Towards a more resource-efficient and circular economy

The role of the G20

A background report prepared for the 2021 G20 Presidency of Italy

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Executive Summary

G20 countries account for approximately 75% of global materials use and 80% of global greenhouse gas emissions. G20 governments thus play a key role in working towards increased resource efficiency and material circularity. While average resource productivity of the G20 grew by about 40% between 2000 and 2017 and more improvements in resource productivity are projected to take place in the future, these will not be sufficient to offset the global increase in materials use (OECD, 2019[1]). Moreover, when accounting for materials embedded in trade, resource efficiency improvements of most G20 countries are more modest. Unless further efforts are taken to increase resource efficiency, close material loops, and improve sustainable materials management, the growing volumes of materials use will result in significant environmental pressures, including land degradation, greenhouse gas emissions and the dispersion of toxic substances in the environment.

With benefits in environmental, economic and social domains, there is a clear rationale for G20 countries to further advance the transition to a more resource efficient and circular economy. Several G20 countries have started to develop national strategies for sustainable materials management, resource productivity or the circular economy. At the G20, resource efficiency has been on the agenda since 2017 and annual G20 Resource Efficiency Dialogues have been held since, providing a platform for exchanging views, policy experiences and good practices. Going forward, the G20 could further advance joint work on resource efficiency and the circular economy.

This Policy Guidance, prepared by the OECD at the request of the Italian G20 Presidency is intended for G20 Leaders, as well as Economic, Finance and Environment Ministries. Based on insights from across the G20 membership, this report presents possible elements of a common G20 policy vision on resource efficiency and the circular economy for different levels of government. It is expected that the vision would help to coordinate and align individual country efforts and foster international co-operation among G20 members. They key elements of a possible G20 policy vision are summarised hereafter.

National and sub-national action to advance towards a more resource efficient and circular economy

Resource efficiency and circular economy principles need to be mainstreamed in domestic policies, taking into account specific country contexts. National and sub-national action also needs to be aligned to fully leverage the role of cities in improving materials management.

Mainstream resource efficiency and circular economy principles into domestic policies

- Promote resource efficiency through a policy mix that covers the full lifecycle of products

Environmental risks are complex and need to be managed in an integrated way. This requires the application of a policy mix that considers the entire lifecycle of products, to avoid simply displacing environmental burdens to different lifecycle stages or from one environmental medium to another. A policy mix of economic instruments, regulations, information-based and voluntary approaches, environmental labelling and public financial support should internalise environmental costs and provide incentives for efficient resource use. Examples of policies that can generate environmentally effective and economically efficient outcomes include Extended Producer Responsibility (EPR), Green Public Procurement (GPP) with integrated lifecycle analysis, or partnerships with businesses and stakeholders across the value chain to support industrial symbiosis and innovation for improved eco-design.

- Align sectoral policies with resource efficiency objectives

The transition to a circular economy requires a comprehensive set of policy measures at the macroeconomic and sectoral level. Resource efficiency and circular economy should be approached as an economy-wide issue, recognising the economic benefits with regards to competitiveness, new business opportunities and innovation, as well as greater resilience against scarcity of resources and volatile prices,. Furthermore, opportunities should be sought to exploit synergies with other policy areas, including climate change. Governments can support the resource-efficient structural economic change by mainstreaming the pursuit of resource efficiency into cross-cutting policies such as in innovation, investment and education and vocational training and by aligning policies to reduce pressures from major resource-consuming sectors.

- Align COVID-19 recovery measures with resource efficiency objectives

In response to the COVID-19 pandemic, many countries committed to a "green recovery" through stimulus packages of unprecedented scale. However, only a small share of the recovery measures announced so far (approximately 1% of total funds) addresses aspects of resource efficiency and waste management. A transition to a more resource efficient and circular economy can contribute to reach long-term environmental objectives and lead to job creations and economic growth. As such, the circular economy can support economic recovery, provided that resource efficiency objectives sufficiently mainstreamed in COVID-19 recovery measures.

- Strengthen policy development and evaluation through better data and analysis

Many G20 countries have established material flow accounts and are developing indicators for resource efficiency and the circular economy. However, important gaps in existing measurement frameworks persist. Appropriate indicators should be developed to measure the environmental externalities associated with resource consumption, the contribution that resources make to economic development and the macroeconomic and employment benefits associated with resource efficiency gains. Where possible, these indicators and metrics should be harmonised across countries, regularly updated and made publicly available. Policy evaluation should also be strengthened to identify good practices and work towards better policies.

Take a phased approach from waste to resource

Specific country contexts require different policy approaches and priorities. The journey from waste to resource can be structured along four phases towards reaching a more resource efficient and circular economy. These phases can serve to identify policy priorities in a given context, depending on where a country situates itself. They are not strictly sequential and may overlap.

1. *Ensure access to affordable waste collection and treatment services*
   - Extend affordable collection services to all in society, irrespective of income level.
   - Introduce formal waste collection and disposal systems in a way that is sensitive to the economic realities of existing informal sector workers. Collaboration between local government and the informal sector is required, to ensure that existing workers are fully integrated into the new formal system.
   - Ensure the controlled treatment and disposal of waste in state-of-the-art facilities, whilst facilitating opportunities towards higher R's (i.e. reduce, reuse, recycle) where possible and avoiding lock-ins into lower-value loops or linear systems, where waste is not transformed into resources.

- Ensure sustainable financing of waste management infrastructure. Consider the use of fiscal transfers from central governments to help fund municipal waste collection and treatment.

2. *Ensure that hazardous substances in waste are managed in an environmentally sound manner*
   - Separate hazardous waste from other waste at source and manage hazardous waste streams separately in environmentally sound facilities.

3. *Start implementing a materials cycle*
   - Increasingly shift away from controlled disposal and move towards material recovery and recycling.
   - Start implementing the polluter pays principle and establish Extended Producer Responsibility schemes and landfill taxes.
   - Keep waste materials segregated, to minimise contamination and facilitate reuse, remanufacture and recycling.
   - For waste that cannot be recycled[1], develop environmentally sound energy recovery facilities and ensure state-of-the-art landfilling for residual wastes where no further materials and/or energy can be recovered.

4. *Work towards higher-value material loops and waste prevention*
   - Mainstream resource efficiency across value chains and enable industrial symbiosis.
   - Maximise repair, reuse and remanufacturing activities.
   - Encourage eco-design that allows products to be repaired, reused and recycled.
   - Enlarge recycling activities to more waste streams and maximise material recovery.

Fully leverage the role of cities in advancing towards a more resource efficient and circular economy

Cities have important competences and levers in infrastructure sectors that are key for the circular economy, such as waste management and recycling, urban transport, the built environment, water supply and sanitation. These services are often managed at the municipal level and aligning policy action on the subnational and urban level with national policies is thus important to advance the circular economy and to fulfil national targets. In shared responsibility with regional and national governments and stakeholders, cities can act as *promoters*, *facilitators* and *enablers* of the circular economy.

As promoters of the circular economy, cities can:

- Define roles and responsibilities in policymaking and implementation of the circular economy at local scale;
- Act as a role model for citizens and businesses and lead by example in several ways such as waste prevention, promotion of the use of secondary materials and sustainable products and the introduction of circular economy criteria in public works.
- Develop a circular economy strategy that builds a clear vision, defines goals, targets and priorities, allocates funds and can help to overcome the fragmentation of existing and future initiatives beyond political cycles.
- Provide information on the benefits of the circular economy to help overcome cultural barriers and improve social acceptance of the concept.

[1] As recycling and sorting technologies evolve, more waste streams can be expected to become recyclable. Countries need to be aware of potential lock-ins associated with capital-intensive waste-to-energy infrastructure.

As facilitators, cities can:

- Ensure co-ordination across different levels of government to align priorities, goals, regulation and funding sources.
- Foster system thinking to ensure policy coherence across different sectors such as waste, water, energy and transport, to maximise synergies and ensure a coherent set of incentives.
- Facilitate collaborations and dialogue between the public sector, not-for-profit actors and businesses to stimulate innovation for more sustainable production and consumption patterns.
- Seek opportunities for urban-rural linkages and partnerships at the most relevant and appropriate scale.

As enablers, cities can:

- Include resource efficiency principles in sectoral policies, such as in the built environment, spatial planning, land use and service provision.
- Mobilise and allocate financial stimulus to support innovation and the uptake of circular business models, where needed.
- Support capacity development within local administrations and across businesses.
- Support business development through spaces for innovation, partnerships and public procurements.
- Introduce an information and evaluation system based on robust data that is regularly updated and made publicly available.

International cooperation and coordination to advance towards a more resource efficient and circular economy

Supply chains have become increasingly globalised and whilst this has led to significant resource efficiency improvements, it has also led to new challenges associated with the increased complexity and lack of transparency in global value chains. The G20, accounting for 75% of global trade, has an important role in helping to ensure that global value chains achieve improved resource efficiency and that potentially adverse impacts are mitigated. Possible areas where the G20 can work together include:

- Support businesses in their value chain management efforts towards improved resource efficiency

Due to their limited jurisdictional reach, it is a challenge for national governments to influence the way global value chains are managed. This can be done more effectively at the international level. G20 countries can work together to facilitate resource efficiency improvements in global supply chains.

For instance, developing due diligence guidance for responsible business conduct, to promote the observance of environmental and social standards, can ensure that business operations contribute to sustainable development goals. An example are the OECD Guidelines for Multinational Enterprises, which currently exist for a number of industrial sectors including the garment and footwear sector, agricultural supply chains, the extractive and the mineral sector (OECD, 2021[2]).

- Alleviate barriers to trade and investment in environmental goods and services to ensure the diffusion of best available environmental technologies.

Barriers to trade in environmental goods and services, such as local content requirements and trade remedies, limit the diffusion of best available environmental technologies and reduce leapfrogging opportunities and the scope and scale of resource efficiency improvements globally. In addition, restrictions on trade in used products and waste and scrap can hamper reuse, remanufacturing and recycling activities.

Alleviating barriers to trade can, in principle, lead to resource efficiency gains. For trade in used goods and waste and scrap, it is however important to carefully monitor possible unintended consequences and environmental leakage effects.

- Harmonise environmental labels and information schemes

The last two decades have seen a multiplication of environmental labelling and information schemes (ELIS) of varying scope, size and nature. This has implications for consumers and producers alike. The growing amount of ELIS tends to increase compliance costs for producers to meet the many (regional) requirements and thus has an effect on international trade and competitiveness. For consumers, the growing label landscape leads to confusion and overall loss of credibility. Competition may also drive down the stringency of labels and standards, as different schemes bid for market share.

The G20 can work towards some degree of harmonisation in the growing field of environmental labelling and information schemes, with the aim of maintaining high standards and allowing for increased mutual recognition of schemes.

- Improve data, indicators and accounts on resource efficiency and waste

Insufficient information is available to effectively support natural resource and materials management, and resource productivity and circular economy policies. Many advances have been made in improving the information base and measurement systems, but significant data and knowledge gaps remain across countries, sectors and material types that make it difficult to get the full picture of materials use and related environmental impacts.

The G20 can strengthen work on data, indicators and accounts on resource efficiency and help develop and mainstream circular economy metrics. This can include the development of compatible material flow accounts in an international database, improve knowledge on the environmental impacts and costs of material resource use throughout the life-cycle of materials and support the development of robust and internationally comparable indicators on circular flows of materials and products, indicators that link resource stocks to material flows, and indicators that link material flows to waste flows.

- Mainstream resource efficiency and material recovery into official development assistance more systematically

A lack of financing or insufficient technical knowledge or capacity are common barriers for setting up or extending waste services in less developed countries or for implementing resource efficiency policies or initiatives. Many of the environmental and health impacts associated with illegal dumping and burning of waste, in particular hazardous waste, can be alleviated with formal waste collection and treatment services that are accessible and affordable for all. To date, a relatively small share of ODA from G20 countries that are also members of the OECD’s Development Assistance Committee (DAC) is earmarked for purposes of material recovery or resource efficiency. DAC members could consider to direct a greater proportion of ODA towards the development of sound waste management infrastructure in recipient countries.

1. Introduction

Global demand for materials has been growing over the past century, following steady economic growth in OECD countries, the industrialisation of emerging economies and a growing world population. At the global level, the extraction of raw materials more than doubled between 1990 and 2017 (OECD, 2019[3]), and it is projected to double again by 2060 (OECD, 2019[1]). Due to the growing volumes of materials use, environmental impacts associated with materials management are projected to more than double in the decades to come, with adverse consequences for human health, ecosystems and the economy. With more materials being used, also more waste was generated. Recycling and recovery rates of these wastes remain low and much is landfilled, or “downcycled” and used as lower-value materials.

G20 countries contribute to an important share of past and projected materials use and have a key role to play in improving resource efficiency and to advance to a more circular economy. Comprising 60% of the world’s population, 80% of the world GDP and 75% of global trade, G20 countries are estimated to contribute to 75% of global material use (G20, 2021[4]; UNEP IRP, 2019[5]). In 2020, the domestic material consumption of G20 countries made up approximately 80 Gt.

Trends towards urbanisation and higher living standards will lead to particularly high levels of materials use in cities. By 2050, 55% of the global population is expected to live in urban areas (OECD/European Commission, 2020[6]). Already, cities represent almost two-thirds of global energy demand, produce up to 50% of solid waste and are responsible for 70% of greenhouse gas emissions (IEA, 2016[7]; World Bank, 2009[8]). Globally, at urban level, material consumption is expected to grow from 40 billion tonnes in 2010 to 90 billion tonnes in 2050, largely driven by the demand for construction material in emerging economies (UNEP, 2018[9]). As such, cities will play a key role in transitioning from a linear to a circular economy. Cities hold important competences for resource efficiency and the circular economy, such as waste management and recycling, urban transport, water supply and sanitation, land use and spatial planning. These services are often managed on municipal level and alignment of subnational and national resource efficiency initiatives is important to advance towards a more circular economy.

The recent outbreak of the COVID-19 pandemic and related economic impacts also has consequences for resource use and waste management. Whilst the growth in materials consumption halted in 2020 due to the economic downturn, announced recovery packages and related infrastructure investments will likely lead to additional resource demands in the near future. Implications on materials use will likely depend on the extent that resource efficiency principles are considered in the spending of stimulus funds. Furthermore, during the pandemic household purchasing patterns shifted and demand increased for some product groups (e.g. packaging for deliveries and online purchases or single-use personal protective equipment comprised of plastics), putting additional pressures on waste management infrastructure (Adyel, 2020[10]; Celis et al., 2021[11]). Many of these behavioural responses by households are likely to be temporary, but there is a risk that some may stick over the long term, affecting materials demand in the long term.

While over the past decades G20 countries have already achieved notable reductions in the materials intensity of their economies and this trend is expected to continue, this will not be sufficient to offset the projected global increase in materials use. Unless countries put further effort in increasing resource efficiency, closing material loops, and improving environmental management, the growing volumes of materials use will determine significant environmental pressures, including land degradation, greenhouse gas emissions and the dispersion of toxic substances in the environment. With much of the materials use and waste generation occurring in urban areas, cities and sub-national governments are important actors in this context.

