roadmaps, strategies and political instruments have been introduced in a range of cities. The City of Amsterdam Circular 2020-2025 Strategy proposes to focus on three core value chains to achieve circularity: food and organic waste streams, consumer goods, and the built environment. A concrete policy instrument to support the food and organic waste streams is, for example, the creation of physical places for collection, re-use and closing nutrient cycles. The city also focuses on awareness-raising and uses its influence on social institutions (City of Amsterdam, 2020[50]). The city of Bristol in the United Kingdom has launched in 2018 the "Slim My Waste – Feed My Face" campaign to support household food waste collection and processing. Residents are asked to put their residual waste bins on a 'no food diet' and decorate their brown food waste bins with face stickers depicting personalities. The campaign helped to cut down the quantities going into landfill and encouraged residents to recycle their leftovers instead, used to power homes across the city. A partnership between the city and local co-operatives helped distribute bins to those in need of them.

Residents were also able to reserve bins online. The campaign was part of the wider strategy on sustainable food in Bristol, co-ordinated by the 2011 created Bristol Food Policy Council (Smart Sustainable Cities, 2019[51]).

Overcoming barriers to managing environmental and energy transition for cities

Despite their many points of leverage, cities face challenges in their efforts to pursue ambitious strategies for environmental and energy transition. In many cases, municipal efforts are constrained by policies and regulations at higher levels of government. A lack of co-ordination among city departments also can impede progress. The below section provides an overview of some of the key implementation barriers and how to overcome them.

Managing disparities between urban areas

Various factors help explain the significant disparities in progress with urban sustainability transitions and the underlying actions among local authorities:

- **City size is a critical factor,** with 80% of cities over 500 000 inhabitants having comprehensive stand-alone mitigation or adaptation plans (Reckien et al., 2018[52])**.** Larger cities often benefit from conditions, which facilitate innovation and deployment, such as the size and organisational structure of the city; higher-income populations; and higher capacities for environmental and energy-related investment and spending.
- Urban authorities may face **different barriers to entering city networks** and benefit from the knowledge sharing that they offer. These barriers can include limited capacity, language barriers and local access barriers. Overcoming these barriers could allow smaller cities to benefit from scale economies.
- Urban authorities may have **different attitudes and willingness to support environmental and energy transitions.** Some cities may resist transition because of the importance of local (polluting) industries and the fear of negative consequences for firms, incomes and tax revenues, and workers' jobs.
- There can be significant **disparities in terms of the skills and competencies** of urban authorities to lead transition efforts and to develop appropriate strategies. Small and mid-sized cities – most in need of networks – might be most affected by capacity issues (Chapman, 2019[53]).

Disparities can be reduced by making more resources available for the aggregation and circulation of knowledge. This can include compilations of best practices, using knowledgeable experts and practitioners, implementation guides/guidebooks and evaluation efforts. Enabling the circulation of experts and practitioners across cities and supporting collaboration between city administrations that have contextual similarities can also help address disparities.

Scaling of urban sustainability innovations

Scaling is key to accelerate transition processes. To prevent isolation and fragmentation of individual initiatives, it is important that sequences of urban environmental and energy transition investments and initiatives are scaled-up. The replication, transfer, scaling up and mainstreaming of successful experiments can be supported through expansion of projects, diffusion, and with more systematic co-operation between initiatives and the cities that support them.

Learning is a central mechanism in supporting the diffusion of urban sustainability initiatives. Knowledge about how successful experiments and innovations travel across contexts and how they are transferred is still limited. There are two main ways to support more structured learning in and between cities:

- **Intracity learning** focuses on the exchange of information and knowledge between initiatives and actors within the boundaries of a particular city or region. Urban policy makers can promote knowledge exchange and collaboration in several ways. On the one hand, they can bring participants from several urban living labs or experimental districts together for the exchange of experience (e.g. through ad hoc workshops or more systematic exchanges). Alternatively, experts can visit different projects, compare experiences, and abstract more general lessons that can be more widely shared (Bulkeley and Castán Broto, 2013[54]).
- **Intercity learning** focuses on the exchange of information and knowledge about practices, experiences and knowledge between cities via networks. City networks can help spread urban innovation by transferring lessons. Examples of city networks are the 2016 Global Covenant of Mayors for Energy and Climate Change, involving more than 7 000 cities worldwide; the International Council for Local Environmental Initiatives (ICLEI), founded in 1990; and the EIT Climate-KIC, which started with 19 cities in 2015 and has grown to a network of 370+ partners spanning universities, businesses, cities and NGOs.

Knowledge about how successful experiments and innovations travel across contexts and how they are transferred is still limited. The emergence of city networks certainly supports learning. Replicating successful initiatives across local settings requires careful consideration of contextual factors. National governments and knowledge sharing initiatives have an important role in the diffusion of urban sustainability innovations, since cities within one country share the same legal environment, geographic proximity and cultural relatedness (Lee and Jung, 2018[55]). National city and municipality networks, such as the Dutch Klimaatverbond, Sweden's Klimatkommunerna and Finland's KINKU network, may be particularly well-positioned to support the diffusion of innovations among its members (Hakelberg, 2014[56]). However, these networks generally appear to be financed by member cities.

Mobilising finance and enabling business models

Finance is essential for the emergence and diffusion of new technologies and practices, driving long-term economic growth and enabling sustainability transitions. According to recent estimates, emission reductions towards net-zero and the transformation of current production-consumption systems will require supplementary annual investments in the magnitude of around 1 to 1.5% of GDP annually (see Chapter 6). Tackling the financial challenge that arises with managing environmental and energy transitions requires urban policy support in a number of ways:

- Cities can work with other actors to build bankability and creditworthiness to **de-risk investment for environmental and energy projects**: Policy frameworks and spatial plans can methodically direct investment towards low-carbon and climate-resilient modes of urban development, while integrated urban development strategies can be used to develop a clear pipeline of climate-compatible projects. It will be important to investigate which of these policy directions will work best for different types of cities with different needs in sectors such as energy efficiency, sustainable transport infrastructure, and low-cost reductions of demand-based emissions, for example with regard to food and beverages.
- **Cities can increase the flow of capital into investments contributing to sustainability transitions**. Public-private partnerships, land value capture and dedicated funds from development finance institutions and green banks can help cities narrow the gap between the municipality's own available funds and what is needed to scale up transition measures (see Chapter 6 on financing sustainability transitions). In particular, land value capture can be a powerful

tool for funding large urban transport and development projects. Improvements in transport infrastructure can lead to increased land and property values nearby and this uplift in value can be used as a source of revenue. Cities can equally support shifting finance and investment away from unsustainable practices.

- **Cities can incentivise and enable firms and households to support transition finance**. Given the huge investment gap, spending decisions by firms and households (e.g. those owning electric vehicles) will be important in financing transition. In addition, cities can also provide financial incentives for new business models.
- **Cities can shift finance and investment away from unsustainable practices**. This requires both re-directing operational expenditures as well as investment spending away from less energy efficient or more carbon-intensive activities to expenditures and investment in line with the net-zero transition.

Ensuring a just transition for cities

A just transition approach in cities involves an explicit focus on how a policy could be used to benefit the poorest persons and take measures to address existing and potentially worsening economic inequalities. For example, transport policies that result in significant reductions in traffic volume, private car use and /or large-scale shift to electric vehicles improve air quality, especially in large cities that struggle with high levels of traffic-related air pollution (Gouldson et al., 2018[27]). The health benefits from improved air quality will accrue primarily to lower-income households who are most likely to live in locations affected by poor air quality from road transport (Hajat, Hsia and O'Neill, 2015[57]). As a result, such policies are likely to reduce health inequalities associated with economic inequality. On the other side, urban transport policies will exacerbate existing inequalities if they increase the costs of mobility, reduce the public transport services or involve redirecting public sector funds to subsidies that benefit primarily medium and higher-income households, leaving low-income groups financially worse off (Jennings, 2016[58]).

Well-designed just transition strategies ensure local employment benefits for disadvantaged areas and population groups. Large-scale retrofitting initiatives to improve energy efficiency in existing buildings will create new jobs in construction and the production of energy-efficient technologies (see section above). Localised retrofit programmes can provide employment benefits and positive equality outcomes for disadvantaged areas and population sub-groups by making the job opportunities available (Ürge-Vorsatz, Boza-Kiss and Chatterjee, 2019[29]). Distribution of the employment impacts, however, depends heavily on equitable access to training opportunities.

Just transition strategies in cities need to consider who may be negatively impacted by a given policy as well as why and how this happens. Inclusive and democratic planning processes involving communities, civil societies and citizens can help. The example of the Green New Deal for New York City illustrates how housing advocates, trade unionists and environmentalists worked together and combined social and environmental concerns to push for radical changes to address the housing crisis and the climate crisis simultaneously (Chapman, 2019[53]). The influence of local grassroots movements for a just transition does not only take place at the local level, but can contribute as well to national-level commitments to environmental and energy transition (REN21, 2019[59]). New ways of sharing and distributing information on the co-impacts and inequality impacts associated with various types of environmental and energy transition policies are therefore needed to enable urban policy makers to better consider the complex social impacts that policies may have and how these outcomes emerge.

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5 Managing environmental and energy transitions in rural areas

This chapter explores how to manage environmental and energy transitions in rural areas. Rural areas follow a particular development pathway adapted to their low population density and specific economic activities. Successful environmental and energy transition in rural areas requires overcoming specific challenges related to rural risk management, governance, and achieving a just transition. The chapter outlines these challenges and analyses a range of instruments and tools to manage the transition, notably with regard to the energy transition, rural mobility, sustainable land management, the circular economy and the bioeconomy.

In Brief

Rural regions face specific barriers and opportunities in environmental and energy transitions

- **Rural regions are diverse and highly influenced by their specific natural endowments**. Their development path is different from urban areas. Rural regions are often characterised by a lower population and development density, as well as a high proportion of natural assets and agricultural land. Common environmental problems in rural areas relate to biodiversity loss, the pollution of soil, water and air and are often the result of poor or environmentally damaging management of natural resources, for example with regard to food production, waste disposal or industrial pollution. In addition, climate change will progressively increase water scarcity, exacerbate flooding and coastal erosion, and increase the intensity and frequency of wildfires across the rural landscapes.
- **Significant potential synergies exist to link environmental and energy transition with sustainable rural development, but they are mostly underutilised**. Sustainability transition contributes to rural development because it can create important well-being gains related to economic performance, but also improved air quality, soil and water quality, biodiversity, and energy security. Local economic development strategies should integrate ambitious and long-term transition pathways for key transition fields. The opportunities for fostering transitions are as diverse as the rural areas. Central fields of action are the energy transition, rural mobility, sustainable agriculture, and moving towards the circular and bio-economy.
- **Rural areas face unique transition challenges, highlighting the importance of a just transition**. Physical isolation, limited economic diversity, high rates of vulnerable populations due to lower incomes and higher poverty rates, combined with lower educational and employment opportunities and an aging population increase the vulnerability of rural communities. Declining public and private services in rural areas and remoteness and limited access also means higher car dependency. Due to limited economic diversity, dependency on transition-inconsistent sectors such as manufacturing and mining is higher in rural areas than in urban areas. Consequently, some rural regions will likely experience employment losses and shifts, which need to be compensated. Ensuring a just transition requires measures to alleviate negative consequences and help firms, employees and regions to reorient. Particular support will be needed for coal regions and carbon-intensive regions.
- **Citizens' and municipality participation in the environmental and energy transition is vital to ensure community ownership and acceptance of transition measures.** To increase the social acceptability of environmental and energy transition projects, many energy developers now offer some form of 'community benefit' as part of their developments. An important part of the transition is that it needs to be economically viable for rural residents, including farmers and local retailers, to be accepted and implemented. This implies the need to restructure food value chains and to create new opportunities for farmers through alternative land-management opportunities.

Introduction

Rural areas play a pivotal role in the success of environmental and energy transition because of their natural resource endowments. Rural regions are complementary to cities through connections related to the flow of people, goods and services. 20% of the total OECD population live in rural regions close to cities, which are defined as territories less than 60 minutes of driving time from urban centres. 6% live in remote rural regions (OECD, 2019[1]). Rural regions provide an important foundation for human wellbeing through the supply of food, freshwater and other important ecosystem services. Sustainable land use is necessary to halt climate change, biodiversity loss and land degradation (IPCC, 2020[2]). Appropriate action and investment in rural regions is required to meet these challenges. Rural development policies need to take a place-based approach tailored to the diverse needs and characteristics of rural communities.

Rural areas face multiple and specific opportunities and challenges in responding to and preparing for environmental and energy transition. Geographic remoteness, an ageing and shrinking population, the depletion of natural resources, and environmental decay are all challenges that threaten rural sustainability. Rural and remote communities can be impacted by a decline in farmers, loss of forests, declining populations in more remote areas, poor access to jobs, services and education, a lack of mobility options beyond carbon-intensive road transport, and limited community planning capacity. At the same time, environmental and energy transitions also generate economic opportunities, secure jobs and come with health benefits. Innovation projects in rural territories can lead to new or modified products and processes that avoid or reduce negative impacts on the environment. Rural areas can also employ circular economy approaches in sectors such as manufacturing and mining to support sustainability transitions. While some rural areas will win from transition, others are likely to have trouble adjusting. Learning from past experience with industrial transition – for example from those related to ending coal mining – is important for a just transition, i.e. to ensure that residents and communities that face specific difficulties in transition are protected from unique vulnerabilities.

Exploring the potential of rural areas to contribute to environmental and energy transitions has received less attention than urban transition processes. Yet, rural areas are highly important. This chapter therefore provides insights into the role of rural areas for sustainability transitions and explores how rural regions can manage sustainability transitions. The chapter draws from the OECD seminar series on “Managing environmental and energy transition for regions and cities”, and in particular from the seminar entitled “Managing environmental and energy transitions in rural areas”. The main theoretical frameworks and regional case studies were identified in or inspired by the following publications:

- Chapter 1 of this publication, “Managing Environmental and Energy Transitions in Regions and Cities: A Place-Based Approach”.
- Halseth (2019), “Peripheries at the Core: Notes from rural places and regions on environmental and energy transition”, Background Report for an OECD/EC Workshop Series on Managing environmental and energy transitions for cities and regions, OECD, Paris, 5 September 2019.
- Phillips (2019), “Challenges and policies to support rural environmental and energy transitions”, Background Report for an OECD/EC Workshop Series on Managing environmental and energy transitions for cities and regions, OECD, Paris, 5 September 2019.

The role of rural regions in environmental and energy transition

Rural areas are diverse and have distinct needs. Rural areas are not homogeneous, and are in constant change. Prospering rural regions, often close to metropolitan regions, contrast with remote rural regions with low economic and employment prospects, weak infrastructure and shrinking populations. There is therefore no uniform definition of the term “rural”, but rather very different definitions and the simple demarcation of "rural" as a counterpart to the "city" is insufficient (Box 5.1).

Box 5.1. Defining rural regions

The term "rurality" is generally recognised as a multidimensional concept, embodying different meanings for different purposes. To date, there is no internationally recognised definition of rural areas for policy purposes. Rural areas have been defined in the context of a global definition of cities, urban and rural-based on the Degree of Urbanisation model (UN Statistical Commission, 2020[3]). However, this definition of rural areas is designed for the purpose of international statistical comparability and does not represent a meaningful definition of rural areas for policy design purposes.