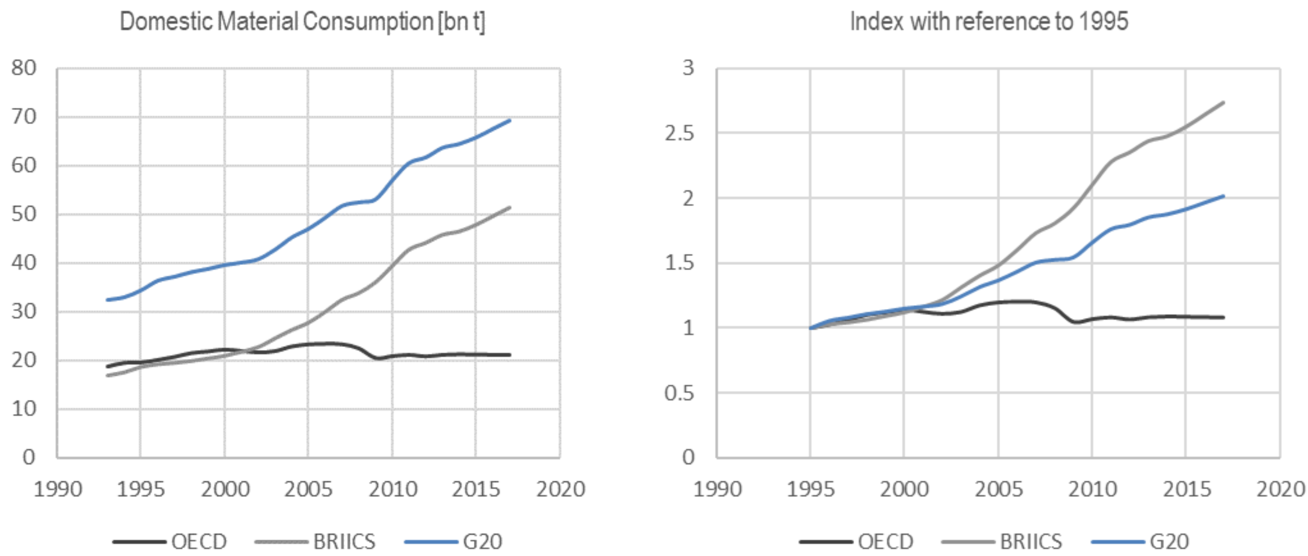
2. Past trends in material consumption and waste generation

Material consumption has drastically increased in past decades

Over the last century, global population and income growth led to a significant increase in global material consumption. Between 1990 and 2017, the world population went from 5 to 7.5 billion people and global gross domestic product (GDP) per capita increased by 50% (United Nations, 2018[12]; World Bank, 2021[13]). As a result, at the global level, annual material consumption grew from 37 billion tonnes in 1990[2] to 88 billion tonnes in 2017, while the average daily materials used per capita went from 22 kg in 1990 to 33 kg in 2017 (OECD, 2019[1]).

At the same time, the productivity of materials has improved, with a significant reduction in the material intensity of the global economy (OECD, 2020[14]). Over the past three decades, these trends have contributed to a relative decoupling between GDP and material consumption, with the global economy growing faster than materials consumption. Decoupling trends have been strongest in the OECD area, in part due to the outsourcing of resource-intensive activities to other countries (OECD, 2015[15]). Across the G20, the material intensity has also decreased, though with some variation among G20 countries. While domestic material consumption in OECD countries remained at similar levels between 1995 and 2017, it almost tripled in BRIICS countries (i.e. Brazil, Russia, India, Indonesia, China and South Africa) (Figure 1).

Figure 1. Domestic Material Consumption in G20, OECD and BRIICS



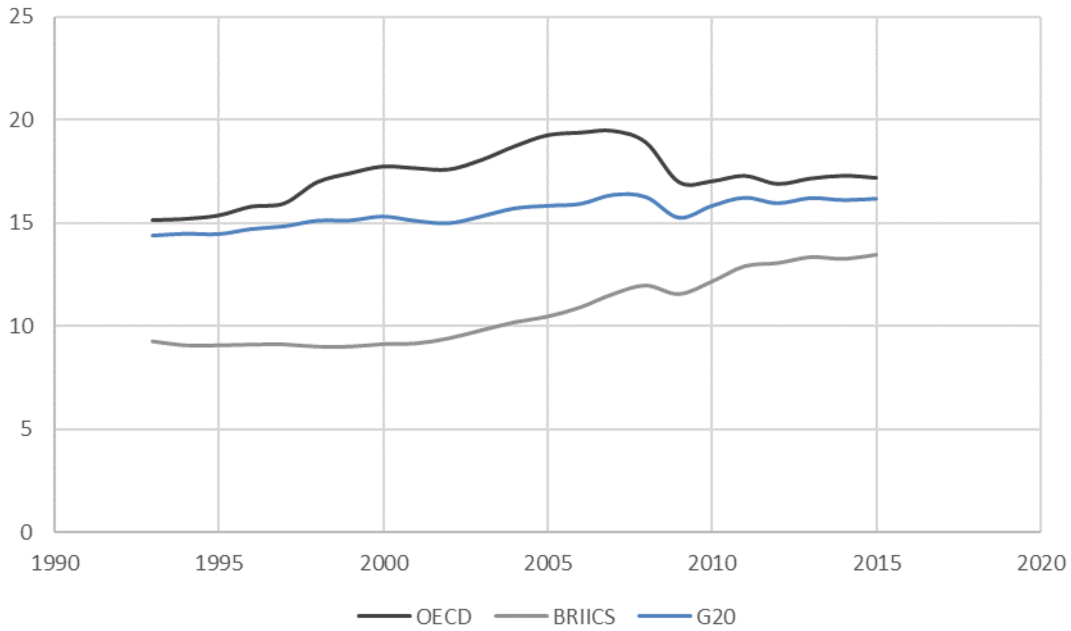
Source: UNEP Global Materials Flows Database

While absolute material consumption in BRIICS and emerging economies increased significantly over the past decades, per-capita material consumption remains lower, but is converging to OECD levels. Whereas prior to 2000, OECD citizens consumed on average 50% more materials than an average BRIICS citizen,

[2] All material consumption data referring to 1990 are likely to be underestimated, due to data availability constraints for both OECD and non-OECD countries.

per-capita DMC of OECD citizens were less than 30% larger in 2017. Per-capita consumption of the G20 increased gradually over the past decades and are close to OECD levels (Figure 2).

Figure 2. Domestic material consumption per capita [tonnes]



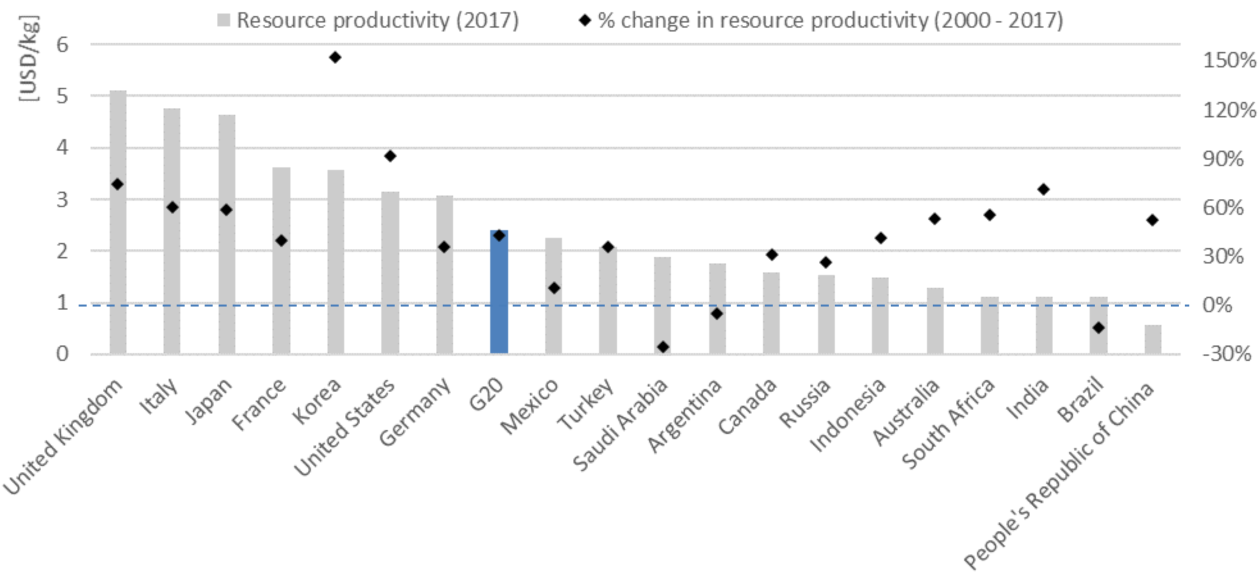
Source: UNEP Global Materials Flows Database

Resource productivity across the G20 has increased, but progress differs and much more remains to be done

The economic structure of G20 countries varies, depending on their resource endowments, development stage, demographics and economic specialisation. As such, resource productivity levels and per-capita material consumption are heterogeneous across the G20 membership. Countries with the highest resource productivity tend to be economies focused on services and high-value products, such as the United Kingdom, Italy or Japan. Countries with economies more reliant on extracting material resources tend to have lower material productivity levels, such as India, Brazil or China (Figure 3).

Among the G20, on average, resource productivity grew by about 40% between 2000 and 2017. In 2017, in G20 countries, one tonne of materials generated on average USD 2 400, while in 2000 the same amount of materials generated USD 1 700. This reflects efficiency gains in the production process, structural changes in the composition of the economy, and the partial substitution of domestic production with imported goods (i.e. the shift of material-intensive activities abroad).

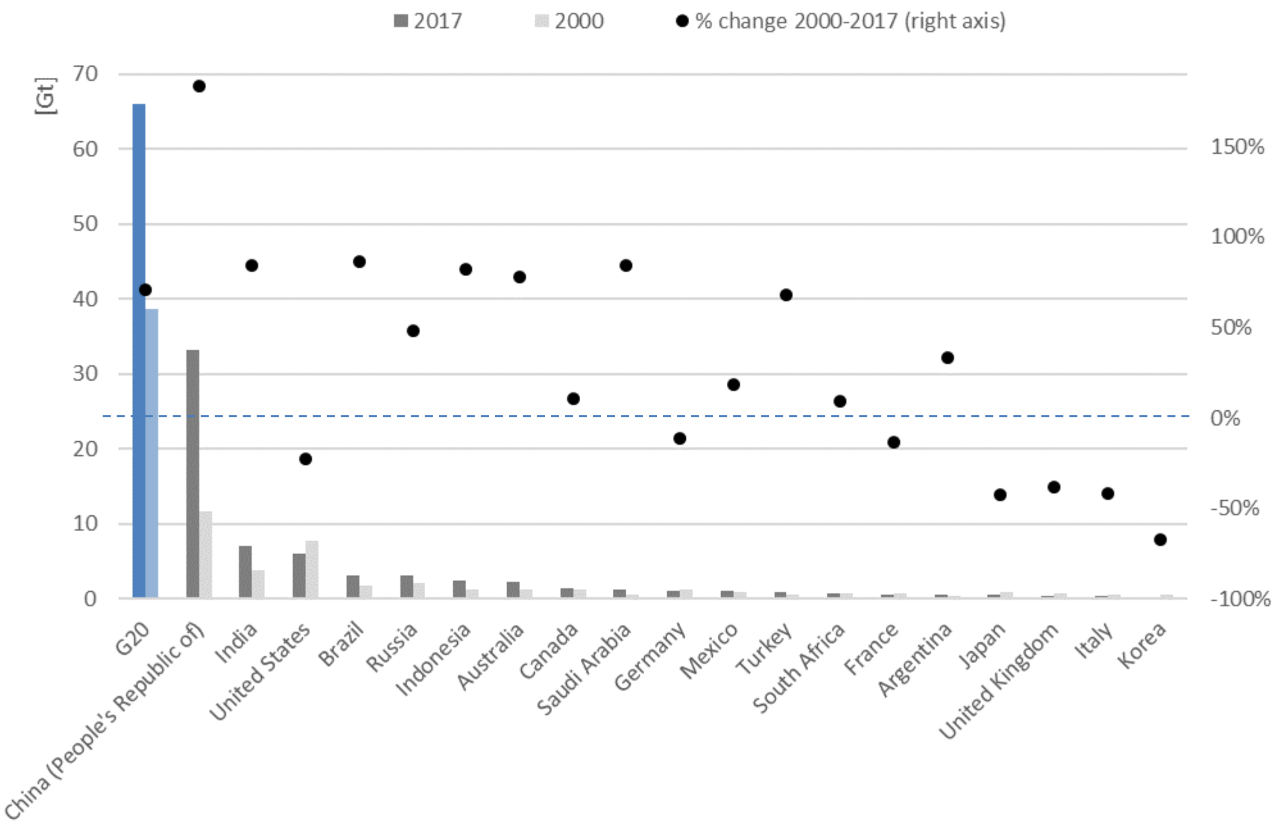
Figure 3. Resource productivity levels differ substantially among G20 countries, but some improvements could be achieved



Note: Resource productivity is gross domestic product (GDP) divided by domestic material consumption (DMC). DMC measures the total amount of materials directly used by an economy.
Source: OECD.Stat

While resource productivity levels have increased for most G20 countries, these gains are counterbalanced by population growth and increased consumption due to economic growth. As a result, material consumption continued to rise in absolute terms for most large G20 countries in the past decades. In particular, fast growing, maturing economies, most notably China, experienced an increase in materials use (Figure 4).

Figure 4. Despite improvements in resource productivity, domestic material consumption increased in G20 countries



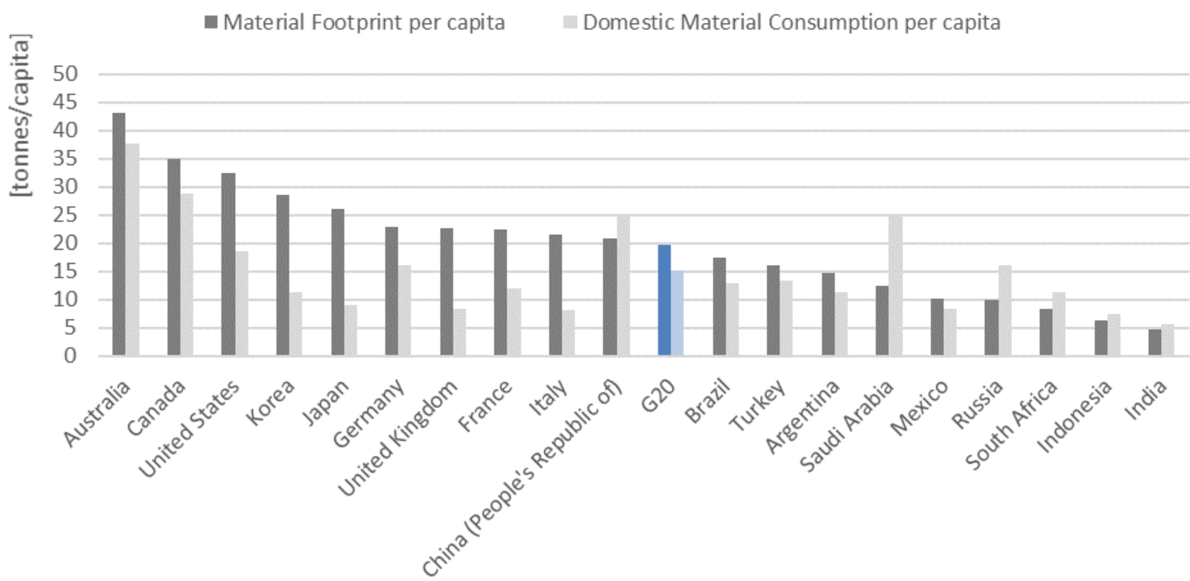
Source: OECD.Stat

Domestic material consumption is a useful indicator to quantify the amount of materials used in national economies, but it does not capture the increasing substitution of domestic production with imported goods. In many cases, G20 countries have outsourced material-intensive production. This shift is not reflected in domestic material consumption, as the metric does not account for indirect flows of raw materials embodied in internationally-traded intermediate goods and final products.

When considering the total material footprint – accounting for all raw materials needed to satisfy domestic final demand for goods – material productivity gains fall out more modest in most G20 countries. Per-capita material footprints across the G20 are on average 30% higher, than per-capita domestic material consumption. This indicates a shift of material-intensive economic activities abroad (Figure 5). Net-importers tend to be EU countries, Japan and South Korea, whereas net-exporters include Russia, Saudi Arabia, South Africa, Australia and China (UNEP IRP, 2019[5]).

Coordinated efforts are needed between importing and exporting states (i.e. between G20 countries with material trade surpluses and deficits) to improve resource efficiency along increasingly globalised value chains.

Figure 5. Material footprint per capita remains high also for countries with low Domestic Material Consumption per capita

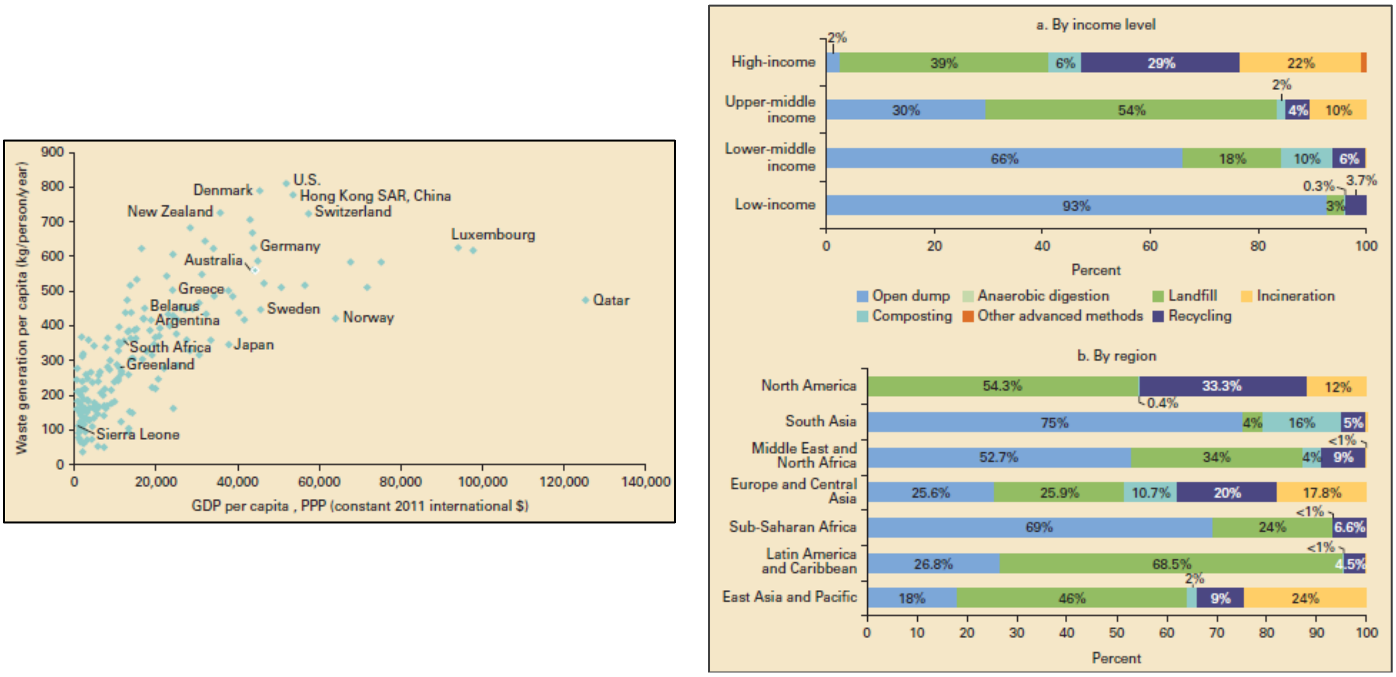


Note: Material footprint accounts for all raw materials needed to satisfy final demand of economies. It takes into account raw materials extracted abroad and embodied in imported goods (i.e. a demand-based measure). The data used for this figure from the UNEP "Environment Live" database (http://uneplive.unep.org/material). They should be interpreted with caution as they may differ from national estimates, and as they may change as international work on methodologies for material footprints progresses.
Source: OECD Environment at a Glance Platform; OECD Environment Statistics (database), http://dotstat.oecd.org/Index.aspx?DataSetCode=MATERIAL_RESOURCES

Waste generation levels and treatment processes differ substantially across the G20

Waste generation and treatment processes differ substantially across the G20, according to the different stages of economic development that countries find themselves in. As countries become more affluent, income levels rise and consumption increases, the amount of household waste generated also increases. However, at the same time waste collection and treatment processes of these wastes tend to improve as countries advance in their development (Figure 6).

Figure 6. As income levels rise, waste generation increases [left], but waste treatment processes improve [right]



Source: (Kaza et al., 2018[16])

Recycling and material recovery rates do not only differ among countries, but also among waste streams. Glass, paper and metal packaging commonly achieve the highest recycling rates as they are used in relatively simple product groups or easily recyclable. Recycling rates of more complex product groups, are significantly lower (Box 1).

Box 1. Textiles and the circular economy

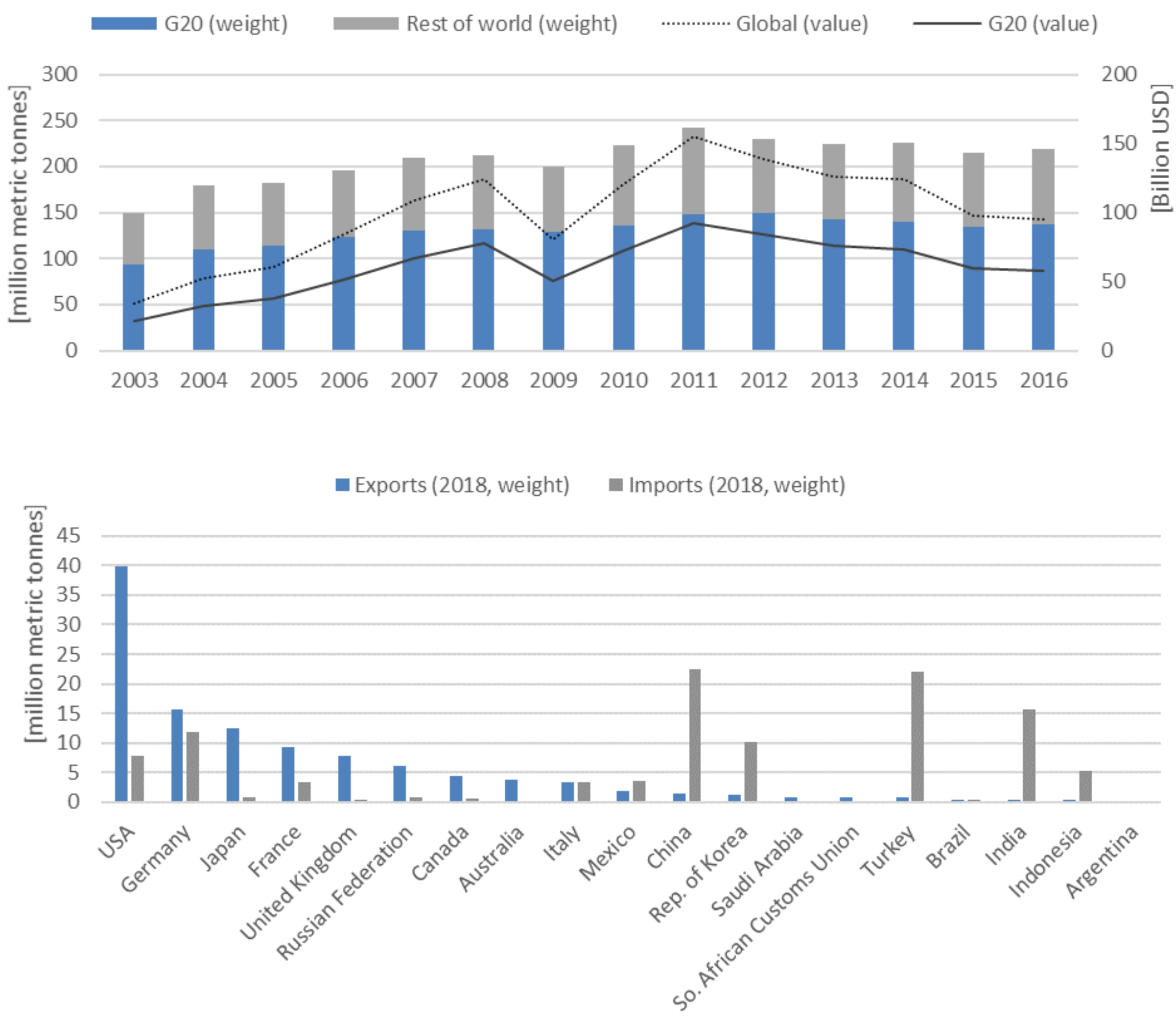
The European Environment Agency (EEA) estimates that in the EU, supply chain pressures of clothing, footwear and household textiles are the fourth highest pressure category for the use of primary raw materials and water, second highest for land use and the fifth highest for greenhouse gas emissions (European Environment Agency, 2019[17]). Globally, the apparel and footwear industries are estimated to account for 8% of the world´s greenhouse gas emissions (Quantis, 2018[18]).

Only a small share of end-of-life textiles is currently recycled. Globally, roughly 73% of EoL textile waste is landfilled or incinerated, 14% is lost in production, use, and collection, 12% is downcycled to a less valuable use, and less than 1% is recycled to make new fibres for a textile of similar value (Ellen MacArthur Foundation, 2019[19]). Increasing re-use and textile-to-textile recycling has the potential to reduce the significant resource footprint and greenhouse gas emissions of the textiles industry (Semba et al., 2020[20]; Watson et al., 2016[21]).

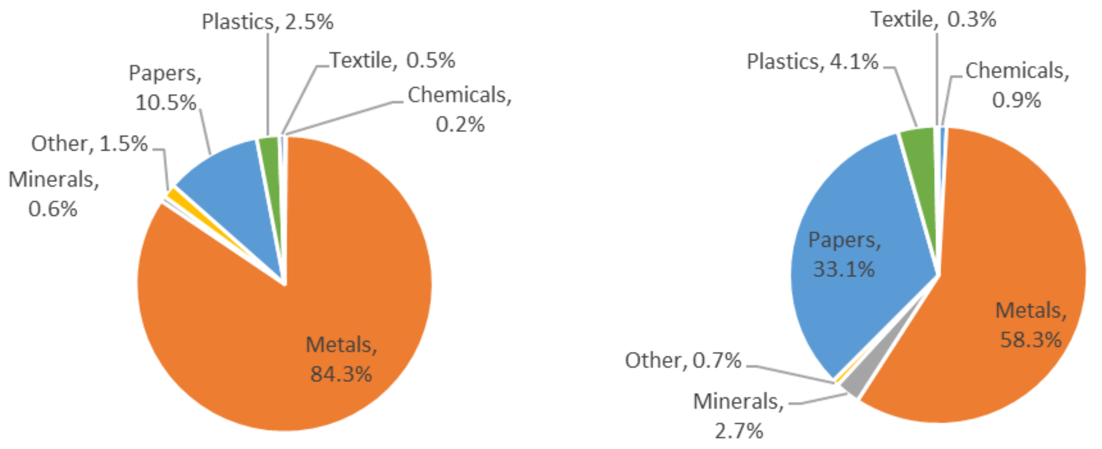
Trade has influenced waste treatment and recycling value chains in the past decades. Trade in waste has led to economically efficient recycling, but also poses risks of environmental leakage, if not managed properly. Between 2003 and 2016, global waste trade between countries for further treatment or disposal increased by around 30% (by weight) and is now common practice (Yamaguchi, 2021[22]). In 2016, global trade in waste and scrap was worth USD 94 billion and amounted to a total weight of 218 million tonnes. The main traded categories of waste and scrap were metals and paper (Garsous, 2019[23]).

G20 countries make up for approximately 60% of the global waste and scrap trade (Figure 7). The largest exporters of waste and scrap in 2018 were the United States, Germany, Japan and France. The largest importers were China, Turkey and India. Metals scrap and waste accounted for 85% of the G20 trade by value, followed by paper (10%) and plastics (2.5%). By weight, metals represented about 60%, and paper about 30% of the traded wastes. Plastics constituted around 4% of global traded waste and scrap by weight in 2018 (Figure 7).

Figure 7. Trends waste and scrap trade in G20 countries



G20 waste and scrap trade composition by value (left) and weight (right) in 2018



Note: Waste and scrap items are those contained in the list of 62 Harmonized System (HS) codes used in (Garsous, 2019[23]) provided by (Kellenberg, 2012[24]).
Source: Author based on Garsous (2019[23]) and (UN Comtrade, n.d.[25]).

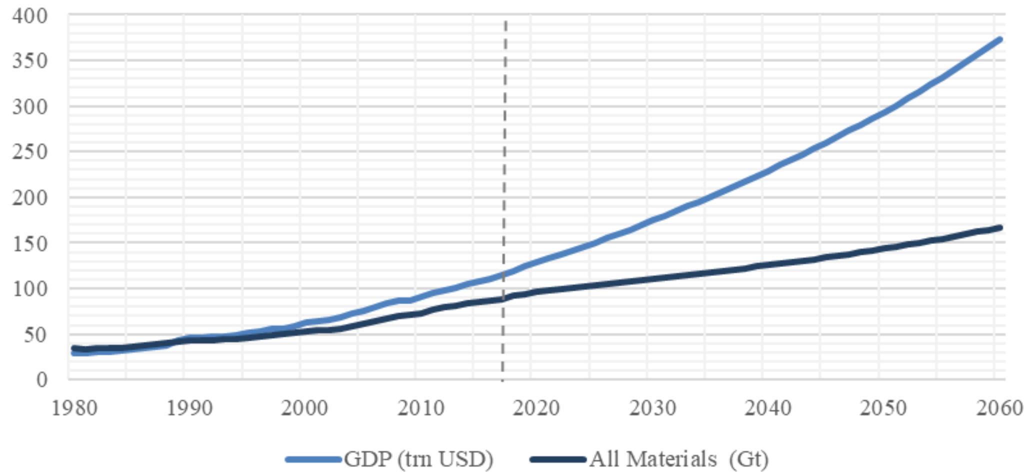
Multilateral cooperation among the G20 is needed to coordinate on trade of end-of-life products and to ensure that trade of waste and scrap enables environmentally sound and economically efficient processing, material recovery and disposal.

3. Projections of future materials use

In the absence of additional policies promoting resource productivity, materials use is projected to nearly double by 2060, compared to 2017 levels (OECD, 2019[1]). The projected growth in materials use is largely associated with the socioeconomic and technological changes that the global economy will face in the decades to come. The world's population is projected to continue growing, driving demand for energy, food and natural resources. Furthermore, global income per capita is projected to reach 2017 OECD levels by 2060. At the global level, daily materials use per capita is projected to increase from 33 kg in 2017 to 45 kg in 2060. Infrastructure and construction have the highest resource footprint of all sectors and will remain a key driver of materials use in the future.

According to OECD projections, a relative decoupling between economic growth and materials use will take place in the coming decades. Indeed, between 2017 and 2060, the world economy will continue growing at an average yearly growth rate of 2.8%, while global materials use is set to increase on average by 1.5% every year (Figure 8). This relative decoupling will happen thanks to technical advances and structural changes in the economy. At the global level, a growing number of countries is projected to progressively shift towards a more service-based economy, thus lowering material intensity and reducing global materials use by 80 billion tonnes by 2060 (as compared to a projection where structural changes would not occur). In addition, in the coming decades, technological advancements are projected to save 68 billion tonnes of materials (as compared to a projection where technological improvements would not occur) (OECD, 2019[1]). Nonetheless, in the absence of additional policy measures, structural and technological changes alone will not be sufficient to contain the growth in global materials use.