Since context and geography matter, it is no surprise that OECD member countries have adopted a wide range of definitions delimiting and adapting urban and rural borders to their geographic characteristics. Indeed, there is no such thing as an optimal or universally agreed upon rural definition for implementing policy. The wide diversity of rural definitions also reflects different criteria that exist to elaborate definitions including density, economic activity, size or distance to services, among others.

From the perspective of regions, the main difference is where the driving source of economic dynamism is located. In highly urbanised regions, it is clearly in the city, whereas in remote regions, it is in rural areas. The vast majority of rural territory falls into an 'intermediate' situation where the urban and rural components of a region are *more balanced* in capacity and there are potentially substantial gains from co-ordination.

Within this complex configuration, there are three types of rural regions, broadly defined each with different characteristics and policy needs:

1. *Rural regions within a functional urban area (FUA)*: these types of rural areas are an integral part of the commuting zone of the urban centre and their development is fully integrated within a FUA.
2. *Rural regions close to* a FUA: these regions have strong linkages to a nearby FUA, but are not part of its labour market. There are flows of goods, environmental services and other economic transactions between them. While the urban and regional economies are not integrated, much of the growth in the rural region is connected to the growth of the FUA. The majority of the rural population in EU and OECD countries live in this type of rural region.
3. *Remote rural regions*: These regions are distant from a FUA. Connections to FUAs largely come through the market exchange of goods and services, and there are only limited and infrequent personal interactions outside the rural region, but there are good connections within the region. The local economy depends largely on exporting the output of the primary activities of the area.

Source: OECD (2020[4]), *Rural Well-being: Geography of Opportunities*, OECD Rural Studies, OECD Publishing, Paris, https://doi.org/10.1787/d25cef80-en.

Opportunities for environmental and energy transitions in rural areas

First, rural areas are important to preserve ecosystems and natural capital. Rural areas support human wellbeing and economic development through important ecosystem services, including as providers of food, wood, water, raw materials and energy, as places of recreation, providers of regulating services (e.g. with regard to climate or water), and for conserving biological diversity. Ecosystems in rural areas can help to mitigate environmental pressures and natural threats. As both synergies and conflicts may arise from the use of ecosystem services (e.g. some current agricultural practices have led to diminishing range of species), managing natural capital in rural areas more effectively is key to preserve

natural capital (Hardelin and Lankoski, 2018[5]). Rural areas also provide natural carbon sinks by absorbing and capturing carbon dioxide from the atmosphere (IPCC, 2020[2]).

Second, environmental and energy transitions can create new job and business opportunities and come with health benefits. Environmental and energy transitions can bring access to employment opportunities. For example, renewable energy deployment in rural areas has the capacity to promote regional and local development because significant parts of the value chain can be established in regions and municipalities and so have beneficial effects on employment and SMEs. The shift from fossil fuel-based energy towards renewable energy deployment increases employment in the European Union (Duscha et al., 2014[6]). The reason for the positive impact of renewable energy deployment is a higher labour intensity in this sector compared to, for instance, power generation from fossil fuel. Despite an overall increase in jobs, some communities will experience more job losses than others. This is especially true for rural regions with a coal-fired power plant or those that are otherwise economically dependent on fossil fuel. A net increase in jobs does not mean that every displaced worker will be provided with a new job. However, a recent study finds that the deployment of clean energy technologies in more than half of the European Union coal regions could offset job losses induced by the transition by creating up to 460 000 jobs in total by 2050 (Zoi et al., 2020[7]). When it comes to agriculture, decarbonisation policies might help protect jobs that depend on ecosystem services (European Commission, 2018[8]). Transition also comes with a range of health benefits, including health effects in air quality (by phasing out polluting activities such as mining for example), transportation and diet, improved soil and water quality and improved biodiversity (Karlsson, Alfredsson and Westling, 2020[9])

Third, environmental and energy transitions provide an opportunity for innovations in products and practices. Innovation is considered particularly important in facilitating sustainable development frameworks that balance economic growth with the production and protection of 'public goods', such as biodiversity and other environmental resources. Innovation processes in rural areas often rely strongly on personal relationships and central actors, combined with the determinant use of institutional devices, local resources and external relational networks. New technologies in information and communication are profoundly modifying the links between activities, knowledge and space, thereby considerably enhancing the innovation potential in rural areas (Carrincazeaux, Doloreux and Shearmur, 2016[10]). Studies show that firms located in rural areas are often as innovative as similar firms located in urban or peri-urban areas (Galliano, Goncalves and Triboulet, 2017[11]). In addition, they point to specific innovation projects in rural territories. These projects are often built on the sustainable use of natural resources and agro-ecology, and have very different paths to those seen in mainstream agro-food systems (Levidow, 2015[12]). The European Innovation Partnership "Agricultural Productivity and Sustainability" is an example of an initiative that aims to strengthen research and innovation in farming and food systems (European Commission, 2020[13]).

Fourth, environmental and energy transitions should foster citizen inclusion and rural empowerment. Energy co-operatives, for example, offer the opportunity for participation and engagement of local citizens and can therefore be seen as a useful driver of transition experiments. They increase by being open to all citizens in the affected region and generate profit for the community as well as for each individual. Indeed, a recent report and project on renewable energy co-operatives showed that increased investments in sustainable energy and a stronger involvement of European citizens are needed to achieve the transition to renewable energy and energy democracy across the European Union. A decentralised ownership of projects encourages greater acceptance for renewable energy installations and benefits local communities. This model has proven its environmental, economic and social added value, but still too few renewable energy installations are owned by local communities in Europe (REScoop MECISE consortium, 2020[14]). For rural development in general, the European Union introduced the method of "community-led local development" in the 2014-20 programming period, which supports local action groups to implement their local development strategies.

Challenges for environmental and energy transitions in rural areas

While environmental and energy transition comes with numerous opportunities for rural areas, it also holds challenges:

- **Rural communities face difficulties diversifying their economies**. One of the most fundamental challenges facing rural economies is the impact of restructuring in both agriculture and traditional industry and the associated need for diversification and growth in the non-farm rural economy. In the past, export industries including mining, manufacturing, and transportation services often have driven economic growth and created employment opportunities in rural regions. These sectors are however often inconsistent with sustainability transitions and need therefore progressive phasing out and greening. At the same time, the decline of industrialism has negatively affected many communities, particularly through declining employment opportunities and private sector investment in small and single resource-dependent communities. This highlights the importance of a just transition (see also the next section). Abandonment of smaller, traditional farming and animal husbandry practices has also encouraged ecological degradation (Halseth, 2019[15]).
- **Rural-urban migration is a persistent issue**. Difficulties with workplace recruitment and retention along with limited educational opportunities have frequently led to rural-urban migration. Rural-urban migration might come with a shift in political power from rural communities towards urban centres, thereby reducing financial support and assistance to rural regions from higher levels of government (Connell et al., 2013[16]). At the same time, rural population decline induces a loss of the local tax base and diminishes local government spending for infrastructure, public and private services (e.g. post offices, pharmacies), and schools. Population decline also deflates property values, often leaving the elderly abandoned as young people depart for cities. In a vicious cycle, net losses undermine local businesses and community development capacity, prompting further abandonments (Halseth, 2019[15]).
- **Rural areas are vulnerable to climate change and natural resource depletion**. Rural areas experience specific vulnerabilities to climate change, both through their dependence on natural resources and weather-dependent activities and their relative lack of resources to deal with climate change and resource depletion. Greater dependence on agriculture and natural resources makes them highly sensitive to climate variability, extreme climate events, and climate change (Phillips, 2019[17]).
- **There is an ecosystem valorisation challenge in rural areas.** Rural areas are pivotal to wellbeing and economic development as providers of resources such as food, water, raw materials and energy, as places of recreation, and for conserving biological diversity. Ecosystems in rural areas can help to mitigate environmental pressures and natural threats. However, decisions regarding the use of ecosystems tend to underestimate both the economic importance of ecosystem services and their relevance to human wellbeing. While several methods have been developed for valuing non-marketed ecosystem services, such as payments for ecosystem services (PES) programs, their application is limited due to their complexity and problematic application (Chan et al., 2017[18]).
- **Rural areas often lack capacity for environmental and energy transitions**. Rural communities are less likely than urban areas to have the human capital, financial means, infrastructure, or resources to address the environmental and economic challenges they encounter. Limited financial means and capacity have made sustainability planning difficult for smaller communities to achieve (Halseth, 2019[15]).

Given the various social, economic, and environmental concerns that threaten the prosperity of rural and remote regions, it is clear that there is a need for innovative solutions and integrated strategic planning. Place-based sustainability transitions in rural areas have the potential to transform regional rural planning and to help smaller communities navigate ongoing social, environmental, and economic challenges.

Overcoming barriers to managing environmental and energy transition for rural areas

Developing environmental and energy transition projects in rural areas requires planning and stakeholder engagement along with greater networking and communication. Developing new value chains can take time. It also requires long-term investments and new knowledge and skills. This means bringing together old and new rural actors to explore, develop and innovate, renewing efforts to engage and empower rural actors who already struggle to have a voice in the more established value chains, such as in the agro-food sector. Doing so requires support, advice and education. This should also include mechanisms that reward first movers and protect them from the risks associated with a sector reliant on an evolving pool of technology and knowledge. Flexibility to adapt will also be important, avoiding system lock-in where choices prevent change.

Building transition capacities for rural places

Institutional capacity is a key factor for the success of environmental and energy transitions. Successfully redirecting action and investment from unsustainable into climate-neutral and circular development pathways in rural regions requires a cultural change and a new mix of skills in rural communities, and incentives for local governments to support environmental and energy transition (Halseth, 2019[15]). Chapter 6 on financing environmental and energy transitions provides suggestions on how particularly smaller administrations can overcome capacity issues: Valuing co-benefits in cost-benefit analysis, peer-to-peer learning between smaller and remote communities and making use of regional experts can help.

Carefully designed policy measures need to be accompanied by social learning and community involvement in rural areas. Involving local stakeholders and in particular local communities and marginalised groups such as indigenous people, women, and the poor enhances effective decision making and governance. In addition, successful environmental and energy transition considers local environmental and socio-economic conditions. Doing so helps take into account local land-use pressures and impacts (e.g. biodiversity decline, soil loss, over-extraction of groundwater, land-use change in agriculture, food production and forestry) as well as preventing, reducing and restoring degraded land. Community involvement can also facilitate the collection of data in order to measure the success and challenges of sustainability transitions.

Often, imbalances exist in the capacity and incentives of the parties involved in supporting climate-neutral and circular initiatives. Small and medium-sized enterprises as well as municipalities in rural communities may be limited in terms of expertise and resources, while large private operators and firms may be well resourced with considerable financial interests to pursue. Limitations in the capacity of municipalities to manage their roles in environmental and energy transition domains such as waste management, tendering processes or awareness-raising among large players are common obstacles in many rural regions. National governments can carry out capacity building activities to support municipalities in their work. Enabling inter-municipal co-operation can also assist in addressing capacity issues in local governments and help to ensure an efficient scale of management (OECD, 2019[19]). Regarding private actors, especially smaller companies and farmers might benefit from capacity and skill development initiatives that help close gaps with large operators (Box 5.2).

Box 5.2. Capacity building for smart and sustainable land management

Lack of digital skills, especially in small-scale farming systems, may increase imbalances in market power along the agro-food chain, further exacerbating the "digital divide" between large and small farmers. Several approaches and tools exist to help farmers develop digital skills and competencies that support environmental sustainability and economic development in rural regions :

- The Flanders Research Institute for agriculture, fisheries and food (ILVO), Belgium provides tailored advice to local farmers and municipalities. Digital testbeds provide approximately 200 ha of experimental fields, 15 000 m2 of greenhouses and more than 20 000 m2 of test sheds. They allow farmers to experiment with new technologies. The living lab involves a large range of stakeholders in its work and demonstration projects, including farmers, technology companies, the food industry, and the local government (ILVO Living Lab, 2020[20]).
- The French training insurance fund for non-salaried agricultural workers VIVEA offers digital blended learning for 600 000 farm managers in rural France. The training supports entrepreneurs in the agricultural sector and their spouses in smart and sustainable farming. The offer includes classroom training as well as face-to-face digital sessions with individual farmers. VIVEA has a regional committee in every French region, allowing to target training offers to local needs (VIVEA, 2020[21]).
- The Bygholm Agricultural College in Denmark has created in co-operation with the regional government and local municipalities a curriculum for young farmers between 16 and 20 years to use and develop digital technologies in farming. Sustainability and the preservation of nature is an explicit focus of the programme. The College also co-operates with local primary schools to help young students understand digital technologies for sustainability that might be applied in agriculture or elsewhere (Eip-Agri, 2019[22]).

Source: (Eip-Agri, 2019[22]; ILVO Living Lab, 2020[20]; VIVEA, 2020[21]).

Benefit-sharing agreements such as applied in the sustainable mining industry can be adapted to other transition fields, including renewable energy developments. Benefit-sharing refers to the distribution of the monetary and non-monetary benefits that a mining project generates. The purpose of benefit-sharing mechanisms is to ensure that the region in which the company operates retains a significant part of the accumulated benefits. Monetary benefits include, for instance, development and investment funds, equity sharing and tax sharing with governments. Non-monetary benefits include education facilities, medical facilities, employment goals, local procurement, training of staff and improved service access. These non-monetary benefits can be particularly important as they provide jobs to local people as well as training and education for local municipalities (Söderhalm and Svahn, 2014[23]). Local-level benefit-sharing approaches can also be applied to renewable energy projects such as wind and solar. Experience shows that improved community participation in benefit-sharing can lead to community projects with better outcomes, lasting local impact, and positive perceptions that add to goodwill. Wind and solar projects can also combine proactive environmental responsibility with local benefit sharing through mechanisms such as environmental education, conservation programs, and sustainable tourism activities (IFC, 2019[24]).

Linking environmental and energy transitions with rural development

Rural policy making has evolved from being sector-focused and centralised to being multi-sectorial, diverse and integrative. As illustrated in Table 5.1, these changes have been summarised as a movement away from an 'Old paradigm' of rural policy making that emerged in the three decades following the Second World War through a 'New Rural Paradigm' that prevailed in the decades around the millennium, and into 'Rural Policy 3.0'. and, very recently, into "Rural Well-being: Geography of Opportunity". This approach focuses on individual well-being at its core and looks at opportunities of rural policies being determined by economic, social, and economic aspects. Enhancing competitive advantages in rural communities is a key element of this framework, however not the only one. The framework is multi-dimensional and strives to enhance well-being based on integrated investments and the delivery of services that are adapted to the needs of different types of rural areas. It describes a partnership-driven approach that includes government as well as the private sector and civil society (OECD, 2020[4]).

Table 5.1. Changes in rural development policy making

Rural Development Strategies	Objectives	Key actors and stakeholders	Policy focus	Policy Approach	Rural Development Concepts
Old rural paradigm	Equalisation and food supply	Agricultural organisations and national government	Primary sector focused	Uniformly applied top-down policy	Exogenous Rural Development
New rural paradigm	Competitiveness	All levels of government plus key stakeholders	Multiple sectors based on their competitiveness	Bottom-up policy, local strategies	Endogenous Rural Development
Rural policy 3.0 and Rural well-being: Geography of opportunity	Improvement in multiple dimensions of economic, social, environmental well-being	Multi-sectoral and multi-level	Low-density economies differentiated by type of rural area	Integrated approach with multiple policy dimensions	Neo-Endogenous Rural Development

Source: Phillips (2019[17]) "Challenges and policies to support rural environmental and energy transitions", Background Report for an OECD/EC Workshop Series on "Managing environmental and energy transitions for cities and regions", OECD, Paris, 5 September 2019; OECD (2020[4]) *Rural Well-being: Geography of Opportunities*, OECD Rural Studies, OECD Publishing, Paris, https://doi.org/10.1787/d25cef80-en.