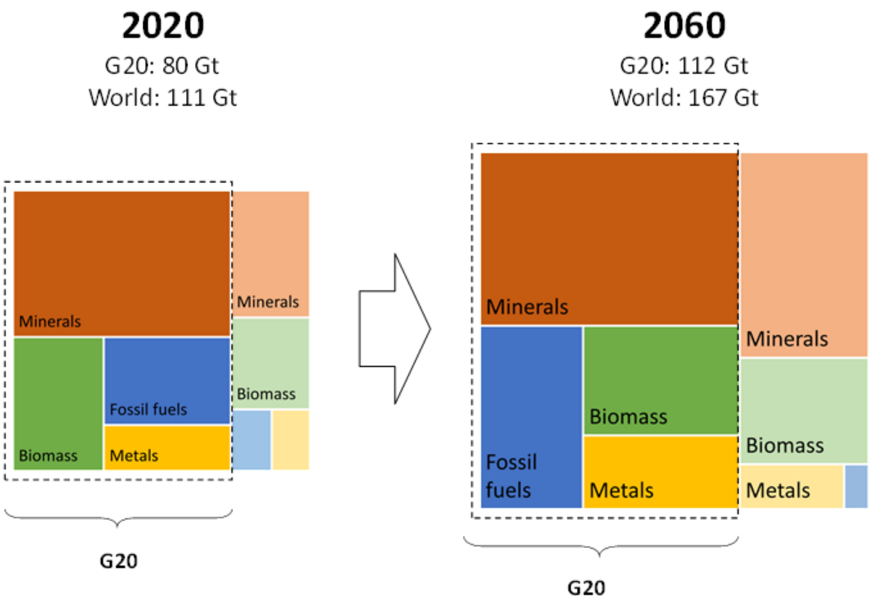
Figure 8. Partial decoupling between economic growth and materials use is projected to continue globally



Note: the dotted vertical line indicates a change from historical data to projections.
Source: (OECD, 2019[1]).

If current trends continue, domestic material consumption of the G20 is projected to increase from 80 Gt in 2020 to 112 Gt in 2060 (Figure 9). Materials use is projected to increase for all resource categories. Consistently with past trends, non-metallic minerals will remain the most used type of material in every region, followed by biomass, fossil fuels and metals. The significant growth characterising non-metallic minerals and metals use can be largely attributed to the sustained expansion of the construction sector, which by 2060 is projected to account for half of the growth in global materials use (Box 2).

Figure 9. Global materials use is projected to further increase in the coming decades



Note: The value for G20 is an approximation, based on domestic material consumption from the Global Materials Resource Outlook to 2060. The aggregate includes Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, South Africa, South Korea, the United Kingdom, and the United States. It does not include values for the Argentina, Turkey and Saudi Arabia, and the European Union, which are G20 countries and it includes New Zealand, which is not a G20 country.
Source: OECD Global Material Resources Outlook to 2060 (OECD, 2019[1])

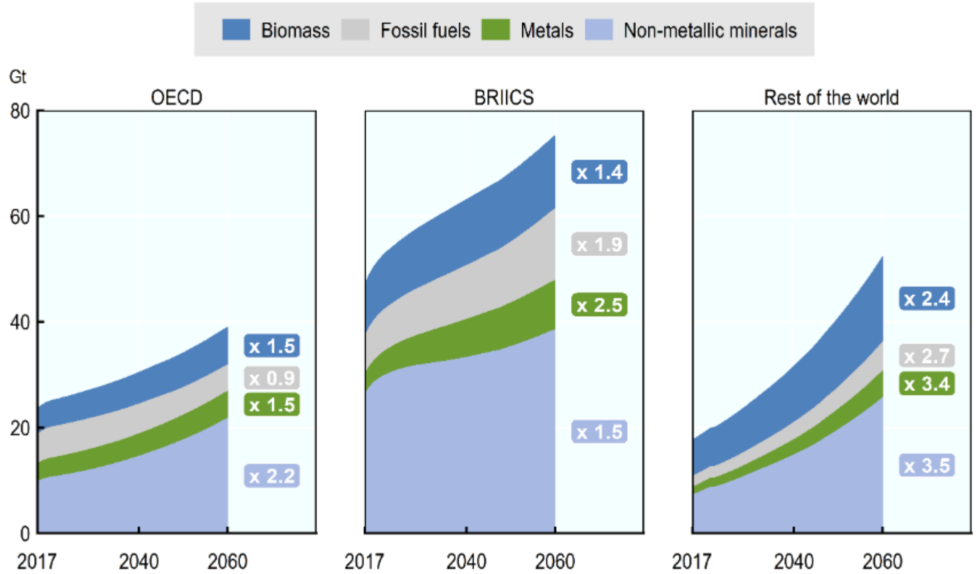
Box 2. The construction sector and the circular economy

The construction sector is responsible for a significant share of current and projected materials use. Globally, the construction industry accounts for roughly 30% of natural resource extraction and 25% of solid waste generation (Benachio, Freitas and Tavares, 2020[26]). Non-metallic minerals, which are mainly used for construction are projected to grow from 35 Gt in 2011 to 82 Gt in 2060, due to sustained construction activities in emerging economies (OECD, 2019[27]).

Increasing circularity and resource efficiency in the construction sector is important to slow global resource consumption. To date, the majority of EoL construction materials are discarded or down-cycled. This is in part due to the current design of constructed buildings. An important opportunity for circularity in the building sector is the reuse of building components and materials, which would significantly reduce the need for virgin construction materials. Further opportunities lie in the intensification of the use of building, for example through sharing economy applications (UNEP, 2020[28]).

Whereas materials use is projected to increase in every region, growth rates are projected to differ significantly across countries. On average, between 2017 and 2060, materials use is projected to grow by 65% in OECD countries and 60% in BRIICS countries. Meanwhile, materials use is projected to almost triple in the rest of the world, driven by high and constant growth rates until 2060. Despite a significant slow-down in the material intensity of BRIICS economies, the six countries together are projected to remain the region consuming the largest amount of materials in absolute terms (Figure 10).

Figure 10. Materials use projections by category and region



Source: (OECD, 2019[1]).

4. The environmental impacts of materials use

A range of environmental impacts occur along the lifecycle of materials, during the extraction, transport, processing, use and disposal of resources, products and waste. Environmental impacts range from land degradation to the release of toxic pollutants that affect human and ecosystems' health. In addition, all stages of materials lifecycle contribute to the emission of greenhouse gases (GHG) into the atmosphere, thus playing a crucial role in climate change. Table 1 provides an overview of selected environmental impacts of materials use.

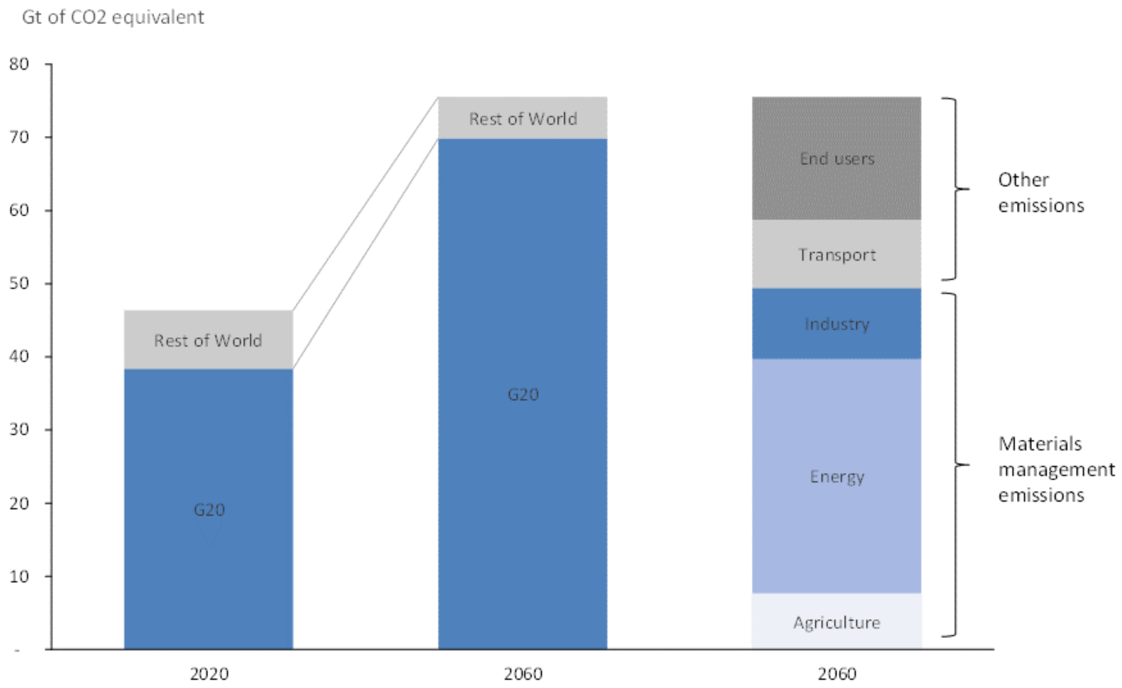
Table 1. Selected environmental impacts of materials use

Acidification	Corrosive impact of pollutants (SO_2, NO_x) on soil, water, ecosystems, buildings
Climate change	Radiative forcing of GHGs causing rising temperatures, sea level rise, extreme weather events
Cumulative energy demand	Total energy use along the production chain
Eutrophication	Impacts of nutrients (N, P) on soil and water quality affecting ecosystems and drinking water
Freshwater eco-toxicity	Impacts of toxic substances on freshwater aquatic ecosystems
Human toxicity	Impacts of toxic substances on human health, via inhalation and the food chain
Land use	Land surface used to produce the resource
Photochemical oxidation	Impacts of tropospheric ozone from air pollutants (VOX, CO)
Terrestrial eco-toxicity	Impacts of toxic substances on terrestrial ecosystems

Source: (OECD, 2019[1]).

The environmental impacts of materials use are projected to increase along with materials use and to more than double between 2011 and 2060 (OECD, 2019[1]). More than two-thirds of global greenhouse gas (GHG) emissions, i.e. 32 Gt, are linked to the materials cycle. By 2060, these emissions will amount to 50 Gt CO2 equivalent (Figure 11). Furthermore, as the nexus between materials and other natural resources – such as land, water and biodiversity – is very close, increasing pressures on one medium are likely to intensify pressures on others (OECD, 2017[29]).

Figure 11. Global greenhouse gas (GHG) emissions are projected to further increase, with more than two-thirds linked to the materials cycle



Note: The value for G20 is an approximation, as it includes Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, South Africa, South Korea, the United Kingdom, and the United States. It does not include values for the Argentina, Turkey and Saudi Arabia, and the European Union which are G20 countries and it includes New Zealand, which is not a G20 country.
Source: OECD Global Material Resources Outlook to 2060 (OECD, 2019[1])

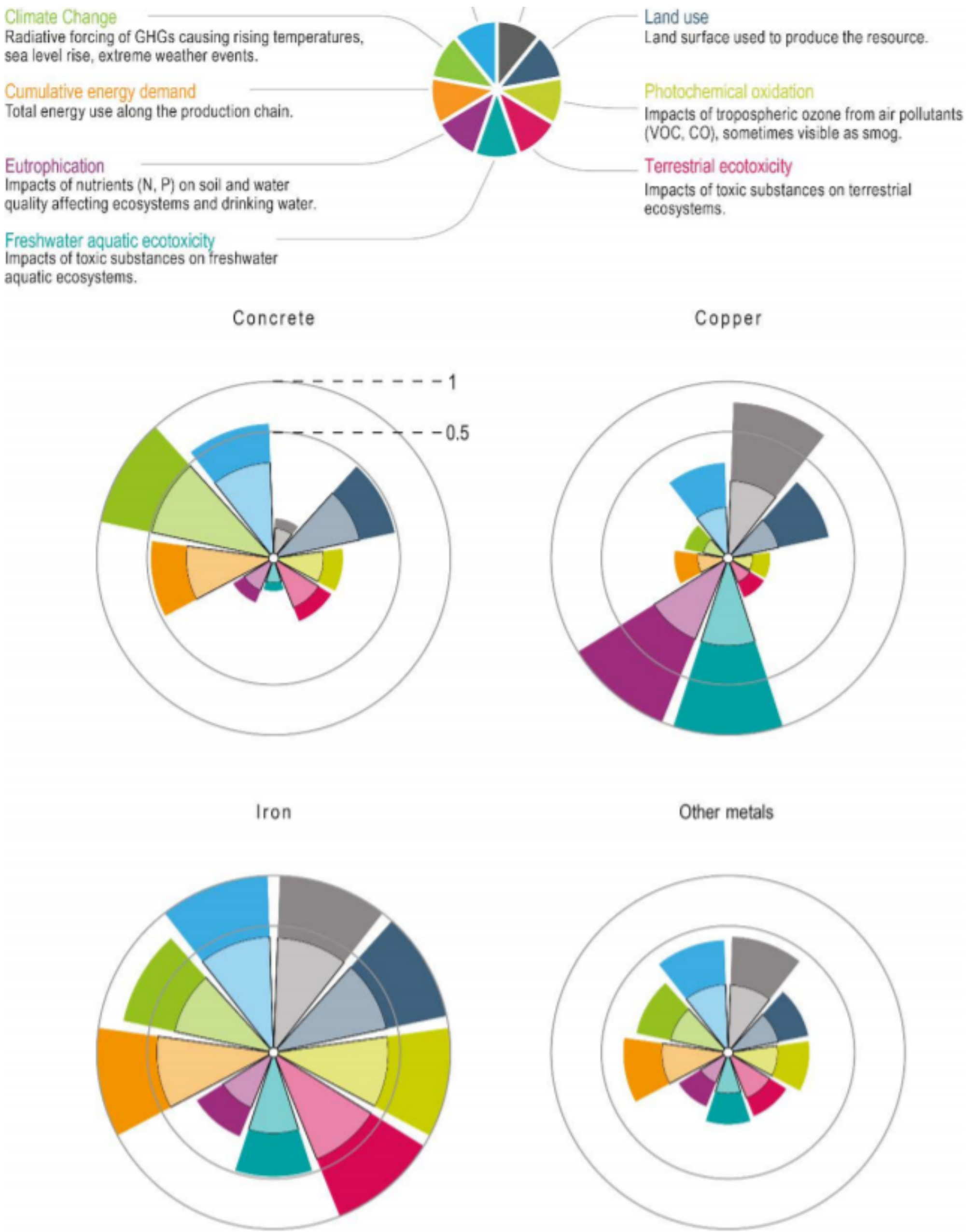
Environmental impacts vary significantly across materials. According to OECD projections, the use of iron, copper, concrete and aluminium is projected to have highest impacts on the environment (OECD, 2019[1]). Figure 12 shows the projected environmental impacts[3] linked to the use of concrete, copper, iron, and other metals – i.e. aluminium, lead, manganese, nickel and zinc.

The increase in environmental impacts is not only caused by increased volumes of materials use, but also by changes in the environmental impacts per unit of production for some refined metals, due to diminishing ore grades (Van der Voet et al., 2018[30]). The per-kilogram environmental impacts are projected to increase for instance for lead, nickel, and zinc. In the case of lead, by 2060 impacts on human toxicity are projected to increase by 76%, while those linked to freshwater eco-toxicity are projected to increase by 58% (compared to 2017). The environmental impacts of other metals, such as aluminium, iron, and manganese are projected to remain constant or decrease over time, due to the decarbonisation of energy used for production and increased use of secondary materials, which tend to have lower overall environmental impacts compared to primary materials.

[3] The environmental impacts displayed are calculated using a cradle-to-gate approach, which assesses impacts related to extraction and production until materials leave the factory “gate” to enter different products. Impacts occurring from further lifecycle phases are not included, as it is no longer possible to assign it to the individual material making up a product. Therefore, the figures presented are likely to be an underestimation.

Figure 12. Projections of global environmental impacts from different materials

Index=1 for the most polluting material in 2060



Note: Environmental impacts are presented for primary and secondary production combined. The lighter shading represents the value in 2015, while the full coloured area represents values in 2060.
Source: (OECD, 2019[1]).

5. A transition to a circular economy can lower resource demands and environmental impacts and contribute to the economic and social recovery

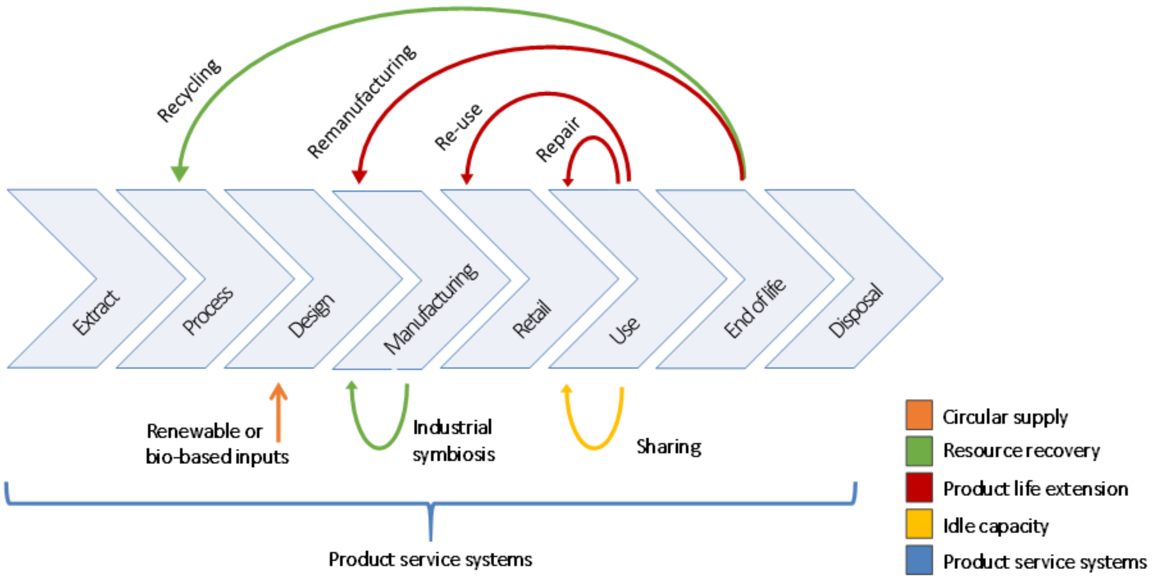
Increasing resource efficiency and moving to a more circular economy aims to maintain materials at their highest values and to keep products, components and materials in the economy for as long as possible, trying to eliminate waste and to reduce virgin resource inputs. Different processes of closing, slowing and narrowing resource loops can contribute to this aim in different ways (McCarthy, Dellink and Bibas, 2018[31]):

- *Closing resource loops* aims at minimising raw material extraction and waste output through improved end-of-life sorting, treatment and increased material recycling.
- *Slowing resource loops* stresses the need for fundamental changes in the economic system towards more durable products and extended lifespans through reuse, repair and remanufacture services.
- *Narrowing resource flows* aims at a more efficient use of natural resources, materials, and products along all phases of the value chain. This third part addresses the significant “structural” waste in current consumption patterns and underutilisation of assets (e.g. office space or private vehicles).

A number of circular business models can serve to close, slow and narrow resource flows and to decouple resource use from production (Figure 13). Sustainable product design and design for environment (DfE) are key to enable these circular business models:

- Circular supply models replace traditional material inputs derived from virgin resources with bio-based, renewable, or recovered materials, which reduces demand for virgin resource extraction in the long run.
- Resource recovery models recycle and reprocess waste into secondary raw materials, diverting waste from final disposal while also displacing the extraction and processing of virgin natural resources.
- Product life extension models, through reuse, repair or remanufacturing extend the use period of existing products, slow the flow of constituent materials through the economy, and reduce the rate of resource extraction and waste generation.
- Idle capacity or sharing models facilitate the sharing of under-utilised products and can therefore reduce demand for new products and their embedded raw materials.
- Product service system models, where services rather than products are marketed, improve incentives for green product design and more efficient product use, promoting a more sparing use of natural resources (OECD, 2019[32]).

Figure 13. Circular business models help close material loops and reduce material throughput



Source: (OECD, 2019[32])

Through these circular business models, a transition to a more circular economy can lead to substantial economic, environmental and social benefits:

An uptake of circular business models as well as investments in research and development of circular technologies can generate new economic growth through innovation (OECD, 2019[32]). Thereby, the circular economy can also contribute to the economic recovery from the recent COVID-19 crisis. Furthermore, making more efficient use of materials can lead to cost savings and increase the autonomy of resource-importing countries, especially for critical materials and minerals[4] (OECD, 2019[1]; Coulomb et al., 2015[33]).

Circular business models allow to mitigate environmental impacts throughout the value chain in various ways. For example, sharing existing assets can lower demands for new products. Recycling materials can substantially reduce environmental impacts compared to primary material production and reduces environmental pressures, as compared to alternative waste treatment options, such as landfilling or incineration. For example, the environmental impacts of recycled metals are estimated to be one order of magnitude lower compared to primary metals (OECD, 2019[32]). Furthermore, increased reuse and repair extends product lifespans and prevents waste generation. With more than two-thirds of the emissions linked to materials management, a transition to more circular economy can substantially contribute to meeting climate targets as outlined in the Paris Agreement.

A transition to a more circular economy can also have a small but positive net effect on employment, with employment gains in particular in waste and recycling sectors. Circularity can be expected to have a positive net effect on job creation, due to the fact that an economy favouring repair, maintenance, upgrading, remanufacturing, reuse and recycling of materials, tends to be more labour intensive than linear extraction and manufacturing processes (Wijkman and Skånberg, 2017[34]). Whilst the development and uptake of new circular business models and services can lead to new employment opportunities, some employment losses may be expected in resource intensive activities. The net employment effect of a

[4] Critical minerals refers to the group of non-renewable materials for which the risk of disruptions in supply is relatively high and for which supply disruptions will be associated with large economic impacts (Coulomb et al., 2015[33]).

circular economy transition will differ per country, depending on its economic structure and specialisation, but at the global level, macroeconomic models show that the circular economy transition could contribute to a slight increase of employment (Chateau and Mavroeidi, 2020[35]; Laubinger, Lanzi and Chateau, 2020[36]). As such, transitioning to a more circular economy can also help to mitigate negative employment effects, triggered by the COVID-19 crisis.

With benefits in economic, environmental and social domains, there is a strong rationale for G20 countries to advance the transition to a more circular economy. COVID-19 recovery packages that governments are currently putting in place, if well designed, can play an important role in realising these benefits.

6. Recent developments on resource efficiency and circular economy policies

During the last decade, principles of resource efficiency and materials circularity – including resource productivity, material recovery, sustainable materials management and the "3Rs" (i.e. reduce, reuse, recycle) – have received increased attention from the highest levels of government of many G20 countries and the G20 and G7 itself. They are also actively promoted by international organisations, including the OECD and the United Nations Environment Programme (UNEP), as well as the European Commission.

National and sub-national strategies and roadmaps are being developed

At the national level, a number of G20 countries developed national strategies, roadmaps and policy packages that address elements of resource productivity. These strategies and roadmaps lay out and support the implementation of resource productivity policies. Some countries focus primarily on waste management, reduction of littering and material recovery, whereas others include upstream aspects on resource efficiency and waste prevention (Table 2).

Several cities and subnational governments in G20 countries have also put forward roadmaps and strategies for the transition to the circular economy. Introducing a circular economy strategy in a city or in a region serves to build a vision, identify priorities and allocate financial resources to achieve these priorities. For example, the cities of Toronto (Canada), London (United Kingdom) and Paris (France) introduced circular economy strategies or roadmaps. Subnational governments such as Scotland and England (United Kingdom) also developed circular economy strategies and engaged with a variety of stakeholders for their implementation (OECD, 2020[37]) (Table 2).

Table 2. Selected examples of national, regional and local strategies for resource efficiency, waste management and the circular economy of G20 countries

Country	Year of introduction	Strategy name
Australia	2018	2018 National Waste Policy: Less waste, more resources
China	2008 2017	Law for the Promotion of the Circular Economy Circular Economy Policy Portfolio
France	2018	Circular Economy roadmap of France
Germany	2020	German Resource Efficiency Programme (ProgRess) III
India	2019	National Resource Efficiency Policy
Indonesia	2017 2018	Presidential Decree No.97/2017 on National Policy & Strategy on Management of Household Waste and household-like Waste (JAKSTRANAS) Presidential Decree No.83/2018 on Marine Debris Management (Plan of Action on Marine Plastic Debris 2017-2025)
Italy	2017	Towards a Model of Circular Economy for Italy
Japan	2018	4th Fundamental Plan for Establishing a Sound Material-Cycle Society
Korea	2018	Framework Act on Resource Circulation (FARC) & Master Plan on Resource Circulation
South Africa	2020	National Waste Management Strategy 2020
South Korea	2016	Framework Act on Resource Circulation
United States	2015	Sustainable Materials Management Action Plan
Region or City	**Year of introduction**	**Strategy name**
England (United Kingdom)	2018	Resources and waste strategy for England
Scotland (United Kingdom)	2016	Making Things Last A Circular Economy Strategy for Scotland
London	2017	London's Circular Economy Route Map

(United Kingdom)		
Nantes (France)	2018	Circular Economy Roadmap
Paris (France)	2017	Circular Economy Plan of Paris 2017 2020
Toronto (Canada)	2018	Circular Economy Procurement Implementation Plan and Framework

A number of high-profile multilateral initiatives affirm the importance of resource productivity and the circular economy at the international level. In the context of the G7 and G20, resource efficiency has been on the agenda for several years (Box 3). In the European Union, the Resource Efficiency Platform was established as well as a first Circular Economy Action Plan in 2015, followed by a new Circular Economy Action Plan, released in 2020, which forms one of the main building blocks of the European Green Deal and also acknowledges the role of cities in the transition. The OECD and UNEP's International Resource Panel (IRP) support these initiatives and provide important scientific assessments and policy guidance towards improving resource efficiency and the monitoring thereof.[5]

Box 3. Resource efficiency at the G20 and G7

At G7 and G20 meetings, resource efficiency has been on the agenda for several years:

The G7 has taken a series of initiatives on resource efficiency and the 3Rs, including the G7 Alliance on Resource Efficiency (G7 Leader's Declaration, 2015[38]), the Toyama Framework on Material Cycles (G7 Leaders' Declaration, 2016[39]) and the G7 Bologna Roadmap (G7 Leaders' Declaration, 2017[40]).

The G20 established a Resource Efficiency Dialogue in 2017 under the German presidency, which provides a platform for exchanging views, policy experiences and good practices on resource efficiency and calls for "broadening the knowledge base on global resource use and future resource needs" (G20 Leaders' Declaration, 2017[41]). Subsequent presidencies continued the Dialogue touching upon issues such as circular economy and finance and marine plastic litter (G20, 2019[42]).

In recent years, the topic of (marine) plastic litter, which has sustainable material and waste management policies at its core, has risen on the political agenda, with a number of initiatives and policy developments on multilateral and national levels (Box 4).

Box 4. The rise of plastics on the political agenda

The growing concern about the adverse environmental impacts of (marine) plastics litter has led to a number of high-profile multilateral and national initiatives specifically on increasing material efficiency, recovery and reducing environmental impacts related to plastics.

Marine plastics litter was introduced to the G20 in 2017 at the G20 Hamburg summit, with the adoption of the "G20 Action Plan on Marine Litter". In 2019, the "G20 Implementation Framework for Actions on Marine Plastic Litter" was established, as well as the "Osaka Blue Ocean Vision", which aims to reduce additional pollution by marine plastics litter to zero by 2050 through a comprehensive life-cycle approach. This Osaka Blue Ocean Vision has since been widely shared at various international fora and promoted as a common global vision (G20, 2020[43]).

In the EU, a plastics strategy was launched in 2018, which sets bold targets for plastics recycling quotas and recycled content requirements. In the G7, the issue of plastic waste and marine litter was first

[5] For example, in 2016 the OECD developed a Policy Guidance on Resource Efficiency for the G7 (OECD, 2016[72]).

included in the agenda in 2015 in the form of the G7 Action Plan to Reduce Marine Litter, and has remained in the spotlight during subsequent G7 presidencies (Government of Canada, 2020[44]). Furthermore, a number of countries have introduced plastic specific policies, such as levies and bans on single use plastic items, initiatives to improve plastic waste sorting and recycling.

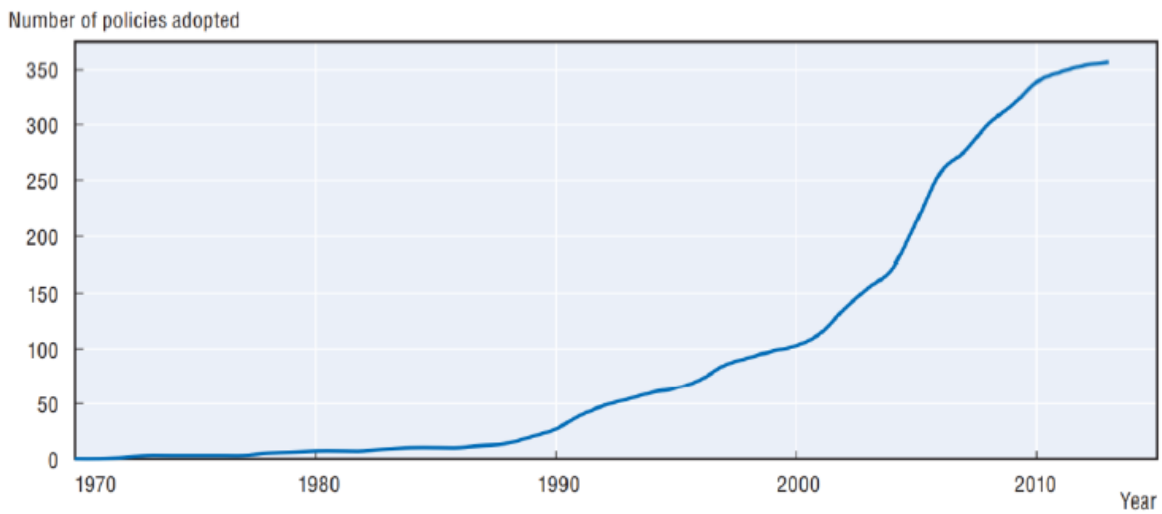
Sources: (G20, 2017[45]; G7, 2019[46]; European Commission, 2018[47])

G20 members use a mix of different policy instruments to increase resource efficiency

To implement these overarching plans, G20 countries are scaling up the use of existing and new policy instruments, including market, regulatory, education and information-based instruments, as well as public financial support and co-operation across value chains.

One of the most widespread and successful policy measures is Extended Producer Responsibility (EPR) (OECD, 2016[48]; OECD, 2001[49]). EPR relies on the polluter-pays principle, which encourages manufacturers to assume responsibility for the environmental impacts of their products throughout the whole product lifecycle. By internalising the end-of-life management costs of materials (i.e. those linked to collection and recycling), EPR represents an important tool to boost innovation and enhance resource efficiency. EPR schemes can include a variety of policy instruments, such as product taxes, recycling requirements, deposit-refund schemes, and disposal fees. EPR schemes have gained increasing popularity in the last decades (Figure 14) and they are currently in place in the majority of G20 countries. Whereas in most cases EPR focuses on packaging, electronic and electric equipment, batteries, tyres and end-of-life vehicles, in recent years some G20 countries have started widening the scope of their EPR systems to cover a wider array of products, including for example furniture and textiles. In addition, whilst EPR fees have usually been set on a per-unit or per-weight basis, countries such as France, Italy or Canada have worked towards more advanced EPR fee modulation to better instigate eco-design (OECD, forthcoming[50]).

Figure 14. Cumulative EPR adoption at the global level



Source: (OECD, 2016[48])

Another key instrument to facilitate the transition to a circular economy is green public procurement (GPP). GPP sets resource efficiency standards for suppliers and products purchased by the public sector, thus stimulating innovation, shaping consumption and production, and ultimately creating markets for greener products. GPP has the potential to introduce further criteria relevant to the circular economy, such as product lifespan or the quality of second hand or repaired products. Green public procurement can have a high impact. For instance, in OECD countries, government procurement accounts for one third of public expenditures and for 12% of GDP (OECD, 2016[51]). Particularly in sectors where public purchasers represent a large share of the market, such as construction, health services and public transport, GPP has a high potential.