Significant potential synergies exist to link environmental and energy transition with sustainable rural development, but they are mostly underutilised. Sustainability transition contributes to rural development because it can create important well-being gains related to economic performance, but also improved air quality, soil and water quality, biodiversity, and energy security (Karlsson, Alfredsson and Westling, 2020[9]). However, an overall finding from international evaluations suggests that most countries have not developed strategies for linking energy and environmental transition with rural development. For example, a recent report from the European Court of Auditors found that most EU Member States did not employ any form of prioritisation of renewable energy when making decisions concerning rural development projects, notwithstanding the presence of national commitments to expand renewable energy production (European Court of Auditors, 2018[25]).

Local economic development strategies should integrate ambitious and long-term transition pathways for key transition fields, including renewable energy development, rural mobility, sustainable land management and moving towards a circular and bio-economy. This would also help the development of upstream and downstream linkages with important rural industries such as forestry or mining. Importantly, rural development strategies also need to highlight synergies between policy goals – sustainable land management can for example contribute to healthier diets– and potential conflicts in policy objectives, e.g. between competitiveness and transition goals. Making use of existing synergies can help minimise trade-offs (OECD, 2019[26]).

Supporting sustainability transitions in rural regions requires better alignment of food, water, and climate policies. The diverse and complex challenges facing a transition towards sustainable land use are often related to resource competition (e.g. water, energy, biodiversity, land), socio-economic concerns (e.g. rural livelihoods, community development, emerging niche markets), and human health and environmental integrity (e.g. ecosystem health, environmental justice, climate change). Overcoming fragmented land-use governance between sectoral ministries and different levels of government is required in order to facilitate the co-ordination across scales necessary to support transitions towards sustainable land use (OECD, 2020[27]).

Ensuring a just transition for rural regions

Rural areas face unique transition challenges, highlighting the importance of a just transition. Physical isolation, limited economic diversity, high rates of vulnerable populations due to lower incomes and higher poverty rates, combined with lower educational and employment opportunities and an aging population increase the vulnerability of rural communities. Declining public and private services in rural areas and remoteness and limited access also means higher car dependency. Due to limited economic diversity, dependency on transition-inconsistent sectors such as manufacturing and mining is higher in rural areas than in urban areas. Consequently, some rural regions will likely experience employment losses and shifts, which need to be compensated. Particular support will be needed for coal regions and carbon-intensive regions.

Rural residents and local communities can face different types of transition risks:

- **Transition comes with distributional effects**. For example, middle-class households tend to be early adopters of subsidised solar panels or electric cars. But this implies a regressive distribution of taxes, with different effects in urban and rural areas. Poorer households in rural areas are benefiting less from the transition (Jenkins, Sovacool and McCauley, 2018[28]).
- **Some social groups may experience vulnerabilities with regard to particular innovations**. The roll-out of smart meters, for example, may not benefit certain social groups, such as people with limited computer skills (e.g. the elderly or those with poor education) or people living in rural areas, where smart meters do not function properly (Sovacool et al., 2017[29]).
- Redirecting investments towards a climate-neutral and circular economy may **lead to the economic decline of existing industries**, often located in rural regions. Renewable energies, for example, are replacing coal-fired power plants and coal-mining regions in Germany (Vögele et al., 2018[30]). This is leading to social resistance and political opposition in local communities and in regions where high-carbon industries are major employers and sources of local tax revenue.

Public authorities in affected rural regions play an important role to mitigate social protests and make transitions more fair and inclusive. Ensuring a just transition requires measures to alleviate negative consequences and help firms, employees and regions to reorient. The International Labour Organization has elaborated guidelines for a just transition, which acknowledge that transitions create both employment opportunities and challenges (ILO, 2015[31]). Addressing rural concerns means listening to stakeholder worries, consulting them in early policy design processes, offering (financial) compensation, and providing assistance or training to vulnerable groups. For the economic decline of existing industries, no easy solutions exist. The past decline of old industrial regions dependent on coal, steel or heavy metals created sometimes long-lasting unemployment and other social problems. Policy needs to assist reorientations in an active manner, including through sustainable industrial policy, robust social protection or safety nets, and wide-reaching labour adjustment programmes (OECD, 2019[32]).

Instruments and tools to manage environmental and energy transitions for rural areas

Rural regions can employ a number of proactive strategies to support a just transition to a climate-neutral and circular economy. Rural areas are key players when it comes to achieving environment and energy transition objectives. While the possibilities and fields of action are diverse, they are different from those of cities. The below section provides an overview of the potential of rural communities and outlines some of the success factors and possible challenges.

Rural areas in changing energy regimes

The share of renewable energy is on the rise in OECD and EU countries. In 2018, the share of renewables in the OECD primary energy supply reached 10.5% (IEA, 2019[33]). In the European Union, it even reached 18.9%, compared with 9.6 % in 2004 (Eurostat, 2020[34]), most of it in electricity generation. The sources of growth have been principally wind power, solid biofuels (including bio-waste) and increasingly solar power. Cost reductions in renewables, in particular wind and solar PV, and advances in digital technologies are opening future opportunities for energy transitions. The Sustainable Development Scenario (SDS) developed by the International Energy Agency projects that the share of renewables needs to rise to two-thirds of electricity generation output by 2040 to be on course towards reaching energy-related SDGs and the Paris Agreement objectives (IEA, 2019[33]). The use of renewable energy has many potential benefits, including a reduction in greenhouse gas emissions, the diversification of energy supplies and a reduced dependency on fossil fuel markets (in particular, oil and gas). The growth of renewable energy sources may also stimulate employment, through the creation of jobs in new 'green' technologies. Recent analysis shows that accelerated uptake of renewables could boost total energy jobs to 100 million by 2050, Jobs in renewables could reach 42 million by 2050, some 62% more than under current plans (IRENA, 2020[35]).

Many renewable developments are located in areas classified as rural. For example, hydroelectric power generation in the United Kingdom is mainly located in Scotland, which also hosted over 60 percent of the wind power generation (Phillips, 2019[17]). Beyond the United Kingdom, a recent study has constructed a map of wind turbine distribution across the European Union, and comparison with the urban-rural typology of the European Union's NUTS3 regions suggests that many of the turbines are located in areas beyond urban regions (Mauro, 2019[36]). Rural areas often have locational advantages when it comes to the generation and decentralised use of electricity and heat from renewable energies such as wind, sun, biomass, hydropower or geothermal energy. This includes the availability of open spaces or resources such as biomass. However, not all rural regions are equally suitable. Particularly in the case of wind power, regional disparities can be large. It is therefore important to identify potential based on physical conditions in a certain area (Phillips, 2019[17]).

The development of renewables in rural areas can be an economic driver for these areas, but this is not always the case. A central question is how profits are distributed to benefit social and economic development of rural regions. Key mechanisms are supply chain benefits, community or shared ownership, and community benefits (Clausen and Rudolph, 2020[37]). Evidence is mixed whether construction, operation and maintenance activities from renewable energy projects support local job creation and local procurement, and to what extent locally sourced labour helps long-term rural development. A case study from rural Sweden found that in the absence of community benefit schemes, employment opportunities are very modest and strongly depend on the presence of local manufactures (Ejdemo and Söderholm, 2015[38]). In contrast, a study about very large wind farms in Texas estimated substantial local economic activities during their life cycles, whereas supply chain impacts accounted for more than 50% of generated jobs (Slattery, Lantz and Johnson, 2011[39]).

Citizens' and municipality participation in the energy transition is vital to ensure community ownership of renewable energy. This can happen for example through civil energy co-operatives or leases of municipal areas to operators of wind turbines or open space photovoltaic systems. To increase the social acceptability of renewable energy development, many energy developers now offer some form of 'community benefit' as part of their developments. The mining industry has a long tradition of benefit-sharing agreements. Local-level benefit-sharing approaches can also be applied to renewable energy projects such as wind and solar (see also the section on capacity building). These benefit schemes can take a range of forms, including:

- financial payment into some form of 'community fund' that can be used for the benefit of local residents
- the delivery, either directly or indirectly, of some form of community 'benefit in kind', such as the construction of some community facility or infrastructural improvement
- 'share ownership' or 'profit-sharing' where residents of an area are given a stake in an energy development such that community benefits are tied to its performance (Phillips, 2019[17]).

Aspects such as regional added value and citizen participation can also increase the acceptance of environmental and energy transition measures among the population. The expansion of and self-supply with energy and heat from regenerative resources also promotes sustainable municipal services, reduces the dependency on imported, conventional energy sources and their price fluctuations and can thus relieve municipal households. In addition, successful and innovative projects in the area of "energy transition" ensure that active municipalities are known across the region, thereby increasing their attractiveness and attracting visitor groups (energy tourism).

The energy transition is often equated with a "power transition" and is not (yet) sufficiently linked to the areas of heat and mobility. The transition towards renewable energy generation poses challenges of how to most efficiently use green energy, for example, by jointly optimising electricity, heating and transport sectors (so-called sector coupling). It also raises questions on how to effectively store green energy, for example, by using modern hydrogen technologies; and how to control electricity consumption and shift demand in times of underproduction towards times of overproduction (Stötzer et al., 2015[40]). Sector coupling has potential for small, rural communities, for example, to lower the operating cost of zero-emission vehicles, on which rural areas depend more than urban areas (see below). Power-to-heat (converting electricity into heat) or power-to-gas (converting electricity into gas) are further options.

Rural energy transition also comes with some challenges. In many OECD and EU countries, it can be difficult for small municipal energy suppliers and energy co-operatives to remain competitive due to considerable planning obligations or complex competitive tenders. In wind energy, for example, considerable planning work has to be undertaken before a contract is secured. Another area of conflict are the use of land for energy generation from renewable sources (wind farms, open spaces photovoltaics) and the associated interventions in the landscape. The negative influences on the natural environment and biodiversity poses an additional challenge. Finally, social resistance centred on visual impacts and aesthetics remains an important barrier (Phillips, 2019[17]).

Sustainable mobility in rural areas

Rural and sparsely populated areas face specific opportunities and challenges in the transition to sustainable mobility. The transport sector accounts for roughly a quarter of all greenhouse emissions. While there has been progress in improving energy efficiency and environmental friendliness of vehicles and technologies, the challenges for reaching sustainable mobility are great. The transport system as a whole is facing changes driven by servitisation, increasing intelligence and automation in vehicles as well as infrastructure (ITF, 2019[41]). When it comes to transportation in rural and remote areas, long distances, sparse population and narrow flows of people and goods pose specific challenges related to rural mobility needs (Kostiainen, Aapaoja and Kinnunen, 2017[42]). Rural transport plays an indispensable role in achieving more than half of the Sustainable Development Goals (SDGs) and fulfilling the promise of the 2030 Agenda for Sustainable Development to 'leave no one behind'.

Effective rural transportation planning at local, regional and national level requires a co-ordinated multimodal transportation system. Such a system provides choices for the movement of people and goods and allows quick transfers between modes when and where they are needed. Transportation linkages should be maintained between rural and urban areas as they are important to the economy, public health, and social structure of rural areas (Saroli, 2015[43]). Effective rural transportation planning should also provide users and stakeholders of the transportation system with the opportunity to participate in the planning process. Rural transport is a public good and should therefore not only be examined from a cost-benefit analysis. There are social and well-being benefits arising from better public transport provision in rural areas, which include greenhouse gas emission reduction, social inclusion, and rural development opportunities, which are often not fully included. For this reason, sufficient public funding is required to support sustainable rural transport provision.

Although the uptake of electric vehicles (EV) in rural areas is lower than in cities, rural drivers and rural economies can save most from zero-emission vehicles. Recent analysis from the United States based on data from the 2017 National Highway Traffic Survey suggests that rural residents have the potential to save up twice as much as urban residents by making the switch from a conventional car to an electric vehicle. These savings are likely to be even greater for drivers of pickup trucks. In addition, emission reduction from EV usage in the most rural counties are almost double the average from EV usage in the US most urban counties (Gatti, 2018[44]). Moving to zero-emission vehicles in rural areas benefits not only rural drivers, but also offers important opportunities for rural economies as savings from lower fuel consumption that rural dwellers can re-invest in the local economy.

A range of barriers persists to scaling-up electric vehicles. First, a lack of charging stations throughout many rural areas restricts the viability of electric vehicles, either for people who live in rural communities or for tourists who wish to visit. Second, although range amongst EVs is improving, as some EVs are having an average range of 150 to 250 kilometres, the fear of running out of battery remains a primary barrier. Third, consumer acceptance and affordability remains crucial for EV adoption (Kester et al., 2020[45]). Bridging the urban-rural EV charging infrastructure gap requires including rural places in plans to expand charging infrastructure. Local authorities in rural areas can work with diverse businesses ranging from popular supermarket chains to retail shopping centres, and EV fleet operators, to help expand the availability of EV charging (Bonsu, 2019[46]). While electric vehicles remain somewhat more expensive in their acquisition (though not in their operating costs) than conventional vehicles, declining battery costs and support for purchase incentives, such as tax relief/taxation incentives on EVs for certain population groups coupled with education programs, can help make electric vehicles affordable for all residents.

Moving to sustainable rural mobility requires decarbonising freight road transport. Goods transport by road consumes around 50% of all diesel fuel and accounts for 80% of the global net increase in diesel use since 2000. Projections see road freight activity at least doubling by 2050, offsetting efficiency gains and increasing road freight CO2 emissions (ITF, 2018[47]). Rural roads often constitute a significant proportion of freight transport. The potential benefits of reduced fossil fuel-dependent freight transport are

substantial and include lower energy import dependence, large reductions in carbon emission and net gains in value-added and employment (due to reduced oil imports over time). The transition also lowers the cost of road freight transportation. At the same time, it challenges the competitiveness of the (fuel-based) auto industry and can negatively affect employment across several sectors, for example by shifting jobs from producing traditional motor vehicle components to advanced technologies (European Climate Foundation, 2018[48]). Policy should foster measures such as stricter emission standards, zero-emission zones, recharging infrastructure and incentives for adoption of alternative fuels by large fleets (ITF, 2018[47]). Local or regional planning approaches play an important role in introducing some of these measures in rural transport planning and funding.

Sharing transport can help achieve zero-emission targets while improving energy and materials efficiency, thereby supporting the energy transition and a more circular economy. At the same time, it is difficult for conventional public transport to meet different accessibility needs of different user groups in rural areas. There is therefore a need to find alternative, flexible transport supply solutions to address mobility issues. Some examples are:

- **Shared mobility solutions**: Shared mobility can be an essential part of the solution set to deal with mobility issues in rural environments, where conventional public transport struggles to meet the actual needs of passengers, and where people are highly dependent on the private car. Informal networks and community goodwill can lead to steady expansion of schemes that have started at a very small scale;
- **Demand Responsive Transport Services**: Demand Responsive Transport (DRT) are services that pick up and drop off people in accordance with actual passenger needs. The ability of DRT to provide efficient and affordable transport services has been greatly enhanced by the use of technology. For example, routes can be adjusted in real-time based on traffic and demand (Leiren and Skollerud, 2015[49]);
- **Rail and bus public transport network**: Rural buses can lower rural traffic by replacing individual car use. They are essential to combat social exclusion for rural households without a car. Buses enable non-drivers to access jobs, shops, education, and services, all of which are increasingly centralised, threatening rural viability. Buses can also serve to bring in visitors and tourists and ensure that the countryside is visited (Saroli, 2015[43]);
- **Cycling**: Cycling, and in particular peddles (motor support when using the pedals) or e-bikes (motor support even without using the pedals) could offer climate-friendly alternatives to the car due to the increased range and possible uses by different people than cyclists, such as older people, (McAndrews, Tabatabaie and Litt, 2018[50]).