Market instruments, such as taxes, subsidies, and tradable permit schemes, are widely used to enhance resource efficiency and incentivise the transition to a circular economy (OECD, 2021[52]). Virgin material taxes incentivise efficient resource use by increasing the cost of extracting and using natural resources and raw materials, while landfill taxes can play a key role in diverting waste flows from landfills. Environmentally-motivated subsidies can encourage increased materials productivity, besides incentivising materials re-use and recycling. Waste management can also benefit from pay-as-you-throw (PAYT) schemes, as well as cap-and-trade schemes, such as the tradable landfill permits scheme implemented in the United Kingdom. Economic instruments for the circular economy are in place in several G20 countries, however, in most cases, resource tax rates remain too low to effectively increase resource productivity (OECD, 2012[53]; OECD, 2021[52]).

Among regulatory instruments, recycling targets, product standards, recycled content requirements, lifetime warranties, bans and restrictions and deposit-refund systems (DRS) useful policies to increase resource efficiency. In recent years, minimum quality standards (e.g. for product design) and legal requirements on the reparability of products have attracted increasing political attention. For example, the EU End-of-life Vehicles Directive banned the use of hazardous materials in car manufacturing (e.g. ban on the use of cadmium, chromium, lead, and mercury) to improve recyclability (OECD, 2019[54]). The government of Scotland, United Kingdom, has introduced standards for reuse quality and for recognition of remanufactured products. In addition, recycling targets are a key instruments to raise recycling rates.

Furthermore, public information, consumer education, and awareness raising campaigns can help to foster behavioural change. For instance, environmental labels can steer consumer choices towards less environmentally harmful products. Examples of successful labelling schemes include the Nordic Swan Ecolabel (Denmark, Finland, Iceland, Norway, Sweden), Blauer Engel (Germany), the EU Ecolabel, and the EU Energy Label, as well as EPEAT (U.S.).

Other policy tools to steer resource productivity include education campaigns, public funding for research and development (R&D), voluntary agreements and other private sector initiatives. In recent years, new policy instruments have started to attract attention and have entered the process of policy planning in several countries. These include eco-design mandates, labelling requirements and schemes, the reform of environmentally harmful subsidies, and recycled content standards.

COVID-19 green recovery and the circular economy

The coronavirus pandemic and subsequent lockdown measures have caused severe short- and long-term effects on the macro-economy (OECD, 2020[55]). The COVID-19 crisis also had its own effect on the circular economy, with disruptions in recycling activities and changes in consumer and firm behaviour. Some recycling activities, such as manual sorting have temporarily come to a halt, border closures disrupted recycling supply chains and increased online shopping and take-away orders, as well as the regular use of personal protective equipment (PPE) have led to an increased consumption and waste generation from single-use plastic items (Paben, 2020[56]; Adyel, 2020[10]).

In reaction to the economic downturn, many countries launched a set of stimulus packages, to absorb the negative economic impacts. Most emphasised that these stimulus packages should lead to a “green recovery” from the pandemic, in alignment with other global challenges. However, recent OECD analysis finds that green measures are a small proportion (17%) of overall stimulus. Importantly, the green recovery measures announced so far include only limited concrete actions for resource efficiency, circular economy and waste management. Across the G20 membership[6], only around 1% of total funds committed to the COVID-19 recovery were estimated to address aspects of waste management and resource efficiency (OECD, 2021[57]).

The uptake of new circular business models can provide a means for economic recovery, which currently remains largely untapped due to a limited focus of recovery measures on the subject. Integrating resource efficiency measures into COVID-19 recovery measures more broadly can lead to positive environmental, as well as economic and social outcomes.

The COVID-19 crisis can also be an opportunity for cities to rethink urban policies towards more sustainable production and consumption patterns. The pandemic triggered initiatives that can also be beneficial for the circular economy, such as the extension of bike lanes, a focus on local food production or the establishment of food banks for people in need. This momentum can be used to further accelerate the transformation in cities and increase their resilience, in line with circular economy principles (OECD, 2021[58]).

[6] The OECD Green Recovery Database contains entries for all G20 countries, except Argentina, Russia and Saudi Arabia.

7. The role of cities towards the circular economy transition

Why are cities important in the transition to the circular economy?

Being the places where people live, work, consume and dispose of products, cities hold a key role in the transition to a circular economy. Megatrends such as climate change, demographic growth and urbanisation lead to reflections on how to improve resources efficiency and prevent waste generation. Cities represent almost two-thirds of global energy demand, produce up to 50% of solid waste and are responsible for 70% of greenhouse gas emissions (IEA, 2016[7]; World Bank, 2009[8]). In fast developing G20 countries, such as in Brazil, Russia, India, Indonesia, China, and South Africa (BRIICS), where urbanisation rates remain high and cities are expanding at a fast rate, there is a crucial need to anticipate and tackle the growth of raw material demand. In OECD countries, where much of the urban infrastructure is already built, the circular economy can offer opportunities for urban mining and industrial symbiosis.

Cities hold key competences on important sectors for the circular economy, such as waste management, water, urban planning and mobility. In the building sector, for example, cities can enforce regulation on commercial and residential buildings and operate public buildings to improve water and energy efficiency. In BRIICS countries, cities often build new urban infrastructure and engage in greenfield development. This can allow for leapfrogging opportunities if circular economy principles are applied early on in the planning and construction of new urban areas. Furthermore, solid waste management is commonly managed on municipal level and cities are key to improving the collection, treatment and recycling of waste. Cities also commonly control water management infrastructures and are well placed to increase water efficiency. Finally, cities are responsible to approving and managing spatial planning and land use. Through these levers, cities are well placed to encourage sustainable production and consumption patterns through a circular economy lens (OECD, 2020[37]).

Unlocking the potential of the circular economy in cities requires coordination across *people, policies and places* (see 3Ps Framework in Box 5). The circular economy is transformative as it implies a cultural shift towards different production and consumption pathways, new business and governance models (*people*). It requires a holistic and systemic approach that cuts across sectoral *policies*, and a functional approach that goes beyond the administrative boundaries of cities and closes, narrows and slows loops at the right scale (*places*).

Box 5. The 3Ps framework: people, policies, place

The 3Ps (people, policies and places) framework provides a conceptual framework to make circular economy happen in cities and regions. In particular:

- **People**: The circular economy implies shared responsibilities across different levels of government and stakeholders. Results from the OECD Survey on the Circular Economy in Cities and Regions carried out across 51 cities and regions in OECD countries[7] show that several stakeholder groups contribute to development and implementation of circular economy initiatives, such as: the business sector (80%), the scientific and academic sector (76%),

[7] The survey addressed 51 cities and regions from 21 OECD countries. It covers the following G20 countries: Australia, Canada, France, Germany, Italy, United Kingdom and United States. Additional countries include Belgium, Chile, Denmark, Finland, France, Germany, Italy, Latvia, the Netherlands, Norway, Portugal, Slovenia, Spain, Sweden and the United Kingdom (OECD, 2020[37]).

producers and citizens (73%), non-governmental organisations (NGOs) and suppliers (65%), service providers, designers and contractors (63%).

- **Polices:** The circular economy is systemic by nature and as such, policy-making requires a holistic approach across all sectors. Almost all the respondents of the OECD survey identified the waste sector as key for the circular economy (98%), followed by the built environment (75%), land use and spatial planning (70%), food and beverages and water and sanitation (65%), amongst others. The circular economy provides opportunities to foster complementarities across environmental, regional development, agricultural and industrial policies.
- **Places**: Circular economy related initiatives take place at various scales. They can vary from the micro-level, including a neighbourhood, to the metropolitan, regional and national levels. At the neighbourhood level, pilot projects can demonstrate innovative technologies but also stimulate and test the participation of citizens. But circular economy initiatives can also stretch beyond a cities boundary and connect to rural areas and a cities' hinterland, by involving local farmers and enabling the local procurement of food. For instance, the Municipalité Régionale de Comté des Sources (Canada) and the economic development organisation Synergie Estrie foster industrial symbiosis projects through the networking of businesses in the region. In Kitakyushu City (Japan), a food recycling loop between rural-urban areas has been established to use compost generated in urban areas as fertilisers in rural areas or as energy source.

Source: (OECD, 2020[37])

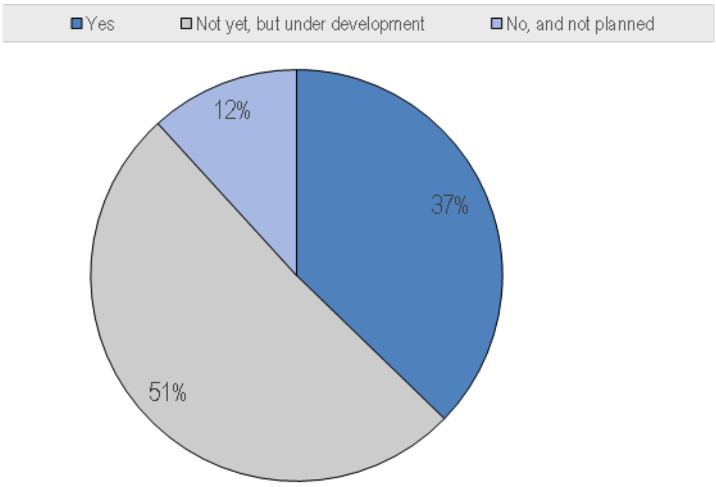
The circular economy in cities: the state of the art

There is substantial momentum to transition to a more circular economy on city-level and an increasing number of cities are implementing circular economy strategies. According to the recent OECD survey on the Circular Economy in Cities and Regions, 37% of the surveyed cities and regions put in place initiatives dedicated to the circular economy, including strategies, plans, programmes or roadmaps, 51% have plans to develop such a strategy and only 12% indicated to not have plans to develop one (Figure 15).

Major drivers for transitioning to a circular economy are environmental (climate change, 73%), institutional (global agendas, 52%) and socioeconomic (changing economic conditions, 51%). Additionally, the circular economy transition is driven by job creations (47%), private sector initiatives (46%), new business models (43%), technical developments (43%) and research and development (R&D) (41%) (OECD, 2020[37]).

For various cities, the first attempt to include circular economy principles in their policies and strategies relate to waste and resource management plans. For example, the waste management corporation of Munich (Germany) has transformed its core business focusing on the collection and management of household waste into a resource-efficient circular economy approach with focus on material recovery. Also the City of Toronto (Canada) included circular economy principles in its Long Term Waste Management Strategy.

Figure 15. Share of surveyed cities and regions with circular economy initiatives in place



Note: Results based on the OECD survey addressing a sample of 51 cities and regions from 21 OECD countries (including seven G20 countries) that responded "Yes", "Not yet, but under development" and "No, and not planned" to the question on the existence of a circular economy initiative (e.g. a strategy, plan, programme, road map, etc.), intended as a set of actions designed to achieve circular economy long-term goals.
Source: (OECD, 2020[37])

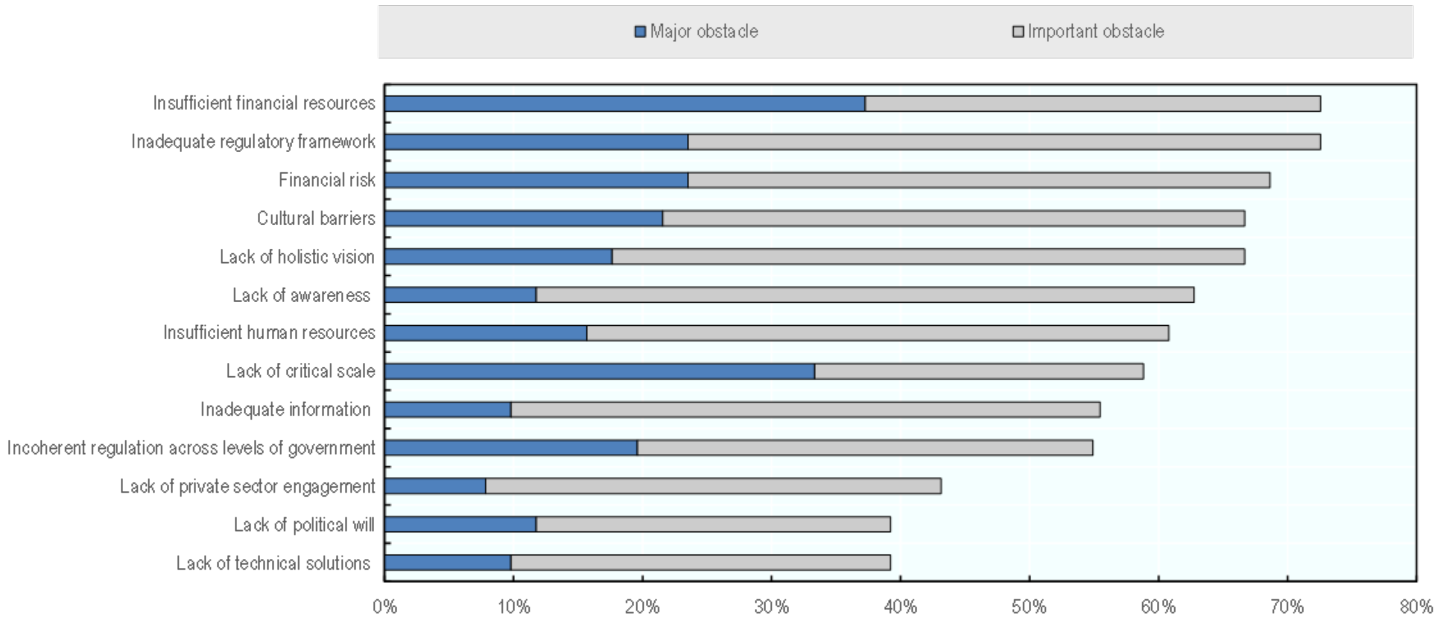
There remains room to further advance circular economy initiatives in cities of the G20. According to the OECD survey, most cities situate themselves at the initial phase of a transition to a circular economy. The majority of the surveyed cities (57%) consider themselves as "newcomers" that recognise the relevance and potential of the circular economy but are still exploring options for implementation. Only 10% of surveyed cities defined themselves as "advanced" and having developed strategies or roadmaps and engage multiple stakeholders. 39% of surveyed cities consider their circular economy policies "in progress', based on *ad hoc* initiatives. Only 4% described the transition towards the circular economy as "not in place" (OECD, 2019[59]).

In BRIICS countries, the development of a circular economy at the urban level sees different approaches and levels of implementation. In many countries, the approach focuses on waste management, but holds potential in sectors such as building and construction. China is seen as a leader in the circular economy among the BRIICS countries. The 2009 "Circular Economy Promotion Law" provided the main national-level framework for pursuing the circular economy. In 2017, the "Circular Development Leading Action Plan" stressed opportunities to integrate circular economy principles at the design stage of products and to develop new circular economy business models. Cities in China can contribute to the transition towards the circular economy as potential incubators of innovative circular solutions at scale (EMF, 2018[60]). In particular, Chinese cities would allow large-scale experiments and upscaling of a circular economy in areas such as e-mobility and car sharing, infrastructure development and housing, food and nutrition, textiles and fashion (Ekins et al., 2019[61]). In Brazil and India, circular opportunities are prevalent in the building and construction sector. In Brazil, the building sector represents 7% of GDP and 9% of the job market and more than half of the waste going to landfill in Brazilian cities originates from demolition and construction (EMF, 2017[62]). Similarly, in India, the construction sector generates more than 8% of GDP and is expected to expand further, to meet the demand for new housing. Circular economy criteria applied to buildings can help to create resilient cities and can allow for material circulation and reuse of components at the end of a building's life (EMF, 2016[63]).