Planning sustainable rural mobility in a more comprehensive way may also consider alternative fuel options for shared and individual transport, as well as re-visiting links between passenger and delivery services. Box 5.3 provides examples of rural shared mobility initiatives.

Box 5.3. Rural mobility initiatives in the spotlight

Several OECD countries have developed shared mobility solutions for rural regions:

- **National Mobility as a Service (MaaS) Framework, Finland:** The National MaaS (Mobility as a Service) Framework in Finland is part of the national government's objective to promote digitalisation in the transport sector. It aims to encourage new and digital business models to make ride-sharing more accessible. To this end, the government passed a new public procurement law favouring digital transport solutions. Special focus was placed on rural with the *Rural MaaS project (2016-2017)* targeting MaaS in rural and sparsely populated areas and led by the Ministry of Agriculture and Forestry of Finland.
- **Ring a Link, Ireland:** Created in 2001 as a grassroots organisation of local transport services, Ring a Link focuses on combatting social exclusion in rural areas in five Irish counties. It provides buses that operate daily on scheduled and demand-responsive services. Service is free of charge but requires pre-booking. 143 000 passengers used the bus system in 2017.
- **Alpine Bus, Switzerland:** Alpine Bus operates buses in Swiss rural mountain areas where mobility demand is not financially viable for conventional transport offer. It is an association with public authorities and private companies under its roof. A national managing board provides oversight and a number of regional partnerships exist. Alpine Bus combines passenger and parcel/postal deliveries.
- **Sopotniki car transport, Slovenia**: The *Sopotniki* provides shared taxi transport for the elderly in rural areas, provided by volunteers and free of charge. This practice supports the mobility of elders in rural areas in Slovenia, where public transport options are lacking. Such 'bottom up' initiatives provide many benefits, including lower costs, lower social exclusion, better flexibility through different transport services and more rides in sparse and remote villages.

Source: https://ruralsharedmobility.eu/wp-content/uploads/2019/12/Smarta-Report-on-rural-good-practices-web-version.pdf.

Investing in circular economy opportunities for rural regions

The circular economy can drive sustainability transitions in important rural industries. The circular economy refers to a development strategy that allows economic growth by optimising the use of natural resources, minimising environmental pressures, transforming supply chains and consumption patterns and redesigning production systems (OECD, 2019[51]). Applying circular economy principles can help rural regions to identify place-based, crosscutting initiatives that enhance environmental conservation and regeneration while creating new jobs, improving food and water security, and promoting a transition to a climate-neutral and circular economy. A successful transition will require concerted efforts by the government, industrial companies, and companies in major value chains, and civil society. Rural industries, including heavy industries, mining, and the food system, will be crucial to enable transition.

The circular economy in heavy industries and mining

Resource and energy-intensive industry holds a central place in achieving a climate-neutral and circular economy. Within the European Union, the production of key materials and chemicals – steel, plastics, ammonia and cement – emits some 500 million tonnes of CO2 per year, or 14% of the EU total. Material needs are still growing and emissions from these sectors might increase as well (Material Economics, 2018[52]). Where heavy industry is located in rural areas, it not only contributes to rising emissions, but also affects water and soil, air pollution and biodiversity. A more circular economy can

enable a more productive use of materials and deep cuts to emissions from heavy industry. Several pathways to achieving net-zero emissions and a circular economy have emerged:

- **Increased materials efficiency**: Many construction projects use 30–50% more cement and steel than would be necessary with an end-to-end optimisation. Opportunities for circularity are wide-ranging and include new manufacturing and construction techniques to reduce waste, co-ordination along value chains for circular product design and end-of-life practices, and new circular business models based on sharing and service provision.
- **Material recirculation**: Already produced materials can be re-used. For example, steel recycling is already integral to steel production, contributing to reducing CO2 emissions. With plastics, more recycling and better use of end-of-life plastics (that cannot be mechanically recycled) as feedstock for new production are required. By 2050, 70% of steel and plastics could be produced through recycling using green electricity and hydrogen inputs.
- **New production processes**: As many current industrial processes link to carbon for either energy or feedstock, deep cuts often require new and adapted processes and inputs. For steel, production processes that use hydrogen instead of carbon can be explored. In cement, low-CO2 alternatives exist. Many solutions have already been developed and need urgent scale-up and deployment to reach large shares by 2050.
- **Carbon capture and storage/use**: The main alternative to mobilising new processes is to fit carbon capture and storage or use (CCS/U) to current processes. This can make for less disruptive change. However, carbon capture and storage requires public acceptance and access to suitable transport and storage infrastructure. These considerations mean that it is not an easy solution applicable to all emissions. Still, it is required to some degree to reach net-zero emissions by 2050. The more cities, regions, and rural areas invest now in circular and climate-neutral measures, the later carbon storage will be needed as an additional measure to reach climate-neutrality (Material Economics, 2019[53]).

The cyclical approach to manufacturing and resource management is also well suited to the rural mining and metals industry. Metals themselves are infinitely recyclable and the sites of mining operations have much scope to adopt a circular approach to business by linking production processes. By-products of mining, for example, can be re-used for construction materials (such as bricks or cement), glass and glazes, in agricultural forestry, or the context of wastewater treatment (ICMM, 2020[54]). Some companies are already actively using circular economy strategies for mining processes such as recycling of electronic waste, as pointed out by the OECD mining case study on Västerbotten and Norrbotten (OECD, 2020[55]).

Circular economy opportunities for the food system

Reducing food waste and valorising organic waste flows can drive a low-carbon bioeconomy as well as help build soil fertility. Circular food production and food resource management could reduce emissions by 49% or 5.6 billion tonnes CO2 emissions, which almost cut emissions from this sector by half in 2050. Important measures to achieve circularity are designing out waste along the whole value chain and keeping materials in use, combined with the development of regenerative agriculture practices in rural areas. By adopting regenerative practices, farmers can go even further, moving from carbon reduction to carbon sequestration. In this way, the soil and plants that are used to feed a growing population can be transformed into a major tool to address sustainability challenges (Material Economics, 2018[52]). The following section provides examples of circular economy food strategies for rural regions:

- **Designing out waste**: Food brands can use ‘ugly’ fruits and vegetables as ingredients for food products, such as baby food and spreads. Digital technology and supporting policy initiatives can play an important role in ensuring any surplus edible food is redistributed for human consumption,

helping divert food waste from landfill, and providing high-quality nutrition to food-insecure neighbourhoods (Ellen MacArthur Foundation, 2019[56]).

- **Keeping products and materials in use**: Surplus organic material (e.g. agricultural by-products, food preparation leftovers and municipal sewage flows) can become feedstock for other parts of the economy. Where waste streams are relatively pure, the materials can be used to produce high-value products such as fabrics for clothes, structural material for packaging and furniture, or innovative new food products. Compost contains nutrients that can strengthen soils, so that using compost in food growing can mean fewer chemical fertilisers and less irrigation are required. This consequently reduces emissions in sectors such as mining (mineral extraction), industry (ammonia production), and energy (pumping power for irrigation) (Ellen MacArthur Foundation, 2019[57]).
- **Regenerating natural systems:** Growing food in ways that improve soil health, agrobiodiversity, and local ecosystems help to improve the soil's physical structure and nurture beneficial microbes, leading to a cascade of system benefits: not only carbon sequestration, but also better water retention and reduced reliance on synthetic fertilisers (OECD, 2019[58]).

Rural areas can stimulate the take-up of circular economy approaches and solutions with strategic public procurement, clear framework conditions, and support to local and regional stakeholders. Local and regional authorities in rural areas can include circular economy considerations in their purchasing decisions by using green public procurement criteria and mechanisms such as pre-commercial procurement. This means in practice to include criteria related to maintenance, recycling and sustainable sourcing of raw materials in the procurement process. More generally, rural areas should also integrate their commitments to a circular economy into relevant strategic documents, setting out local priorities, planned measures and forms of support available. This sends a clear signal to local and regional stakeholders, enabling them to plan their activities in the long term. Creating a dedicated entity supporting regional governments to implement circular economy strategies and principles can also foster the circular economy (OECD, 2020[59]).

Fostering the bioeconomy

The bioeconomy can support environmental and energy transition in rural areas because it helps preserve natural resources and supports the restoration of environmental and ecosystem health. In the bioeconomy, all materials, chemicals and energy are developed and derived from renewable biological resources (Birner, 2017[60]). It focuses on reducing waste streams of bioresources, as well as developing new products and economic value chains based on such waste streams. According to the European Commission's new Bioeconomy strategy, a bioeconomy relies on renewable biological resources (e.g., crops, forests, animals and organic waste) and their conversion into food, feed, products, energy and services. A bioeconomy includes all primary production sectors (agriculture, forestry, fisheries and aquaculture) and all economic and industrial sectors based on biological resources (European Commission, 2018[61]).

The development of a bio-economy is often seen as a stimulus to rural development as biomass production is usually located in rural areas. The transition to a bio-economy might stimulate new business opportunities in rural areas, for example, around the development of bio-refinery facilities. The development of sustainable rural bio-economy value chains, whether product-based or service-based, offers great opportunities for rural actors in economic (i.e. generating income), social (i.e. job creation in local communities) and environmental (i.e. reduction of GHG emissions) terms (OECD, 2018[62]). One of the opportunities in developing new sustainable rural bio-economy value chains lies in strengthening the linkages between rural and urban areas, and developing new ways of ensuring that value, materials, nutrients and energy can be made to flow back to these primary sectors, to farmers and foresters.

There are overlaps and differences between the bioeconomy and the circular economy. The bioeconomy is closely linked to the circular economy agenda, as it also highlights resource efficiency, the re-use of resources, and more sustainable consumption and production patterns. However, the bioeconomy is not fully part of the circular economy as most material flows, including fossil, biomass, metals and minerals are not yet circular. In addition, many elements of the bioeconomy go beyond the objectives of the circular economy. These include aspects focused on product or service functionality such as new chemical building blocks, new processing routes, new functionalities and properties of products (OECD, 2018[62]). The Green Lab Skive in Denmark provides an example of a circular bioeconomy cluster of different firms and municipal services such as waste management and district heating that unites businesses operating with renewables and bioenergy (Box 5.4).

Box 5.4. GreenLab Skive: A circular bioeconomy case

GreenLab Skive hosts a green industrial energy park. The businesses located in the business park are supplied with sustainable energy from wind, solar and biogas energy, which are combined in an industrial mini-grid. In addition, GreenLab is currently building a large electrolysis production facility to provide green hydrogen for industrial processes and electro fuels.

The focus of GreenLab is simultaneously on the bioeconomy and the expansion of the biomass value chain, with input from land and sea, nutrients and protein extraction, and biogas production. The loops and processes include blue biomass, where starfish, an invasive species in the Limfjord, are processed into organic feedstuff for pigs and poultry. High-quality synthetic fuels and chemical products are also produced from non-recyclable waste.

A small team dedicated to energy-themes in the municipality of Skive developed the vision for GreenLab Skive. A local business foundation acted as the driver and facilitator of the development and formed partnerships around GreenLab. The strengths and vision of the project include the strong partnerships and cultural approach established in the consortium, and the combined focus on the bioeconomy and Power to X (transmission of renewable electricity to a product that can be stored, e.g. hydrogen).

The initiative has led to several positive outcomes:

- Investments of approximately DKK 1.1 billion at the end of 2020.
- Job growth and development in the Skive region, with an estimated 70 permanent jobs in 2020 and added business tourism of about 2 000 business tourists.
- International attention from Mexico, China (People's Republic of), Japan, and Gabon; and interest in system exports.
- Indicated CO2 reduction of 89 000 tons (new calculations in energy consumption).
- Accelerator for the commercialisation of new technologies.

The birth and development of GreenLab is a useful learning case for other initiatives to start small and quickly build strong partnerships between public and private entities. The initiative has also shown that policy instruments favouring open innovation and entrepreneurial spirits are important. Rural and local entities were involved in the project on equal footing with the regional, national, and the European Union level.

Source: https://pub.norden.org/nord2020-001/#18513.

Different territorial approaches exist to support the bioeconomy. Action plans for bioeconomy are designed at increasing speed all over Europe at the level of nation-states, regions, and cities. Compared to national approaches, regional strategies include the possibility to tailor the bioeconomy strategy more closely with local strengths and weaknesses. In general, the promotion of bioeconomy and related strategies is highly uneven across Europe, with a few leading regions but many more still not using their potential. Existing barriers to the bioeconomy include incompatible regulations and standards around bio-wastes; conflicting policy objectives of different ministries and departments; uncertainty over environmental impacts; "one-size-fits-all" policies; and simply an absence of consideration to rural development issues or objectives. Moreover, in countries and regions where fossil fuel economies are well developed, there are significant path dependencies caused by sunk-investments and interest groups, which bio-economy interests have to address.

Sustainable land use and food production

Sustainable land use plays an important role in rural economies and beyond. Agricultural systems, which include non-food as well as food products, livestock, fisheries, and forestry, provide the main source of food for rural and urban dwellers alike. Agriculture also contributes to economic development in rural areas, for example by providing employment. It also provides important agro-environmental services to society, such as flood risk mitigation, and resilience to droughts. Importantly, agriculture and forestry have the potential to remove carbon dioxide from the atmosphere, which can provide a significant contribution to environmental and energy transition (OECD, 2019[58]).

However, the current food system is not sustainable. It is responsible for around 30% of global greenhouse gas emissions, of which agriculture directly contributes approximately 12% of global GHG emissions and is responsible for an additional 9% of global GHG emissions each year from changes in land use, such as the conversion of forestland to cropland and grassland. The collective global effort to mitigate GHG emissions in the agricultural sector has been weak (OECD, 2019[58]). The current food system also negatively affects other aspects of well-being, such as health and the environment. Agriculture can be highly resource-intensive, using over 70% of freshwater available globally (Gruère and Le Boëdec, 2019[63]). It is also a major source of biodiversity loss, land degradation and water pollution. Agricultural fertiliser, pesticide use and livestock effluents contribute to disappearing species in fauna and flora, the pollution of waterways and groundwater, and harm a number of important ecosystem services such as pollination (IPCC, 2020[2]). In addition, malnutrition affects an estimated 2 billion people and nearly one-third of the food production is lost, causing health and sustainability issues (FAO, 2019[64]).

There are important synergies and trade-offs in land use. Land use has multiple objectives such as ensuring food security and contributing to healthy diets, limiting climate change, preserving a healthy and safe environment, and ensuring the sustainable management of natural resources. Policies encouraging food production with lower emission intensity may have a significant mitigation potential while also benefitting health (IPCC, 2020[2]). For example, a dietary shift from animal-based proteins towards plant-based proteins leads to lower CO2 emissions while also resulting in better health outcomes (Aleksandrowicz et al., 2016[65]). Important trade-offs can arise between climate policy and food security. Stringent climate mitigation policies can increase the risk for people at hunger while the amount of food that needs to be produced by 2050 to feed an estimated world population of 9.3 billion will rise by 60% (FAO, 2019[64]). Policies aiming for food-competitiveness may be incompatible with the objective of protecting the environment, too (which might entail rising rather than falling production costs). Unsustainable land management also leads to bad health and environmental outcomes and threatens ecosystem services.