Financial, regulatory, policy, awareness and capacity gaps currently hamper the transition to the circular economy (Figure 16):

- Funding gaps: The transition towards a circular economy requires investments and adequate incentives. Cities and regions responding to the OECD survey face constraints in terms of insufficient financial resources (73%), financial risks (69%), lack of critical scale for business and investments (59%), and lack of private sector engagement (43%).
- Regulatory gaps: Inadequate regulatory frameworks and incoherent regulations across levels of government represent a challenge for 73% and 55% of the surveyed cities and regions respectively.
- Policy gaps: A lack of holistic vision is an obstacle for 67% of surveyed cities and regions. This can be due to poor leadership and co-ordination. Other policy gaps concern the lack of political will (39%).
- Awareness gaps: Cultural barriers represent a challenge for 67% of surveyed cities and regions along with a lack of awareness (63%) and inadequate or insufficient information (55%) for policymakers to take decisions, businesses to innovate and residents to embrace sustainable consumption patterns.
- Capacity gaps: Lack of human resources and of technical solutions represent a challenge for 61% and 39% of surveyed cities and regions.

Figure 16. Main obstacles to the circular economy in surveyed cities and regions



Note: Results based on a sample of 51 respondents that indicated obstacles as being "Major" and "Important".
Source: (OECD, 2020[37])

Several cities in G20 countries set up financial, economic, regulatory tools and capacity building programmes to advance the circular economy transition:

- The financial instruments employed in cities include loans, grants, revolving funds, venture capital and growing capital (OECD, 2020[37]). For example, the London Waste and Recycling Board (LWARB) in the United Kingdom supports circular economy businesses through the "Circular Economy Business Support Programme", a venture capital fund supporting SMEs in scaling up their circular economy businesses.

- A range of economic instruments such as tax rebates, environmental pollution taxes and differentiated tariffs incentivise or discourage specific behaviours and business activities. For example, the City of Milan (Italy) introduced a 20% discount on waste taxes for businesses that donate their food surplus to charity.
- Some cities also introduced circular economy related requirements in public procurement and public tenders. For example, the City Kitakyushu (Japan) promotes the use of recycled materials and the reuse and repair of uniforms and work-clothes through procurement. In the city of San Francisco (U.S.), all carpets installed in public buildings are required to have a Cradle-To-Cradle Certified™ Silver rating or higher.
- Cities are also implementing capacity-building initiatives. Inside their own administration capacity building can for instance help to improve public procurement. But capacity building programmes also exist for other stakeholders such as businesses, entrepreneurs or start-ups. For instance, Mexico City (Mexico) launched a training programme for technicians for the installation and maintenance of solar systems, in the context of its Solar City program (U20, 2020[64]). Co-operation between cities can also be useful to enhance capacities and exchange good practices. For instance, Zero Waste Scotland co-ordinates the development of regional projects and enables the exchange of good practices across cities and regions in Scotland, including Edinburgh, Glasgow, North East Scotland and Tayside.

Results from the OECD survey show that 85% of respondents employ new circular business models (OECD, 2020[37]). Collaborative consumption and production models such as the sharing economy or crowdfunding have been introduced by several cities such as Milan (Italy) or Paris (France). Product-service-system models (PSS) have also been introduced where consumers pay for a service rather than buying the product itself. For instance, public school buildings in the municipality of Bollnäs (Sweden), or the Dutch Schiphol Airport rent light as a service, providing an incentive for the service provider to maximise durability and energy efficiency of the lighting equipment.

Circular economy strategies and projects in surveyed cities are often based on experimentation and pilots, allowing to test new technologies, foster innovation and raise awareness. For example, in Riyadh (Saudi Arabia) the Home of Innovation Demonstration Villa Project explores the construction of a sustainable dwelling with commercially available materials in conformity with Saudi building codes, whilst leading to a 40% reduction in energy and potable water use (U20, 2020[64]).

Digitalisation can also help to foster specific actions foreseen in circular economy initiatives at the local and regional scale. For example, the City of Paris (France) developed an online collaborative platform that brings together initiatives, tools, news and events relevant to the circular economy and enables stakeholders to connect and share knowledge. The City of Phoenix (U.S.) developed the “Recycle Right Wizard” website, which provides recycling information for citizens. The City of São Paulo (Brazil) set up a digital tool that connects large waste generators with transportation, composting and treatment centres, through smart data to allow for traceability and monitoring (U20, 2020[64]).

Improving resource efficiency in the built environment of cities

Applying circular economy criteria to the building sector implies rethinking upstream and downstream processes with the scope of maximising resource use and minimising waste production. Construction boom in emerging economies, especially China, will be a major driver for increased materials use in the coming years (OECD, 2019[27]). The circular economy can play an important role in reducing materials use for construction projects, as well as reducing GHG emissions and energy and water demand of existing buildings (Box 2).

A circular urban building sector considers the entire life cycle, from the designing and construction of buildings, their use, to their end of life. Collaboration between designers, constructors, contractors, real estate investors, suppliers and owners can enable opportunities for resource efficiency. The key phases of a circular building are planning, design, construction, operation and end of current life.

- Planning a building in a circular way implies considering circular economy aspects in its entire life cycle from improving the environmental performance of buildings, to conceive modular buildings that allow for reuse and/or reassembly of building components and materials. It also implies to plan new urban scenarios in line with the opportunities to regenerate natural systems, including vertical gardens, urban agriculture and green roofs.
- A circular design pays particular attention to the choice of materials, the consumption of resources such as water and energy, the reduction of waste and the possibility to reuse building components. For example, to help the application of circular economy principles in the design of buildings, the Public Waste Agency of Flanders in Belgium (OVAM), the Walloon Public Service (SPW) and the Brussels Environment Agency (Brussels Environment) developed a "Tool to Optimise the Total Environmental Impact of Materials (TOTEM)". TOTEM is an online open-access calculation tool aimed at supporting architects, designers and builders in improving material and energy performance of buildings and at assessing the environmental impact of building materials (Wille, 2013[65])
- In the construction phase, circular economy principles can be applied to identify more sustainable materials and to minimise the variety of the materials used. As well, improving data collection on the construction materials used in a building can enable reuse in the future. Building passports provide constructors and policymakers with information on materials embedded in the building stock and can create a database that enables urban mining at the end of a building's life (Cradle to Cradle Products Innovation Institute, 2019[66]).
- The operation phase can include circular solutions for the use of renewable energy and new technologies to improve resource efficiency in buildings. For example, the City of Paris (France) recovers heat from wastewater and uses it for the heating and cooling in public buildings. Paris also developed a network of non-potable water taps for cleaning purposes, to optimise drinking water use.
- At a building's end of life, there are opportunities for entire buildings or their components and materials to be repurposed or reused. This can include repurposing an existing asset, materials and components without applying significant changes and transformations and maintaining the same location, reusing existing assets for the same purpose, but in a different location, or reusing materials and components of existing assets in the same and different locations (Stronati and Berry, 2018[67]).

8. Towards a G20 policy vision on resource efficiency

Whereas policy responses to address resource efficiency and the circular economy have already emerged, they have been insufficient to curb the environmental impacts linked to materials consumption. Further and stronger policy action is needed to slow down the growth of materials use, improve the share of materials that are kept in the economy, and change the materials mix towards less toxic and more environmentally-efficient materials.

G20 members may want to develop their policies according to four principles in order to achieve these objectives:

- Promote resource efficiency throughout the full lifecycle of products;
- Align sectoral policies and COVID-19 recovery packages with resource efficiency objectives;
- Strengthen policy development through better data and indicators; and
- Enhance international co-operation.

In addition, given the diversity of countries in the G20, each country will need to assess their specific context and determine appropriate policy approaches and priorities for their transition from waste to resource, which can be structured along different phases. These phases are not strictly sequential and may overlap, but can help to identify policy priorities in a given context.

Finally, cities as key proponents of the circular economy transition are needed to promote, facilitate and enable circular activities on their territories in order to ensure that national level measures lead to effective implementation on the ground.

Promote resource efficiency throughout the full lifecycle of products

Resource efficiency policies should target all stages of materials lifecycle, namely material extraction, transport, manufacturing, consumption, recycling and disposal. Focusing on only one stage of a product's lifecycle risks to shift the burden to other stages, without reducing the overall environmental impacts (OECD, 2016[51]; OECD, 2021[52]). However, one of the main challenges to integrated lifecycle approaches is that material lifecycles and their impacts often involve a multitude of actors and extend across political and geographic boundaries.

To promote resource efficiency throughout the whole lifecycle of materials, governments need to enhance policy coherence across economic sectors, jurisdictions and all stages of the value chain, creating a coherent set of incentives for all relevant stakeholders. Strengthened policy coherence, together with increased coordination among all relevant stakeholders, can effectively counterbalance the increasing fragmentation of the global value chain. In addition, undertaking thorough lifecycle analyses can help to better understand the variety of environmental impacts occurring at different stages of materials use. It is important to consider all the environmental trade-offs among materials and their impacts, in order not to shift the environmental burden from one pressure to another.

Measures to promote resource efficiency throughout the lifecycle can include EPR schemes, GPP, and multi-stakeholder partnerships. Whereas EPR schemes have been widely adopted in many countries, further efforts are needed to broaden their scope (e.g. include new waste streams and stronger incentives for eco-design), strengthen their enforcement, and ensure that they operate in a transparent and accountable way. Integrating resource efficiency objectives in green public procurement schemes can be another successful way to improve the effectiveness of GPP systems and to encourage resource efficiency along a product's lifecycle. Finally, establishing and incentivising partnerships with businesses and other stakeholders involved in different stages of the value chain can improve coordination, while stimulating a lifecycle approach. Partnerships have a variety of additional benefits, as they enrich human capital, facilitate technology and knowledge transfer, and favour the diffusion of best practices. These efforts can be further supported by facilitating the availability of information on materials, material content and environmental impacts across value chains.

Altogether, policy mixes targeting the circular economy should provide incentives for narrowing, slowing and closing material loops. This includes promoting a more efficient use of natural resources, materials and products and incentivising the production and use of more durable products. Increased material recycling, reuse, repair and remanufacturing, together with improved end-of-life sorting and treatment, are key elements in the transition towards a more circular economy.

Align sectoral policies and COVID-19 recovery measures with resource efficiency objectives

Policy misalignments, perverse incentives and conflicting priorities often represent an obstacle to the implementation of effective resource efficiency policies. Policy misalignments are often linked to inefficient incentives for transitioning to a circular economy across policy communities, levels of government, and stakeholders. For example, trade restrictions (e.g. on exported raw materials, used goods, and environmental goods and services) can weaken markets for secondary materials and lower opportunities for material reuse and recovery, and hamper resource efficiency efforts in other.

National and international policy frameworks need to mainstream resource efficiency and to treat the transition to the circular economy as an overarching economic policy challenge. Cross-cutting policies, such as innovation, investment and education strategies, should integrate resource efficiency objectives. Supporting innovation in small and medium enterprises (SMEs) can help to achieve decoupling of materials use from economic growth, while mainstreaming resource efficiency into investment plans and strategies can support a more resource-efficient and low-carbon development. Assessing the set of skills required for the transition to the circular economy will help to adjust education and training programmes.

Importantly COVID-19 economic recovery should be aligned with resource efficiency goals (Box 6).

Box 6. Mainstream resource efficiency in COVID-19 recovery packages

In response to the COVID-19 pandemic, many countries were quick to commit to a "green recovery" through stimulus packages of unprecedented scale. Of the recovery measures announced so far, only a small share (approximately 1% of total funds) incorporates aspects of resource efficiency and waste management (OECD, 2021[57]).

The circular economy can provide a means to economic recovery. Yet, for this to happen, resource efficiency objectives need to be more mainstreamed into COVID-19 recovery packages.

Resource efficiency objectives should also be integrated in sectoral policy domains, with a particular focus on the most resource-consuming industries, such as agriculture, energy and transport. Aligning sectoral policies with resource efficiency principles is an effective tool to ensure coherent policy action and to effectively prevent and correct potential misalignments in the policy framework. At the same time, governments could also seek opportunities to exploit synergies across different policy objectives. For example, as the extraction, processing and disposal of raw materials are responsible for large volumes of greenhouse gas emissions, policies addressing resource efficiency could have significant climate co-benefits, contributing to countries' Nationally Determined Contributions (NDCs) and scaling up efforts to keep the average rise in temperatures well below 2 degrees.

Strengthen policy development through better data and indicators

To attain resource efficiency and circular economy objectives, it is fundamental to ensure the availability of accurate and reliable data. Evidence on material flows, resource efficiency and the costs of environmental impacts is necessary to build the case for sustainable materials management and to support policy design and implementation. However, incomplete datasets and significant data gaps (e.g. on international material flows, material flows across industries, and recyclable materials) hamper policy development. Data comparability is an additional challenge, as information is often collected on the basis of definitions and methodologies that are inconsistent across countries.

Countries should carefully assess their data needs and develop data systems that ensure the availability, quality and consistency of information, at national level, as well as in collaboration with other countries. Existing data gaps that need to be addressed include for example information on unused materials, secondary raw materials, recyclables, reuse, refurbishment and remanufacturing, urban mining, harmful substances, waste flows, as well as the uptake of circular business models and the indirect materials flows associated to international trade.

Furthermore, countries should develop effective metrics and indicators to monitor the different dimensions of materials use and track the progress and effectiveness of policy measures. In particular, countries could make additional efforts in tracking progress with regards to information on resource use and productivity, material stocks and flows, and decoupling trends.

Finally, it is fundamental to monitor and consider all the impacts of materials use, as well as their trade-offs and costs. For example, the substitution of one material with another might improve resource productivity while worsening the overall environmental impacts. Similarly, the socioeconomic impacts of materials use should be considered too, taking into account distributional and employment implications, such as for example employment levels and job quality.

In addition to developing sound data systems, governments should invest in capacity building to strengthen their ability to analyse material flows and resulting environmental and socioeconomic impacts. In this context, governments could also engage in international efforts to help strengthening developing countries' data and analytical capacity.

Enhance international co-operation

Whilst global supply chains have led to significant resource efficiency improvements, the increasing globalisation of our economy has also created new issues associated with increased complexity and lack of transparency. In light of increasing transboundary flows of resources, products and waste, international co-operation is necessary to ensure policy coordination and sustained benefits for all. The G20, which is accounting for 75% of global trade (G20, 2021[4]), has an important role to play to help ensure that trade and global value chains lead to improved resource efficiency.

Policy action at the international level is well placed to address challenges to resource efficiency in supply chains. For example, trade restrictions on raw materials and used products affect the efficiency with which materials are used, while other barriers to trade can hinder the diffusion of best available technologies (BAT) across countries. At the same time, international efforts can support companies in managing their supply chains, thus facilitating the integration of resource efficiency considerations in global value chains.

International co-operation can also help to improve and harmonise environmental labelling and information schemes. Facilitating the multilateral recognition of national or regional schemes would ensure the adequate stringency of environmental standards and ease compliance by producers. International co-operation could also help improving information gaps on resource efficiency and the circular economy (i.e. develop indicators and collect data on primary and secondary material flows and on existing stocks of natural resources), harmonising methodologies and ensuring the compatibility of data.

Finally, international coordination could support the systematic mainstreaming of resource efficiency in Official Development Assistance (ODA). To date, a relatively small share of ODA from G20 countries that are also members of the OECD's Development Assistance Committee is earmarked for purposes of resource efficiency or waste management. Significant effects could be achieved if resource efficiency was mainstreamed further into ODA (Box 7). ODA can contribute to effective capacity development and technology transfer. Aligning development finance with resource productivity goals would also provide an opportunity to reduce the burden generated by the increasing outsourcing of production.