An important part of sustainability transitions is that it needs to be economically viable for rural residents, including farmers and local retailers, to be accepted and implemented. This implies the need to restructure food value chains and to create new opportunities for farmers through alternative land-management opportunities. Several policy approaches can support the transition:

- Policies that look at **food value chains**, including those that reduce food loss and waste and influence dietary choices, enable a more sustainable land-use management, enhanced food security and public health, and lower emissions trajectories (OECD, 2019[26]). Roughly one-third of all food produced is lost (WRI, 2018[66]). Improving local waste management at every stage of the food chain reduces food loss and waste. Where food loss cannot be avoided, it may be re-integrated into natural nutrition cycles. Organic waste from municipal waste or crop residues can replace synthetic fertiliser. Waste can also be used to create energy, contributing to environmental and energy transition objectives (Tomperi et al., 2017[67]).
- Land-management responses, including those that enable alternative forms of agriculture, such as **organic agriculture initiatives**. Organic farming promotes the use of natural fertilisers and ecologically based pest controls derived largely from animal and plant wastes. Organic farming is growing across the OECD and covers between 10 and 20 percent of total agricultural area in some countries, notably Austria, Sweden, Estonia and the Czech Republic (OECD, 2019[68]). Organic farming can come with multiple benefits such as new business opportunities, job creation, improved ecosystem services, and positive environmental effects on soil, water and biodiversity. Effects are mixed on greenhouse gas emission reduction (OECD, 2016[69]). Barriers that prevent farmers from adopting organic farming approaches are that it requires different equipment and other costly up-front investments. It also requires more labour (Stephenson et al., 2017[70]). Rural policy makers can support organic agriculture with certification and labelling frameworks, financial incentives as well as regulations (OECD, 2016[69]). The French strategy for organic farming, Organic Ambition 2022, is an example of a strategy that aims to reach 15% of all agriculture being organic in 2022. The strategy focuses on production and consumption development and the provision of training in the agriculture and food industries (Agreenium, 2018[71]).
- An important tool for rural regions in the transformation process will be **digitisation**. Digital technologies can help reduce water and fertiliser consumption without reducing yield. However, the use of digital technology in land use in rural regions in the European Union and the OECD (Organisation for Economic Co-operation and Development) is, on average, low. A lack of technical infrastructure (e.g. broadband connectivity), as well as high start-up costs with a risk of insufficient return on investments seem to be key obstacles for the adoption of digital practices in rural areas (OECD, 2016[69]). Key elements to build effective digital strategies are the provision of infrastructure (and technology) and access to adequate financing instruments. Skills development, education, and training, covering several aspects from access to basic ICT skills in rural communities to keeping up with new developments in knowledge and technology are equally important issues to consider fostering digital farming methods such as precision farming (Box 5.5).

Box 5.5. Precision farming at the nexus of agricultural production and environmental protection

A widely cited example of the use of digital technologies in agriculture in order to increase economic and environmental sustainability is **precision agriculture**. Precision agriculture is a management approach that focuses on observation, measurement, and responses to variability in crops, fields and animals. It uses sensors to optimise the use of pesticides, fertilisers, and water (OECD, 2016[69]). It can help increase crop yields and animal performance, reduce costs (including labour costs) and optimise process inputs. All of these can help increase profitability. At the same time, precision farming can increase work safety and reduce the environmental impacts of agriculture and farming practices (Finger et al., 2019[72]). It can also make farming more attractive for young people, improve the quality of life of farmers and rural communities, and support the development of rural businesses, thus helping to fight rural depopulation (Eip-Agri, 2019[22]). Adoption rates of precision agriculture reach about 20% in the United Kingdom and Denmark. For most countries, available data on adoption rates are fragmented and often outdated because most countries do not regularly collect data on the use of precision agriculture (Lowenberg-DeBoer and Erickson, 2019[73]). The lack of sufficient technical infrastructure, including broadband access, provides a key obstacle to the expansion of precision farming. Precision farming, despite its benefits, also raises significant legal and socio-ethical questions. Among other things, the collection and processing of data within this management framework is expected to cause major shifts in roles and power relations, posing regulatory challenges (EPRS, 2017[74]).

Improving soil and water management practices can boost crop yields and ensure sustainability. For example, agroforestry, or incorporating trees on farms and pastures, can help regenerate degraded land and boost yields. When it comes to water, the agricultural sector is increasingly affected by climate-change-induced water shortages while also being a major source of water pollution. This trend is encouraged by the fact that irrigating farmers in most countries do not pay for the full cost of the water they use. Policy at farm, community, and national level needs to improve information systems on water resources, quality and risks as well to build local resistance against uncertainties associated with weather events and climate change. Water charges need to reflect its full price, including the opportunity cost of water withdrawals, accompanied by a transition policy to compensate poor farmers (Gruère and Le Boëdec, 2019[63]).

Productivity gains should be linked to the protection of natural ecosystems. Policies can affect agriculture's environmental performance by stimulating (or harming) the provision of environmental services such as carbon storage, preservation of rural landscapes, resilience to natural disasters, or pollination. Most OECD and EU countries have policies to overcome market failures to provide ecosystem services in agriculture, although the effectiveness of some of them needs improvement in order for agriculture to provide more ecosystem services (Hardelin and Lankoski, 2018[5]). This also includes reforming policies that pose a barrier to providing ecosystem services such as market price support and area-based crop-specific payment (Chan et al., 2017[18]). A widely used instrument for biodiversity conservation are Payments for Environmental or Ecosystem Services (PES). In PES schemes, people managing and using natural resources (typically forest owners or farmers) are paid to manage their resources to protect watersheds, conserve biodiversity or capture carbon dioxide (carbon sequestration). PES programmes differ in the type and scale of the ecosystem service targeted, the payment source, and the type of activity paid for (OECD, 2013[75]). Agricultural subsidies can be reformed in order to align direct payment systems with biodiversity conversation. Switzerland, for example, has reformed its direct payment system by removing direct payments to livestock farmers and increasing payments to farmers able to meet biodiversity goals such as extensive upland grazing. Transition payments were used to minimise negative impacts on farmers and environmental groups were instrumental in ensuring that those who stood to benefit from the reforms were informed (OECD, 2017[76]).

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6 Financing environmental and energy transitions for regions and cities

Preparing cities and regions for successful environmental and energy transition will require moving large amounts of investment into clean technologies and related infrastructures and away from fossil fuels, carbon-intensive or wasteful activities. This chapter explores how cities and regions can scale-up and deploy financing for transition projects. It discusses some of the barriers subnational governments face in accessing transition finance and how they can be overcome. Finally, it proposes a set of policy levers to meet investment needs and incentivise private investments.

In Brief

Cities and regions need to enhance subnational transition finance

- **Investment pathways are still inconsistent with the aim of climate-neutrality and circularity by 2050 and spending still far below what will be required**. Redirecting and mobilising resources across the financial spectrum (including from banks, institutional investors, corporations and capital markets) is therefore essential for the environmental and energy transition. Emission reductions towards net-zero and the transformation of current production-consumption systems will require supplementary annual investments in the magnitude of around 1 to 1.5% of GDP annually. Investment is likely to be significantly affected by the COVID-19 crisis, but still need to deliver the green transition.
- **Cities and regions are particularly well placed to support environmental and energy transition finance**. Subnational governments were responsible for 55% of public spending and 64% of public investment in selected sectors that have a direct implication for climate change and the environment over the period 2000-2016 in 30 OECD countries for which data are available. However, subnational climate-related spending and investments represented only respectively around 1.3% and 0.4% of GDP on average over 2000-2016, indicating a need to scale-up transition finance efforts.
- **To address the financing and investment gap, there are a number of ways forward**. First, subnational governments need more financial support from the international community and national governments, just as they need to be able to mobilise more of their own revenues to dedicate towards transition priorities, in particular tax revenues, user charges and property income. However, government budgets on their own are insufficient to cover the required investment. Therefore, private capital mobilisation through sustainable finance instruments is crucial to address the gap. To this end, banks and private institutional investors, such as pension funds and insurance companies, are fundamental actors in supporting the transition to climate-neutral economies.
- **While investor's awareness is on the rise, the challenges of attracting private investment are significant**, in particular at the subnational level, given capacity constraints and lack of creditworthiness of subnational governments. Some promising instruments to mobilise private finance exist, among them in particular green bonds and equity funds. Their exact use will differ among regions and cities and will depend on the sector in which the finance challenge occurs.
- **Scaling the use of private transition finance requires overcoming significant barriers**. These are particularly related to a lack co-operation structures between public and private actors, a lack of harmonised standards for transition finance and missing scale-up vehicles for green projects of often-small nature. While promising solutions exist for all these challenges, they need to be further developed and scaled. Subnational governments can implement a number of initiatives to overcome practical problems of particularly smaller administrations, including: (i) integrating environmental well-being gains in cost-benefit analysis; (ii) standardising project documentation; and (iii) strengthening peer to-peer learning.

Introduction

Preparing regions and cities for a climate-neutral and circular economy by 2050 requires redirecting and mobilising large amount of investment in sustainable infrastructure and business models. Governments at all levels need to set the right incentives to mobilise finance away from emission-intensive and non-circular projects. While there has been some progress, policies, government revenues and economic interests continue to be intertwined with fossil fuels, emission-intensive and linear activities. Drastic and urgent efforts are needed to redirect investment towards transformative action. Regions and cities play an important role in this context, being responsible for a large share of environmental and climate-related public spending across OECD countries. However, investment pathways are still inconsistent with the aim of climate-neutrality and circularity by 2050 and spending still far below what will be required. Redirecting and mobilising resources across the financial spectrum (including from banks, institutional investors, corporations and capital markets) is therefore essential for the environmental and energy transition. In addition to sufficient financing, the transition requires many new solutions that often go beyond technological innovation and include social innovation, new business models, behavioural changes and new governance approaches.

Regions and cities face several obstacles in mobilising public and private resources for scaling-up environmental and energy transition finance. First, subnational authorities often do not make sufficient use of their ability to mobilise revenues from own budgetary or external (public or private) sources. Another major barrier is the difficulty to give priority to green expenditure when other pressing issues need to be considered, too. The COVID-19 crisis presents such a challenge as addressing the health crisis and providing relief to affected business and workers are the main current priorities. Some subnational jurisdictions also lack the capacities to enhance green budgeting or use innovative financing tools, and/or to engage in arrangements with the private sector. A lack of project pipelines and the insufficient scale of finance provided by some subnational governments are also obstacles. In addition, obstacles and challenges exist concerning national framework conditions. These can range from inadequate regulations to instability in the legal and regulatory frameworks, resulting in uncertainty regarding technological developments. A key question is therefore how to strengthen the capacities of subnational and national governments to better mobilise and scale-up environmental and energy transition finance and related tools.

This chapter discusses the opportunities and challenges for regions and cities to scale-up and deploy transition finance. The chapter focuses mostly on financing to reach climate and energy related SDGS due to the dominant focus on this dimension in the literature. The chapter builds on the OECD-EC seminar series on “Managing environmental and energy transition for regions and cities” and in particular on the seminar entitled “Financing environmental and energy transitions for regions and cities: creating local solutions for global challenges”. The main theoretical frameworks and regional case studies were identified in or inspired by the following publications:

- Chapter 1 of this publication: “Managing Environmental and Energy Transitions for Regions and Cities: A Place-Based Approach”.
- Schoenmaker/Schramade (2019), “Financing environmental and energy transitions for regions and cities: creating local solutions for global challenges”, Background paper for an OECD/EC Workshop on 18 October 2019 within the workshop series “Managing environmental and energy transitions for regions and cities”, OECD, Paris.
- Robert (2019), “Financing Environmental and Energy Transitions in Cities and Regions: Enabling Environments and Other Conditions for Success”, Background paper for an OECD/EC Workshop on 18 October 2019 within the workshop series “Managing environmental and energy transitions for regions and cities”, OECD, Paris.

The need to mobilise financial flows for sustainable innovations and investments

Emission reductions towards net-zero and the transformation of current energy systems will require supplementary annual investments in the magnitude of around 1 to 1.5% of GDP annually. Table 6.1 includes several estimates, including globally as well as EU-wide and with different time horizons (2030 to 2040). According to recent investment scenarios of the IEA, reaching the energy-related Sustainable Development Goals (SDG 7 on universal access to energy, SDG 3 on reducing air pollution and SDG 13 on tackling climate change) will require net additional annual investment in energy production and use of around USD 600 billion in main economies across the world (IEA, 2019[1]). Several international estimates are roughly similar (Table 6.1). The OECD evaluates that USD 600 billion additional investment in infrastructure investment is required to make planned infrastructure investments climate compatible (OECD, 2017[2]). The IPCC, in its 1.5°C Report, estimates that by 2035, 2.5% of the global GDP will have to be devoted to sustainable energy-related investment every year, of which a bit more than a third constitutes additional net investment needs (IPCC, 2018[3]). The European Commission evaluates the needed increase in annual investment in energy production and use at up to 1.2% of the GDP between 2030 and 2050 to achieve the net-zero greenhouse gas emissions goal for the European Union (between 175 and EUR 290 billion annually on average, depending on the scenario chosen). Investment would gradually increase by 1% of the GDP in 2035 with the increase peaking at 2% around 2040 (European Commission, 2018[4]). By comparison, the estimated annual investments needed to meet the SDGs equates to approximately 4-6% of global economic output, of which roughly a third constitutes additional net investment needs (UNEP, 2018[5]).

Table 6.1. Estimates of additional future investment needs to reach environmental and energy transition goals

Domain	Total annual investment needs	Net additional annual investment needed compared to baseline	Climate objectives	Sectors included	Reference
SDGs (global)	USD 5-7 trillion over the period 2015-2030	USD 1.5 trillion	2030 emission objectives compatible with the 2°C and 1.5°C pathways	Key strategic SDG sectors (power, transport, telecommunications, water and sanitation, food and agriculture, climate change mitigation, climate change adaptation, ecosystems and biodiversity, health, education	(UNCTAD, 2014[6]), (UNEP, 2018[5])
Environmental and energy transition (global)	USD 2 695 billion over the period 2019-2040	USD 602 billion	well below 2 degree	All energy-related investments	(IEA, 2019[1])
Environmental and energy transition (global)	USD 1.38-3.25 trillion over the period 2016-2035	USD 830 billion	limit climate change to 1.5°C	All energy-related investments	(IPCC, 2018[3])
Environmental and energy transition (global)	USD 6.3 trillion over the period 2016-2030	USD 600 billion	limit climate change to 2°C	All energy-related investments plus transportation and other infrastructure (water, sanitation, and telecommunication)	(OECD, 2017[2])
Environmental and energy transition (Europe)	EUR 520–575 billion	EUR 175-290 billion	2050 climate neutrality	All energy-related investments	(European Commission, 2018[4])

Notes: Difference between the Sustainable Development Scenario (SDS) and the Current Policies Scenario (CPS). Energy-related investment reflect investments in the energy system (production and use). They do not include investments necessary for decarbonisation of agriculture, industrial processes and waste treatment.
Source: OECD compilation.

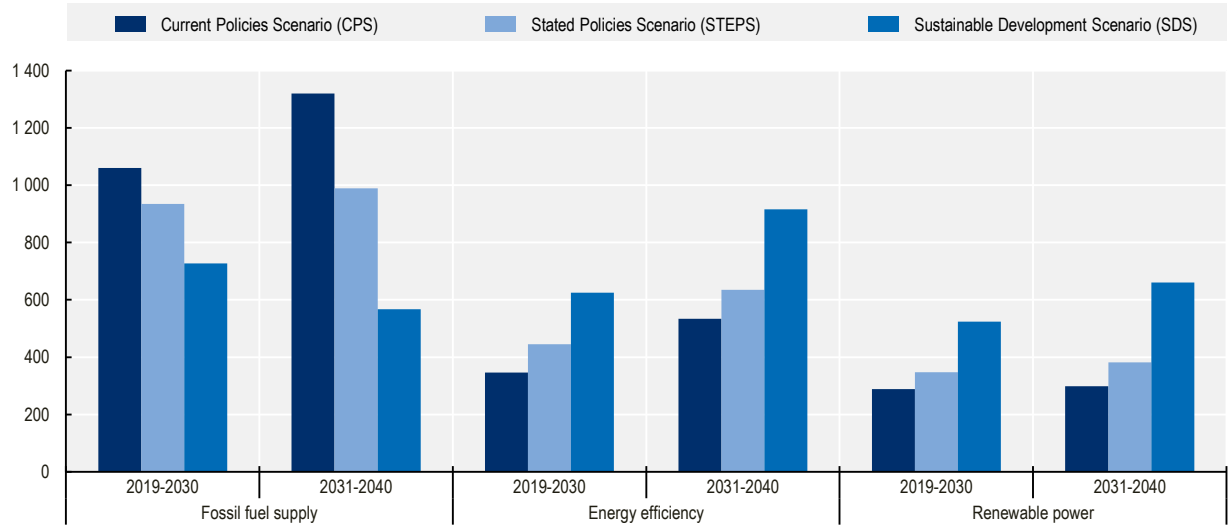
Investment is likely to be significantly affected by the COVID-19 crisis, but still need to deliver the green transition. Investment after the COVID-19 crisis is affected by lower levels of demand, higher uncertainty, supply side constraints on investment and worsening financial conditions. At the same time, the European Commission estimates that the investment needs for delivering the green transition and digital transformation are at least EUR 595 bn per year. This amount includes the additional investments needed to reach the EU's current 2030 climate and environmental policy goals, which are around EUR 470 bn per year, and the European Union's needs to pursue digital transformation, which amount to EUR 125 bn per year (European Commission, 2020[7]). It is, therefore, important to align current stimulus packages with the objectives of sustainability transitions. Stimulus packages can be designed to orient investment towards sectors and technologies that can accelerate the transition, and improve resilience to future shocks from environmental pressures. Investments in energy-efficiencies are a prominent example that offers many win-win opportunities: energy efficiency projects in construction and manufacturing can create local jobs and reinvigorate local supply chains (IEA, 2020[8]).

Aligning financial flows with zero-emission objectives and circularity is essential to deliver environmental and energy transition. Governments at all levels of government need to set the right incentives to orient finance away from emission intensive and non-circular projects, and orient it towards investments that support a rapid transformation. The world is not on track reaching these objectives. Massive reorientation of investment flows is required. IEA estimates show investment in fossil fuel supplies keep rising under current and announced policy scenarios between the periods 2019-2030 and 2031-2040 (Figure 6.1). Even though the increase is lower in the stated policy scenario, which takes into account planned policies, *both current policies and policy plans do not avoid inconsistent investment*.

Energy investment is set to fall due to the COVID-19 pandemic. Global energy demand in the first quarter of 2020 (Q1 2020) declined by 3.8%, or 150 million tonnes of oil equivalent (Mt), relative to the first quarter of 2019, reversing all the energy demand growth of 2019. The evolution of energy demand through the remainder of 2020 will depend most notably on the duration, stringency and geographical spread of lockdowns, and the speed of recoveries. Initial IEA evaluations indicate that full-year energy demand could decline by around 6%. Although clean energy investment has been relatively resilient in the downturn, investment levels remain far short of what would be required to put the world on a more sustainable pathway. In the IEA Sustainable Development Scenario (SDS), for example, spending on renewable power would need to double by the late 2020s (IEA, 2020[8]). To achieve the SDS pathway, investments need to be directed from fossil fuels to renewable energies and other low-carbon sources as well as to electricity (Figure 6.1). Additional investment costs are partially offset by lower fuel costs, which are not taken into account. The largest increases in investment are in renewables, and energy efficiency. The latter includes expenses for more efficient buildings, industrial processes and transportation as well as demand-side infrastructures, e.g. for charging electric vehicles (IEA, 2019[1]).

Figure 6.1. Annual energy investment according to different policy scenarios

USD billion



Note: The Current Policies Scenario shows what happens if the world continues along its present path, without any additional changes in policy. The Stated Policies Scenario incorporates today's policy intentions and targets. The Sustainable Development Scenario maps out a way to meet sustainable energy goals, including limiting global warming to well below 2 degrees and lowering air pollution while providing universal access to energy.
Source: IEA (2019[1]), *World Energy Outlook 2019*, OECD Publishing, Paris, https://dx.doi.org/10.1787/caf32f3b-en.

The additional investment needs depend on a range of factors. For example, rapid transformation to a circular economy or behavioural changes can reduce investment needs. Additional unknowns explaining differences in projections are transition paths, the future costs of technologies, life styles and demand patterns. They provide, however, an estimation of the magnitude of additional investments needed to meet energy and environmental transition objectives. The additional investment is net of investment that would be undertaken in the baseline but needs to be avoided in the transition. If such inconsistent investment were not avoided net additional investment would be higher.

Delaying action to a climate-neutral and circular economy results in substantially higher costs. If governments continue to invest in fossil-fuel infrastructure, they risk locking in even higher levels of greenhouse gas emissions for decades to come, and they will enhance the risk of stranded assets (Box 6.1). Such a delay would increase the transition costs and require a more abrupt adjustment at a later stage of action. According to the OECD, in a delayed action scenario where action on climate change accelerates only after 2025, GDP losses are estimated to be 2% on average across the G20 after 10 years, relative to the decisive transition, and would be higher for net fossil fuel exporting countries (OECD, 2017[2]).

Long-term infrastructure planning is key. Failure to invest in the right type of infrastructure in the next decades would either lock the world into an emission-intensive development pathway or enhance the risk of stranded assets. At the same time, current policies tend to foster an incremental approach towards climate policies with some progress on developing and implementing policies towards sustainable infrastructure. Long-term strategies can provide a powerful tool for governments and non-state actors to drive transformational change. They can help create consensus on economic trajectories, provide long-term signals to markets and inform near-term investment decisions. Long-term planning needs to take into account the opportunities and challenges of digital technologies, ranging from enabling technologies (e.g. the Internet of Things) to sector-specific technologies (e.g. electric vehicles) to new business models (e.g.

ride sharing) and digital finance systems (e.g. Pay-as-you-go systems). They can make pricing of infrastructure services more efficient, e.g. to enable optimal use of renewables or optimal use of road infrastructure and replace fossil fuel taxes, thereby providing revenue streams and reducing infrastructure cost. The use of long-term scenarios and strategic foresight techniques can help taking into account how socio-economic and technological pathways might shape future infrastructure supply and demand. Back casting techniques can help by working backwards from the objective of climate-neutrality by 2050 to unveil investment decision needs and trade-offs along the road (OECD/The World Bank/UN Environment, 2018[9]). Recognising the pivotal role cities and regions play in advancing climate and circular action and mobilising investment needs, developing long-term infrastructure plans provides an important opportunity to align national, regional, and local action.

Box 6.1. Dealing with stranded assets

A resource becomes an asset when it is commercially invested in and used. This asset becomes stranded when it is prematurely retired (i.e. e.g. a coal power plant closing before it has recouped investment as its electricity is no longer competitive). The more long-lived assets are they sooner new investments in them risk stranding if they are consistent with the zero-emission and circular transition.

Environmental and energy transition implies phasing out technologies and business models that are inconsistent with reaching environmental sustainability objectives, such as new coal power plants, fossil fuel passenger cars or deforestation (Kuramochi et al., 2018[10]). This can be difficult because businesses, workers, and citizens who gain income and wellbeing from these technologies and business models resist. Governments may be expected to offer compensation of losses to overcome resistance. The Just Transition Mechanism, launched by the European Commission in 2020 under the European Green Deal, is an example of a scheme that provides financial as well as technical and advisory support to coal and other carbon-intensive regions in the European Union (see Box 2.5). Governments also need to support new and alternative growth trajectories that support the transition. Moreover, such compensation can give rise to expectations among investors that they may receive compensation for upcoming investment decisions, which are inconsistent with the environment and energy transition, aggravating the stranded asset problem.

Cities and regions play a key role in advocating phasing out unsustainable pathways. Cities and regions can do so with public infrastructure investment decisions, with bans or regulations, removal of implicit or explicit subsidies and targeted financial incentives, which make a technology more or less attractive. Although explicit phasing-out policies are still quite rare, several cities (e.g. London or Madrid) have for example introduced or announced restrictions or bans on petrol and diesel cars.

Cities and regions are particularly well placed to support environmental and energy transition finance. On average, across the OECD, the largest share of climate-related public spending occurs at the subnational level. Recent estimates show that cities and regions were responsible for 55% of public spending in selected sectors that have a direct implication for climate change over the period 2000-2016. Compared to spending, an even larger share of environment and climate-related public investment occurs at the subnational government level. On average, subnational governments are responsible for 64% of environmental and climate-related infrastructure investment over the period 2000-2016. However, subnational climate-related spending and investments represented on average respectively around 1.3% and 0.4% of GDP over 2000-2016, indicating a need to scale-up transition finance efforts (OECD, 2019[11]).

Encouraging circular economy business models supports the transition. Circular business models are important to finance and scale sustainability transition because they significantly reduce the environmental pressure associated with economic production and consumption and support a more resource efficient economy. This includes efforts to promote more efficient material use, for example through better

product design, re-use, and recycling of materials such as steel, aluminium, cement and plastics. Cities and regions can facilitate the emergence of circular business models through circular labs and a flexible regulatory framework under which new business models can be developed and tested. Subnational governments can further promote the supply and demand of circular products and advocate their use through education and information programs among citizens and consumers (see Chapter 3 on the circular economy).

Clean energy investment is growing, but not rapidly enough

Growing volumes of sustainability transition finance highlight the importance of environmental and energy transitions for the financial sector. The financial sector has expanded the range of environmentally friendly products and services significantly and is beginning to include environmental considerations in its financial decisions. Subnational governments are playing an increasingly important role in financing sustainable investment projects, particularly in the areas of transport, water infrastructure and public buildings. The financial sector is providing products to finance clean energy and electrified transport (CBI, 2019[12]). Sustainable investments in other sectors are increasing more slowly and need to be scaled further.

Investments in clean energy are increasing. Investment in renewable energy has grown significantly in the past decade. Overall, clean energy investment has increased from around USD 60 billion in 2004 to an average of USD 300 billion a year in the past decade (IEA, 2019[13]). Many investors choose to invest more in sectors that support the energy transition, and less in areas that are perceived as risky. In addition, a number of financial investors have signalled restrictions on financing coal assets due to the potential (future) risk of investing in stranded assets (ibid).

However, the still modest share of renewable energies in global energy supply offsets the impressive growth rate. Coal had the largest share of global electricity generation at 37% in 2018, compared to 7% in wind and sun (although it should be noted that when combined with all other carbon-free sources, including hydropower and nuclear power, 36% of low-carbon electricity was accounted for) (IEA, 2019[1]). Low-carbon investment in non-electricity sectors is increasing, but need to be scaled up even more. The transportation sector saw robust growth in low-carbon investments due to falling battery costs and financial incentives. Tax incentives, low operating costs and air pollution and fuel consumption standards have led to continued growth in electric vehicles in particular (IEA, 2019[14]). However, one has to bear in mind that the sale of electric vehicles is still only a fraction of the 87 million cars that were sold worldwide in 2018. Although the proportion of new cars is expected to increase to 30% in 2030 and 57% in 2040, electric vehicles will only make up 9% in 2030 and 30% in 2040 of all passenger cars on the road (Bloomberg, 2019[15]). Progress on road freight, air and shipping is slower. Investment in the buildings sector is also behind (IEA, 2019[16])(see also Chapter 4).

The industrial and land use sector, including agriculture, still has to make significant low-carbon investments. In 2018, only 2% of revenue from green bonds was earmarked for low-carbon projects in the industrial sector and 10% in the land use sector (CBI, 2019[12]). At the same time, heavy industry, heavy goods transport and land use contribute more than 50% to global annual emissions (ETC, 2018[17]). Their emissions are also still expected to increase with current policies while other parts of the economy, such as the electricity and building sectors, are increasingly decarbonising, albeit at too slow a pace.

Mobilising transition finance requires investment from public and private actors

A large range of actors operates in the sustainable finance arena and performs different functions across the investment chain. Table 6.2 outlines two main categories of actors: Policy makers and public finance actors on the one side, and private finance actors on the other. Policy makers in national, regional and local governments set public policies that establish the frameworks, conditions, and priorities for investments. For example, subnational governments can set sectoral standards to drive investments in a

particular direction, or they can establish the necessary legal framework so private low-carbon investments generate revenues. Public subsidies can make projects investable where costs or uncertainty would otherwise be too high, and they can support early-stage R&D for new technologies.

The private sector and the financial system play a key role in supporting transition pathways. However, current financial sector practices are not yet very suitable for financing environmental and energy transitions since the finance structures of private investors (e.g. investment mandates and asset classes) are too often incompatible with the financial needs and capacities of subnational governments. Efforts to align financial flows with climate objectives remain incremental and fail to deliver the radical transformation needed (OECD, 2019[11]). One big challenge for sustainable finance is therefore to better align current public and private actors in transition financing.