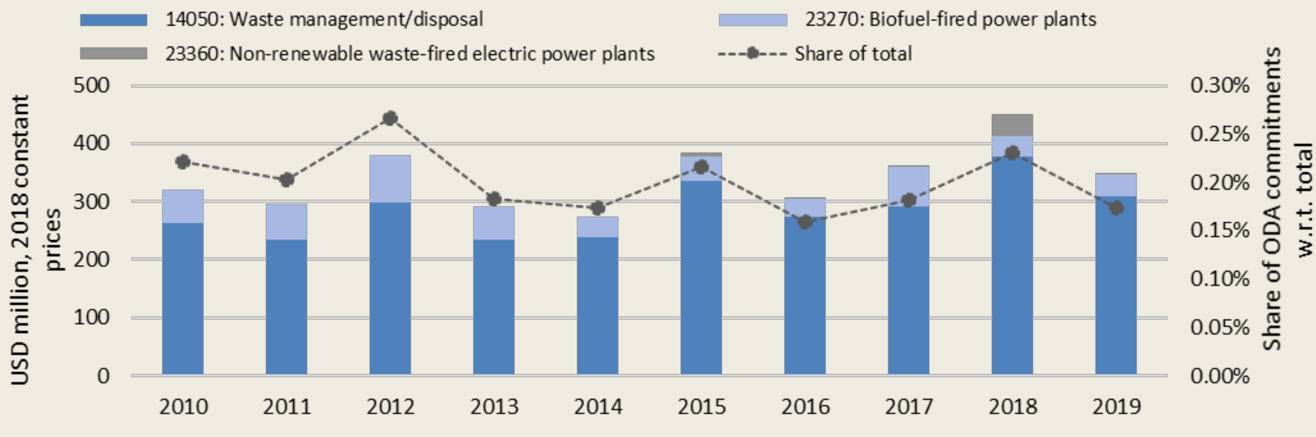
Box 7. Significant effects could be achieved if resource efficiency was mainstreamed into ODA more systematically

A lack of financing or insufficient technical knowledge or capacity are common barriers for setting up or extending waste services in less developed countries or for implementing resource efficiency policies or initiatives. In addition, many of the environmental and health impacts associated with illegal dumping and burning of waste, in particular hazardous waste, can be alleviated with formal waste collection and treatment services that are accessible and affordable for all.

Official Development Assistance that is targeted at these purposes can lead to cost-effective environmental outcomes. Technical assistance and capacity development can identify and realise "low-hanging fruits" for resource efficiency improvements in global value chains. Development co-operation can also contribute to reducing the "ecological backpack" caused by the increased imports of processed goods, and to mitigating the negative effects of production relocation.

To date, a relatively small share of ODA from G20 countries that are also members of the OECD's Development Assistance Committee is earmarked for purposes of resource efficiency or waste management. In 2019, ODA specifically earmarked for these purposes accounted for around USD 350 million, less than 0.2% of the overall ODA commitment budget spent by G20 DAC countries. No significant trend is notable over the past years. Between 2010 and 2019, ODA for resource efficiency and waste purposes have remained at small shares of around 0.15-0.25% of total ODA commitments (Figure 17).

Figure 17. The share of ODA commitments by G20 donor countries for the purpose of resource efficiency and waste projects is low



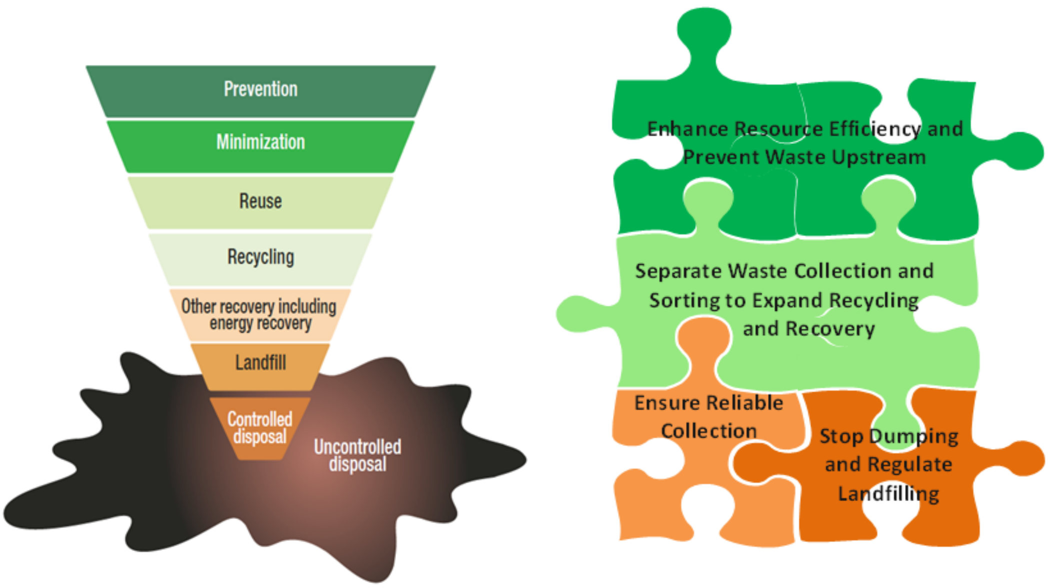
Note: Not all G20 countries are registered as official donors in the Creditor Reporting System. G20 donors considered in this graph include: Australia, Canada, France, Germany, Italy, Japan, Korea, Russia, Saudi Arabia, Turkey, United Kingdom, United States, as well as EU Institutions.
Source: Authors' calculations based on (OECD, 2021[68]) *Creditor Reporting System* (database)

Transitioning to a more circular economy is a phased approach where a country's context shapes policy priorities

Resource efficiency and waste challenges differ across G20 countries, depending on a country's context, economic structure and stage of development. Specific contexts and local circumstances lead to different priority actions and objectives in different G20 countries. For example, in emerging economies, a priority may be to phase out uncontrolled disposal (open burning and dumping) and extend controlled waste collection and management to the entire population in order to improve public health. In more developed economies, where basic waste collection is already in place, the management of hazardous and non-hazardous waste is usually carried-out in an environmentally sound manner, and the priority is to increase material recovery as well as to reduce waste generation.

As such, transitioning to a more circular economy is a phased approach, along a hierarchy of different objectives that aim to improve public health, mitigate environmental impacts from disposal and facilitate environmental improvements through material efficiency and recovery. The UNEP Global Waste Management Outlook describes several phases, moving from "waste management" to "resource management" (Figure 18) (UNEP, 2015[69]). Whilst these phases overlap and are not strictly sequential, they can provide an indication for policy-makers on policy priorities in a given context.

Figure 18. Waste management hierarchy and complementary policy actions



Source: (UNEP, 2015[69])

First, to protect the environment and public health, waste needs to be properly managed. To eliminate uncontrolled dumping and open burning, adequate, safe and affordable waste collection services are essential prerequisites. This includes formalising the informal waste sector or, where relevant, integrating informal waste services into formal waste management systems. The aim is to phase out uncontrolled disposal and to divert waste towards controlled, state-of-the-art landfills to reduce harmful impacts on public health.

Second, waste classified as "hazardous" requires special attention. Improper disposal, dumping or leakage of this waste can lead to severe impacts on the environment and human health. All G20 countries are producing hazardous waste that requires special attention. For instance, in the context of the COVID-19 pandemic, hazardous waste of the healthcare sector (e.g. infectious, pathological, radioactive or genotoxic waste, pharmaceutical waste and sharps) has surged (Das et al., 2021[70]). Inadequate and inappropriate handling of such wastes can have serious environmental and public health consequences and should thus be a key concern for G20 countries.

Third, where key public health risks have been mitigated through proper collection and environmentally sound treatment of wastes, countries need to start implementing a materials cycle to shift away from disposal and increase material recovery. Separate collection at source and improved sorting facilities are required to increase material recovery and recycling. These activities increase waste management costs, but can also lead to significant environmental benefits. Once material recovery is maximised, residual waste that cannot be further recycled, can be incinerated in environmentally sound energy recovery facilities. This also allows to minimise the volume of waste that is landfilled.

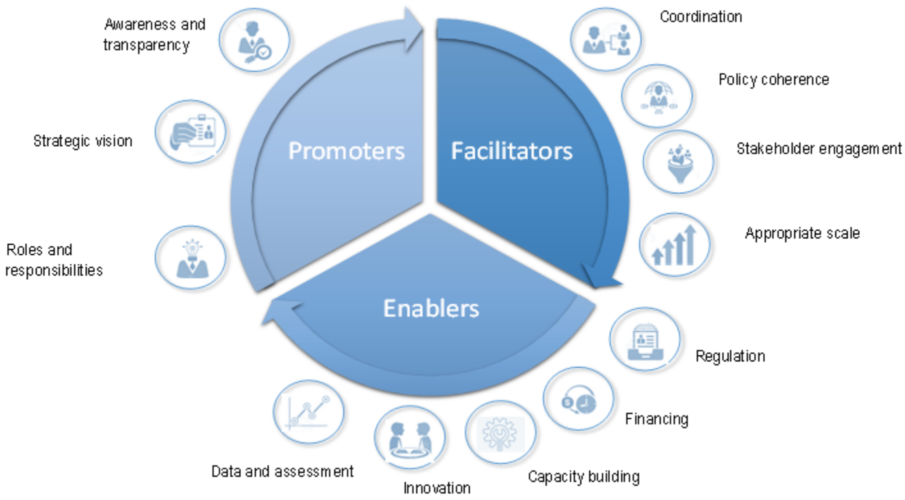
Fourth, whilst increasing material recovery at the end of the product lifecycle, countries also need to close “higher-value material and product loops” that enable retention of material values at earlier stages of the lifecycle. Tackling the issue at the source and target upstream lifecycle stages that prevent products from becoming waste and leads to more sustainable consumption and production is in most cases preferable from a lifecycle point of view. Governments should thus work towards product lifespan maximisation and encourage reuse and repair, where this is environmentally preferable. Often, better product designs will be needed to achieve these objectives.

Policy guidance for circular cities: promoting, facilitating and enabling the circular economy

Cities can act simultaneously as promoters, facilitators and enablers of the circular economy. This can be done in a shared responsibility with national government and stakeholders. As promoters of the circular economy, cities can act as a role model for citizens, business and other stakeholders, providing clear information and introducing goals and targets within long term circular economy strategies. As facilitators, cities can facilitate connections and dialogue across stakeholders and offer soft and hard infrastructures for new circular businesses. As enablers, cities can create the enabling governance conditions for the transition to a circular economy to happen and the uptake of circular economy business models.

The OECD created a “Checklist for Action” based on twelve key governance dimensions that can serve as guidance for governments to act as promoters, facilitators and enablers of the circular economy (Figure 19). The checklist was designed to be used by cities, but it can also be applicable at other levels of government.

Figure 19. The governance of the circular economy in cities and regions: A Checklist for Action



Source: (OECD, 2020[37])

In order to *promote* the circular economy, cities can define roles and responsibilities and lead by example, develop circular economy strategies including clear goals and actions to achieve them, raise awareness on circular economy, guarantee transparency and enhance trust:

- Roles and responsibilities should be defined to clarify who does what in policymaking and implementation within the circular economy transition. Certain cities created dedicated offices to coordinate circular economy related activities. In others, responsibilities are attributed to waste management, environmental or urban planning departments. Importantly, horizontal coordination across municipal departments is needed to enhance policy coherence. Cities can also lead by example, through introducing waste prevention measures, promoting the use of secondary materials, adopting circular business models or establishing circular economy criteria in public procurement.
- Developing a circular economy strategy with clear goals and actions is fundamental to build a robust vision, identify priorities and allocate financial resources. A clear vision for the circular economy can address the fragmentation of existing initiatives and ensure continuity beyond political cycles. An urban circular economy strategy can be based on: 1) the analysis of stock and flows of materials and energy; 2) the mapping of existing related initiatives; 3) clear and achievable goals, actions and expected outcomes and results; 4) the analysis and allocation of budget and resources; 5) a consensus and common vision among relevant stakeholders based on a shared understanding and co-creation process; 6) an effective monitoring and evaluation framework.
- Practices enhancing transparency and information can overcome cultural obstacles in recycling and the use of secondary materials, facilitate co-operation of companies across the value chain, increase social acceptance and lead to more responsible choices on circular products and services. Promoting a circular economy culture can be done through communication campaigns, dedicated websites, knowledge sharing events and the use of social media. For example, the London Waste and Recycling Board (LWARB) in the United Kingdom recruited ambassadors for the circular economy to share information on the benefits of the circular economy for each economic sector (London Waste and Recycling Board, 2017[71]). Certificates, labels and awards can enhance trust in the circular economy benefits and solutions, and lead to more conscious production and consumption choices.

Cities can play the role of *facilitators* for the circular economy. They can implement effective multi-level governance coordination mechanisms, foster policy coherence and facilitate stakeholder engagement and collaboration between public sector, businesses and not-for-profit actors:

Co-ordination among different levels of government is important to address circular economy related issues effectively, align objectives and actions and avoid asymmetries or lack of information between the actors at local, regional and national levels. Co-ordination on the city level can be implemented through the introduction of specific co-ordinating bodies in public administration, the organisation of ad hoc meetings for city-province-region-state co-ordination, setting up of common databases and information systems or contracts/deals with the national government as tools for dialogue, for experimenting, empowering and learning. For example, the City of Toronto, Canada, created a Cross-Divisional Circular Economy Working Group comprising 11 divisions, with the scope to co-ordinate and enhance the capacity of the city divisions in implementing circular economy initiatives.

- The circular economy is systemic by nature and includes a variety of actors, sectors and goals. As such, for the circular economy to be effective, it requires integration across policies and plans (e.g. regional development, environmental, climate, mobility and land use, agricultural and industrial). To date, these sectoral policies have been often developed in silos.
- Local and regional authorities can foster synergies amongst public actors, non-for-profit organisations, knowledge institutions and businesses by facilitating the exchange of relevant information and experiences and engaging stakeholders. For example, cities can identify possible pilots and experimentations that would involve R&D and university departments, based on the needs of developing innovative urban solutions for mobility, tourism, food, waste, or the bioeconomy.
- Cities and regions can facilitate the creation of opportunities across urban and rural areas, as well at the micro level (e.g. neighbour or districts). For example, the City of Kitakyushu (Japan) introduced a food-recycling loop in which the compost produced by food-waste generated in urban areas is used as fertiliser in rural areas.

Cities can play the role of *enablers* of the circular economy transition by providing conditions for circular business models to thrive. Cities can introduce specific regulation, mobilise and allocate financial resources, develop training programmes, support business development and innovation, generate information systems and assess achievements of policies and strategies' goals and results:

- The transition to the circular economy requires conducive regulation in key sectors such as waste, water, food and building and construction. Identifying available tools (such as specific requirements for land use), environmental permits (e.g. for decentralised water, waste and energy systems) and regulation for pilot projects would clarify potential regulatory uncertainties across different legal entities, gaps and future needs.
- Cities can facilitate the access to finance. According to available funding options and budget capabilities, local and regional authorities can support circular businesses by using a range of financial instruments, from grants to venture capital. For example, in the United Kingdom, the "Circular Economy Business Support Programme" was created, a venture capital and growth capital fund that supports circular businesses.
- Training programmes can address public administrations, as well as private sector and civil society. Training can improve the capacities to address technical issues in specific sectors, to draft, launch and implement circular economy strategies, or to green public procurement. Experimentation and pilot projects can create new knowledge and information and improve capacities both in the public and private sectors. Training can also support entrepreneurs and employees to improve their knowledge on the circular economy opportunities and to succeed in circular economy projects. The

Glasgow Chamber of Commerce (United Kingdom) organised workshops and events on capacity building and good practices in context of the circular economy.

- Cities can introduce specific initiatives to support market innovation and business development. For instance, the start-up in Residence (San Francisco, United States) connects start-ups and businesses to develop solutions to the city's problems through transparent selection processes. Local and regional incubators can also promote innovative circular economy projects.
- Data can allow public authorities and businesses to improve policymaking and implementation of the circular economy. Data can also support the monitoring and evaluation of policies, programmes and strategies. Cities can collect and process environmental data, such as data on empty buildings, materials used for construction and waste streams, as well as data on existing circular economy initiatives. Digitalisation plays an important role in data collection and processing.

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