Table 6.2. Categories of actors: Public policy, public finance, and private actors

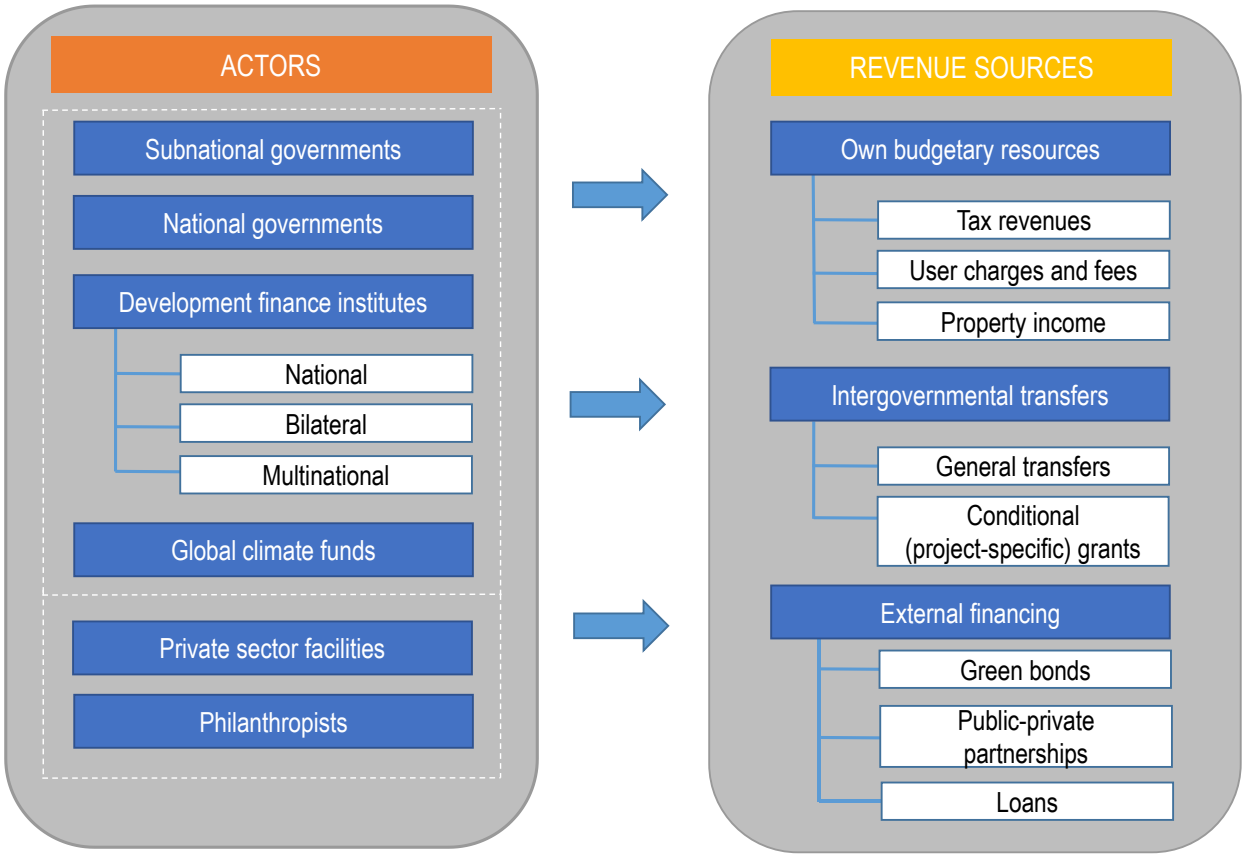
Categories of actors	Main roles in the financial system
Policy makers and public finance actors	• Local and national policy makers play a key role in guiding and supervising environmental and energy transitions through setting targets, policies, technology standards, and regulations. Policy provides the enabling framework for private-sector engagement in the climate-neutral transition. Local governments can be instrumental in the creation of frameworks to incentivise investment. Critical public policies also include creating fair, predictable, and transparent rules that increase transparency and help investors find green projects. • Public finance includes government finance and public finance institutions such as public banks. While public budgets on their own are not sufficient to finance the transition, they can help improve the viability of low-carbon investments by increasing returns through for example subsidies and tax incentives, green public procurement or R&D funding for new technologies. Public budgets can be important first movers in opening up green markets and catalysing private sector capital to green projects. They employ a range of instruments such as partial blended finance, partial guarantees, project preparation and political risk insurance.
Private finance actors	Private finance actors include institutional investors such as pension funds and insurance companies, banks, project developers, asset managers, and asset owners. While private finance tis well positioned to play a significant role in the transition, it must to so profitably. Return on investment is a crucial driver for investment decisions. Privately financed projects need therefore to generate revenues and have risk-return profiles matched to investor requirements. The extent to which these conditions can be meet at the level of cities and regions varies across sectors, technologies, and geographies.

Source: Own compilation based on Robert, A. (2019[18]), "Financing environmental and energy transitions in cities and regions: Enabling environments and other conditions for success", Background paper for an OECD/EC workshop on 18 October 2019 within the workshop series "Managing environmental and energy transitions for regions and cities", OECD, Paris.

Sources of environmental and energy transition finance for cities and regions

Financing environmental and energy transitions in cities and regions will necessarily draw on a diverse array of transition finance actors and revenue sources. Figure 6.2 provides an illustration of main actors and revenue sources to support transition finance. Three core mechanisms to channel transition finance are: i) greening subnational governments' traditional budgetary resources through earmarking budgets for transition objectives; ii) mobilising transfers from higher levels of government; and iii) and making use of external finance mechanisms and attracting private investors, including through certified green bonds and loans as well as public-private partnerships. Often, subnational governments do not use one tool at the expense of another, but deploy a mix of inter-governmental transfers, own revenues, and external credit to finance environmental and energy transition. External finance only holds a small percentage of cities' overall investment finance across the European Union. According to the 2017 Investment Survey of the European Investment Bank (EIB), it only represents 18% of municipalities' investment finance.[1] Overall, municipalities resort mainly to own resources. Yet, many investments are economically viable and thus well suited for external finance (Windisch, 2019[19]). This points to a number of challenges smaller municipalities face in accessing loans, funds and other types of external financing, including limited expertise and administrative challenges.

Figure 6.2. Overview of transition finance actors and revenue sources



Source: Own compilation based on Robert, A. (2019[18]), "Financing environmental and energy transitions in cities and regions: Enabling environments and other conditions for success", Background paper for an OECD/EC workshop on 18 October 2019 within the workshop series "Managing environmental and energy transitions for regions and cities", OECD, Paris.

Deployment of own revenue sources

Many of subnational governments' sources of revenue can be designed to foster the environmental and energy transition and help finance it. Own-source revenues include taxes levied by subnational governments, user charges and fees, and income from assets, which local and regional governments can use to finance green investments as well as encourage more environmentally sustainable use. Exploiting the potential of taxes set by subnational governments means at least to eliminate any anti-green bias of some local tax provisions. For example, property taxes should support the development of urban cores and transport linkages instead of favouring urban sprawl (OECD, 2019[11]). Fees that can both raise revenue and support environmental and energy transition include congestion charges, parking fees, high occupancy toll lanes, and water and wastewater user fees (Merk et al., 2012[20]). Some subnational governments have also introduced carbon-pricing schemes, although these are more efficiently used at higher government levels. Fees should reflect all costs, including environmental costs. This can improve incentives as well as revenue streams for subnational governments and their public enterprises. These revenues can leverage investment, for example, in infrastructure for more sustainable water use. Using revenues from charges to invest in sustainable infrastructure and protect vulnerable groups upfront also tends to improve citizen support for them (Kallbekken and Aasen, 2010[21]; Baranzini and Carattini, 2017[22]; Kallbekken, Kroll and Cherry, 2011[23]). Property income and land-based financing instruments help local authorities reclaim gains from investments or changes in land regulations, thereby generating revenue that may be used to close some of the funding gaps of environmental and energy transition.

Many subnational governments are able to raise revenue through sources they control, but this varies greatly. In many OECD countries, subnational governments have constitutional rights and/or local government financial laws, which gives them the right to raise taxes. In some other OECD countries, in particular in the United States, voters must approve tax increases for specific purposes, such as infrastructure investment. This requires making a much stronger link between the rates payers must contribute and the benefits they enjoy in return. Where local governments are allowed to alter local taxes as needed, creditworthiness of local municipalities is reinforced. In Sweden, the local government-funding agency *Kommuninvest* makes use of the high creditworthiness of Swedish municipalities to help them raise capital through the issuance of bonds, which it places in Europe, Japan and other countries.

Support from higher levels of government to finance green investment

The international community and national governments have made strong commitments to support environmental and energy transition, but the access they provide to finance it remains limited for cities and regions. Several multilateral banks such as the World Bank, bilateral banks, and global climate funds such as the Green Climate Fund and the Special Climate Change Fund have earmarked funding they provide for the transition. However, most support is channelled through national governments, with limited access for regional and local governments (OECD, 2019[11]). A notable exception is the European Union, which invests directly in regions and cities through the cohesion policy funds.

National governments provide grants/transfers and subsidies. Systematically integrating environmental conditions into general and project-specific grants would allow national governments to nudge regions and cities to support the transition more strongly. Specific grants could also be established to support green projects, and to compensate for potential local costs generated by green policies (OECD, 2019[11]). An example of an intergovernmental transfer dedicated to transition funding is Germany's National Climate Initiative (Box 6.2).

Box 6.2. Making use of inter-governmental transfers: the German National Climate Initiative (NCI)

Germany's most significant tool to support subnational green finance is the National Climate Initiative (NCI). Over 2008-2017, the NCI invested close to EUR 800 million of governmental funding in over 25 000 projects domestically. The NCI funds activities across a range of sectors, including transport, energy and sanitation services. Funded activities include consultation, climate action planning as well as infrastructure.

A recent evaluation concludes that the NCI added approximately EUR 1.8 billion of total gross investments. About 16.8 million tonnes of lifetime CO2 emissions were saved compared to a reference development. With respect to employment, the evaluated projects/programs directly involved more than 14 000 persons (full-time annual equivalents, gross), for example as climate managers or technicians for the installation of the respective equipment. Indirect jobs in the supply industries for renewable energy technologies, micro-CHP and commercial cooling systems were derived using an input-output model for Germany and amounted to approximately 35 000. In addition, NCI projects seemed to have raised awareness among consumers, businesses and municipalities on climate action. The evaluation recommends involving municipalities more strongly in future climate change activities.

Replicating this approach in another country would require similar commitment to financing green investments. However, useful lessons can be drawn from the leveraging effect of NCI's grant funding. National governments interested in funding green investments on a smaller scale than the NCI could benefit from prioritising projects with the potential leverage of additional investment at the regional and local government levels.

Source: BMU (2018[24]), *Climate Action in Figures*, Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU); Schumacher, K. et al. (2019[25]), *The German national climate initiative – evaluation of its impact and success factors on the occasion of its 10-year anniversary*, European Council for an Energy Efficient Economy.

Accessing capital markets and attracting private investors

Private finance can help close funding gaps. Banks and private institutional investors such as pension funds and insurance companies are fundamental actors in supporting environmental and energy transitions, but the private sector provides thus far only a small share of transition finance. Subnational governments face bigger challenges than national governments in accessing private capital due to a lack of creditworthiness and a lack of capacity to access sustainable finance instruments, such as green bonds. In addition, subnational governments are not everywhere allowed to borrow on capital markets. In many unitary countries, bond financing by local governments is not allowed. This is for example the case in Denmark, where subnational governments only issue bonds jointly through *KommunKredit*. Other countries, such as Greece and Ireland, do not issue subnational bonds. Even when they are allowed to issue bonds, they are not widespread, especially in Europe where loans is the preferred source of external financing. By contrast, in the United States and Canada, bonds represent more than 90% of the subnational government debt stock (OECD/UCLG, 2019[26]). Despite these limitations, green bonds gain prominence in some countries, notably in France, where subnational green finance includes a prominent role for green bonds (Box 6.3).

Public-private partnerships (PPPs) represent an important potential source of external funding. PPPs are a long-term contract between a private party and a government entity for providing a public asset or service, with some of the risk and management responsibility shifted to the private party. Although the average value of PPPs is generally higher at the national level, the number of PPPs is often greatest at subnational level (OECD, 2018[27]). For example, in Germany, subnational PPPs constitute approximately 80% of PPP investment. In France, subnational governments granted 79% of the *contrats de partenariat* between 2005 and 2011. Subnational PPPs come however not without risks. Challenges emerge in areas such as financing and funding (private borrowing costs might be higher than public ones for example, raising the costs of the PPP project overall) , intergovernmental regulatory coherence, cross-jurisdictional co-ordination, economies of scale and asymmetric information between the contracting parties, which may put local governments at a disadvantage (OECD, 2019[11]). Given the need for large administrative capacity and accountability to deal with these challenges, using PPPs to finance environmental and energy transitions will likely be limited to larger jurisdictions, metropolitan areas or regions with sufficient capacities.

Box 6.3. Subnational green bonds in France

Three regions were the first issuers of green bonds in France, in 2012: Ile-de-France, Nord-Pas-de-Calais, and Provence-Rhone Alpes. Ile-de-France was the largest of these, and as of 2018 had issued three green bonds, for a total of EUR 1.5 billion in outstanding debt. The majority of green bond proceeds (both public and private) go to energy and buildings (61%). Paris has also issued its first green bond, under the name *Fonds Vert*, which raised EUR 100 million as of July 2018. Successful experiences also pave the way for other subnational governments to issue their own green bonds. Most recently, the Pays-de-la-Loire Region raised EUR 100 million in 2018 to fund building and transport projects related to the energy transition.

The strength of the country's green bonds market derives in part from best practices in reporting, certification and external reviews, which increases investor confidence. Nearly all green bond issuers use external reviews (97.5% of bonds by value), and reporting on green bond portfolios have demonstrated transparency. As the country does not have a system for pooling subnational loans, the ability to issue a green bond depends on a local government's borrowing capacity. Green bonds are a viable financing tool only for local governments with sufficient revenues and borrowing capacity. In practice, only large cities (e.g. Paris) and regions have had the capacity to make use of green bonds to fund their investments related to the energy transition and the circular economy. Intergovernmental grants remain another important source of green funding for subnational governments. The *Territoire à*

Energie Positive pour la Croissance Verte grant program provides grants to local governments to support the energy transition.

The case of France points to the need for national regulatory frameworks and standards that increase transparency and investor confidence. This is particularly important in the absence of subnational finance pools, as individual subnational governments pose a greater credit risk than those that have pooled their risk together, thereby diversifying it.

Sources: (CBI, 2018[28]; METS, 2018[29]; Municipality of Paris, 2019[30]; Région Pays de Loire, 2018[31]).

What are the main obstacles cities and regions face in making use of environmental and energy transition finance?

Local and regional authorities face a range of barriers that can hinder the scaling and deployment of transition finance. The below section lists some of the core obstacles as identified through the OECD seminar and further desk research.

- **Lack of awareness about transition finance options**: Cities and regions have a wide range of potential tools at their disposal to finance sustainability innovations and related infrastructure, but they are not always aware of all of them. As cities and regions often primarily rely on public funds to finance environmental and energy objectives, there is a particular lack of knowledge about the use of private financing (e.g. green bonds, blended finance). Not being aware of all available financing options makes it difficult to identify and select the best financing instruments to support planned investments in sustainability innovations (Schoenmaker and Schramade, 2019[32]). Dedicated training for cities and regions, such as the Cities Climate Finance Training funded by the Climate-KIC (Institute for Climate Economics, 2019[33]), can help here by informing local authorities about how financial opportunities are can be best used.
- **Insufficient technical knowledge to carry out projects**: Insufficient administrative capacity is one of the biggest obstacles to access transition finance at the local level. Even when local and regional authorities have identified the most suitable instruments for transition finance, the associated administrative effort and securing of funding can be challenging. Larger projects in particular require a good understanding of technical knowledge, the preparation of a risk assessment and detailed financial analysis. Not all local and regional authorities have the necessary human resources and skills to undertake such efforts. New skills, such as financial and risk management skills, and technical knowledge on how to measure the sustainability and financial benefits of urban and regional development projects must be acquired. Local and regional authorities can often build on existing knowledge and resources from domains such as urban and infrastructure development, public engagement and communication and develop them further. It is particularly important to avoid silo work in city and regional administrations and to create a regular exchange between the finance department and the environmental and climate department that helps acquiring much-needed skills and expertise (Robert, 2019[18]).
- **Budgetary, regulatory, and political constraints**: Fiscal constraints and "mandatory" expenditures can lead to a lack of room for manoeuvre. Increasing administrative capacity for transition financing might require hiring of new personnel or buying outside expertise, which not every local and regional authority can do. Additionally, many budgets at subnational-level require long-term planning and accountability, making experimentation and financing of risky projects difficult. Another issue is that legislation on financing of municipal investments varies across countries. Some subnational governments are legally constrained in taking on debt. Political reluctance can have various reasons, including low public acceptance of transition projects (for example where "more pressing issues" such as fighting unemployment exist), and vested interests profiting from the status quo (Røpke, 2016[34]).

Overcoming financing challenges: Scale-up and deployment of transition finance

Scaling-up and deploying transition finance means that subnational governments must play a more proactive role than in the past in financing the transition. Because the local context often plays an important role in determining investment needs, local levels play an important complementary role to national governments. However, subnational governments often lack the knowledge and ability to structure transitions in such a way that they can attract private funding. Therefore, although recent trends in climate finance are promising, too few and too small transition projects are currently being carried out, which hinders the timely transition to a climate-neutral and circular economy. This section outlines how building subnational capacities, creating clear signals for investors and facilitating investment as well as deeper financial reform can help scale transition finance.

Building subnational capacities

Subnational authorities face a range of practical challenges due to a lack of capacity and expertise. For example, a recent study on the climate efforts of 13 small and medium-sized cities in the Netherlands showed that even where there were good practices in transition management and finance, there are few exchanges between municipalities. A lack of co-operation and a low level of awareness of existing best practices meant that good initiatives were not repeated in other municipalities, which led to missed opportunities for local measures to support environmental and energy transition (Boehnke et al., 2019[35]). Subnational governments can implement a number of initiatives to overcome practical problems of particularly smaller administrations. This section highlights some examples and suggestions:

- **Valuing co-benefits in cost-benefit analysis**: Many environmental and energy transition investments in cities and regions offer significant co-benefits such as better health and job opportunities. For example, in the transportation sector, greenhouse gas emissions and air pollution have a common source that also causes congestion, accidents, and noise. Addressing these problems at the same time will create the potential of large cost reductions, as well as the preservation of ecosystems and health improvements (Rashidi, Stadelmann and Patt, 2017[36]). One way of translating co-benefits into policy evaluation is through monetising the impact of co-benefits on the financial rate of return. For this purpose, cost-benefit analysis should include environmental and social criteria, including shadow carbon pricing, that make environmental costs and benefits part of a broad economic analysis.
- **Enhanced use of tools via templates and protocols**: National or international standards can reduce the workload of subnational authorities. By standardising the documentation and assessment of projects contributing to transition, such as energy efficiency projects in buildings, assessing the economic and environmental feasibility of a project becomes easier. The Horizon 2020 funded project *Investor Confidence Europe* has, for example, developed the *Investor Ready Energy Efficiency Certification*, which assembles best practices and existing technical standards into a set of Protocols that define a clear roadmap for developing projects, determining savings estimates, and documenting and verifying results (ICP Europe, 2020[37]).
- **Peer-to-peer learning between subnational authorities and smaller cities/communities**: Regional peer learning provides a platform to discuss reforms, achievements and challenges on integrating environmental and energy transition finance into national and subnational budgets. It can provide a regular opportunity for government officials to meet face to face and discuss transition finance. Workshops and consultation groups can help smaller cities and communities to exchange and learn from each other. Thematic working groups can be set up to deal with technical details of the market for sustainable finance. Co-operation via regional agencies, associations and NGOs can also help spread good practices and replicate initiatives in a cost and time-efficient manner (Schoenmaker and Schramade, 2019[32]).

- **Overcoming limited expertise through outsourcing of project pre-evaluation to regional experts**: Outsourcing the financial evaluation of green projects to external contractors can facilitate access to finance because it reduces the in-house expertise and associated project risks. This is particularly relevant for smaller cities in which the number of bankable projects is limited and where less know-how can be accumulated internally. In the city of Oostende in Belgium, an independent company, fully owned by the city, manages the whole life cycle of green energy project finance (Windisch, 2019[19]).

Creating clear signals for investors

Cities and regions can deploy several policy instruments to reorient capital flows. Subnational governments can increase returns on investments in sustainability innovations and related infrastructures through well-known policy tools such as financial incentives, regulations and standards to increase returns and reduce risk ratios. Many environmental and energy projects have unattractive risk-return profiles due to technological risks (especially for less mature innovations), commercial risks (especially if sustainability innovations are more costly or have uncertain business models) and long payback times (Schoenmaker and Schramade, 2019[32]).

In order to reduce risks and stimulate investments, policy makers at all levels of government have a mixture of tools at their disposal. These tools can help create markets for sustainability innovations and provide a clear signal of intended development pathways. Selected tools in relation to energy investment are, for example, minimum performance standards for energy efficiency in buildings or purchase subsidies for electricity storage (IEA and IRENA, 2017[38]). However, the rate of return is only high as long as the policy signals are in effect or as long as their effects continue. Sudden shifts in policy priorities may represent an important source of risk that can significantly undermine investor confidence.

Combining investment sources through 'blended finance' mechanisms can also increase financial flows. Blended finance uses relatively small amounts of public funds to mitigate specific investments risks and help rebalance risk-reward profiles of high-impact investment so that they have the potential to become commercially viable over time. This requires deciding the appropriate role for the public sector. For example, public/private co-financing of large solar power projects in mid-income countries was appropriate when the technology was untested, but now such projects can be done privately. Subnational governments need also to balance risk taking and risk avoidance to take on as much risk as needed but not more (Schoenmaker and Schramade, 2019[32]). Providers of concessional finance and institutional investors can help build the capacities of subnational authorities to engage meaningfully in the design and implementation of blended finance deals.

Facilitating investments by financial institutions

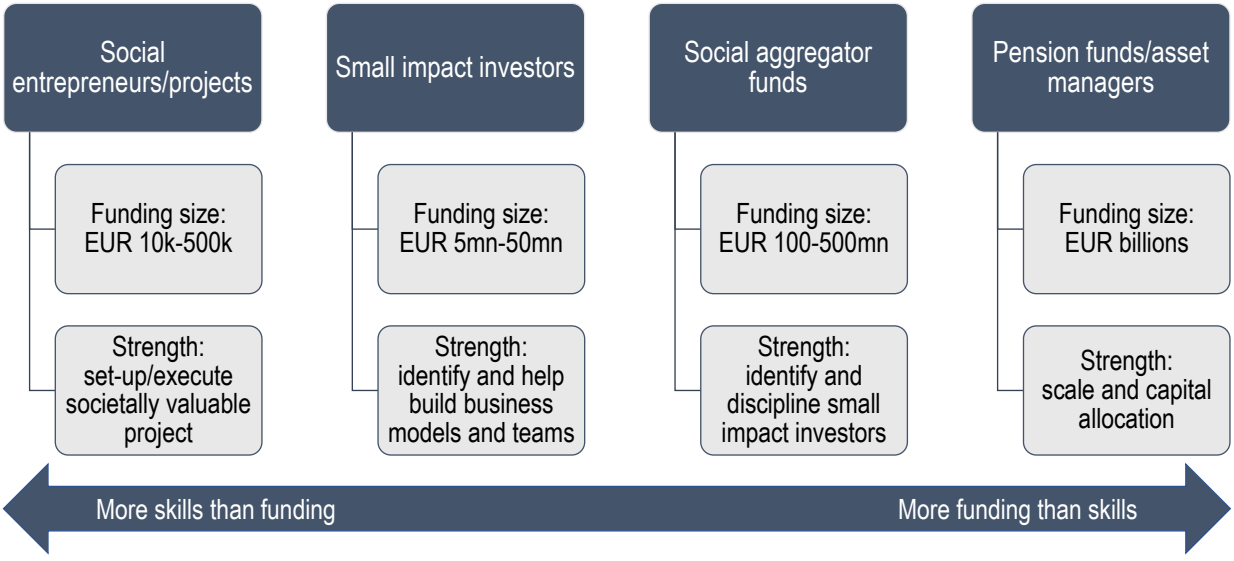
Policy interventions should address barriers that hinder investments by large financial institutions. One key issue for banks and institutional investors is a lack of a transparent project pipeline with high quality and sizeable projects that offer stable investment returns. Energy efficiency investments, for example, are potentially large in numbers but are often small and distributed across numerous households and businesses, implying high transaction costs. Responding to this challenge is likely to involve developing technical and knowledge capacity at the level of subnational governments to help ensure a steady pipeline of good-quality projects (OECD/The World Bank/UN Environment, 2018[9]).

Another useful approach involves standardisation and securitisation, i.e. bundling together small projects or assets (such as green mortgages) into a larger pool so that they can be traded in financial markets. This can be particular attractive for cities and regions, which often struggle to attract private finance because municipal or regional projects with financing needs are often too small in volume to be attractive for private investors and lack suitable aggregation mechanisms. Bonds for example

typically need to have a size of USD 200 million to be relevant for institutional investors (CBI, 2019[12]). Inter-municipal co-operation can help upscale projects and co-operation across jurisdictions. Cities and regions can encourage the creation of two types of organisations that stand between small projects and large institutional investors (see Figure 6.3 below):

- **Small Impact Investors**: Small impact investors provide funding and advice to companies that deliver sustainable financial and social returns. They often focus on a single city or region and can use their local network and knowledge. An example of such a Fund is the Social Impact Fund Rotterdam. The Fund is part of a local network of actors that help each other to advance the environmental and energy transition.
- **Social Aggregator Funds**: Social Aggregator Funds invest in dozens of small impact investors who choose them for their ability to create both financial and social value. Aggregator funds exist for traditional private equity, but aggregate funds with an impact goal are still rare.

Figure 6.3. Bridging the gap between small projects and big finance



Source: Schoenmaker, D. and W. Schramade (2019[32]), "Financing environmental and energy transitions for regions and cities: Creating local solutions for global challenges", Background paper for an OECD/EC Workshop on 18 October 2019 within the workshop series "Managing environmental and energy transitions for regions and cities", OECD, Paris.

Green bonds and sustainability bonds provide another mechanism for increasing large-scale institutional investments. Green bonds are an instrument, to finance green projects that deliver environmental benefits. The green bond market has expanded rapidly rising from global issuance of USD 3.4 billion in 2012 to USD 167 billion in 2018. Sustainability bond issuance in 2018 totalled USD 21 billion; representing 114% growth compared to 2017. Subnational governments are increasingly active in the green bond market, accounting for 13% of green bonds issued in 2016, with budgets earmarked for investment mainly in transport, water infrastructure and public buildings (CBI, 2019[12]).

The growing interest in Green Bonds is representative of an aggregate increase in impact-based investing, or investments with intended social and environmental benefits. These securities are a unique form of ESG (Environmental, Social, and Corporate Governance) investing and face many of the same issues and benefits as the larger impact investing market. These include struggling with defining objective metrics to value the impact achieved and incentivising investors to divert their capital into more

sustainable businesses and projects. Social impact investing can reduce investors' exposure to the risk of investing in stranded assets through a diversification of investments into sustainable assets such as clean energy equities and green bonds.

The green bond market also holds some challenges. First, greenwashing, meaning unsubstantiated claims about a product's environmental benefits, needs to be avoided. Second, despite its rapid growth, green bonds today account for less than 1 % of the global bond market. One of the reasons for such a low number is that the ongoing flow of investments into fossil fuel exploitation continues to overshadow global investments in renewables (OECD/The World Bank/UN Environment, 2018[9]). While green bonds can reduce investors' exposure to stranded assets through a diversification of investments into more low-carbon assets such as green bonds, they do not avoid that parallel investments into (still profitable) stranded assets continue. Whether green bonds increase financing flows to "green" projects depends on whether investors are willing to accept a lower return on them. Green bonds may also suffer from multiple certification standards. Broader and more consistent disclosure of risks from investments according to how consistent they are with the environment and energy transition could strengthen investors' willingness to price the funding they are willing to provide in line with the transition (see below).

Deeper institutional reform

A deeper layer of policy reform could address mainstreaming of environmental and energy transition concerns into the financial sector and its regulation. Deeper institutional reform could help overcome structural problems such as short-term oriented returns in the financial sector or a lack of focus on incentives that support sustainability transitions.

Additional measures could seek to reformulate institutional rules and formal expectations of financial actors. Cities and regions can play an important role in advocating for such reforms. Reforms should include strengthening classification systems for sustainable investment. An important first step in this direction has been the political agreement between the European Parliament and the Council on the creation of a taxonomy of sustainable finance from June 2020 (Box 6.4). Based on advice from the Technical Expert Group on Sustainable Finance, a list of sustainable economic activities as well as a standard for green bonds is currently under development.

Box 6.4. The European Union taxonomy on sustainable finance

The European Union taxonomy regulation provides a classification system for sustainable economic activities, with the aim to create a common language that investors can use everywhere when investing in projects and economic activities that have a substantial positive impact on the climate and the environment. By enabling investors to re-orient investments towards more sustainable technologies and businesses, the regulation is instrumental for the European Union to become climate neutral by 2050. The regulation is based on an action plan on financing sustainable growth and a subsequent proposal for a sustainable finance taxonomy, put forward by the European Commission in March 2018 and adopted by the European Parliament in June 2020.

Source: European Commission (2020[39]), Sustainable Finance: Commission welcomes the adoption, https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1112 (accessed on 16 August 2020).

Strengthening disclosure responsibilities is an important part of redirecting financial flows because it requires companies to inform investors about sustainability performance and related financial risks. Disclosure can help investors, financial intermediaries and governments avoid financing stranded assets. Disclosure could be based on the recommendations of the Task Force on Climate-related Financial Disclosures and the European Union taxonomy. Linking public funding of regional infrastructure or development projects to improved disclosure and its results can also contribute to environmental and climate goals.

Financial supervision is increasingly addressing sustainability considerations. In April 2019, the Network for Greening the Financial System (NGFS) recommended to include climate risks in the monitoring of financial stability. Some countries have already followed these recommendations. Since 2015 - even before the NGFS recommendations were published - Article 173 of the French Energy Transition Act requires institutional investors to report on how they incorporate environmental, social, and governance (ESG) criteria into their investment policies (National Assembly of France, 2015[40]). In April 2019, the Bank of England issued a supervisory statement that calls on the United Kingdom banks and insurers to embed climate risks in corporate governance and risk management and to improve climate-related disclosure (Bank of England, 2019[41]).

Some researchers have suggested changing the mandate of central banks. The narrow focus on price stability and financial stability and regulation could be broadened in OECD countries (Campiglio et al., 2018[42]). In many emerging economies [Brazil, China (People's Republic of)], central bank mandates are broader and focus on economic development or provide support for strategic sectors. Changes in central bank mandates could, for example, enable green quantitative easing. This could lead to green bond purchases and to investments in financial assets supporting environmental and energy transition projects.

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Note

[1] Only cities and municipalities with 100 000 inhabitants or less are within scope of the cited report.

Managing Environmental and Energy Transitions for Regions and Cities

This report offers guidance on how to prepare regions and cities for the transition towards a climate-neutral and circular economy by 2050 and is directed to all policymakers seeking to identify and implement concrete and ambitious transition pathways. It describes how cities, regions, and rural areas can manage the transition in a range of policy domains, including energy supply, conversion, and use, the transformation of mobility systems, and land use practices. It takes stock of discussions between academic and policy experts emanating from a series of high-level expert workshops organised in 2019 by the OECD and the European Commission. Bringing together frontier thinking and practical examples regarding the transition to a climate-neutral economy, the transition to a circular economy, the transition in cities, the transition in rural areas, and financing and scale-up of transition action, this report identifies cross-cutting lessons to support urban, regional, and rural decision makers in managing trade-offs and in promoting, facilitating and enabling environmental and energy transitions.

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