Improving resource efficiency and the circularity of economies for a greener world

POLICY PERSPECTIVES

OECD ENVIRONMENT POLICY PAPER NO. 20

OECD
BETTER POLICIES FOR BETTER LIVES

Disclaimers

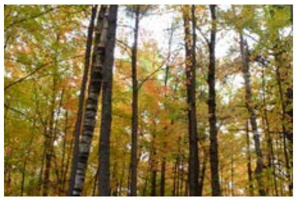
This paper is published under the responsibility of the Secretary-General of the OECD. The opinions expressed and the arguments employed herein do not necessarily reflect the official views of OECD member countries.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

For Israel, change is measured between 1997-99 and 2009-11. The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

ISSN 2309-7841

Authorised for publication by Rodolfo Lacy, Director, Environment Directorate



Contents

Abstract

Global demand for materials has been growing over the past century, driven by a steady economic growth in OECD countries, the industrialisation of emerging economies and a growing world population. Global materials use more than doubled between 1990 and 2017 and is projected to double again by 2060. Due to the growing amounts of materials use, environmental pressures such as land degradation, greenhouse gas emissions and the dispersion of toxic substances in the environment are projected to more than double in the decades to come. In this context, improving resource efficiency and stimulating the transition towards a more circular economy has become crucial. In recent years an increasing number of governments have started implementing policies and strategies to meet this objective. However, stronger efforts are needed. In particular, resource efficiency policies need to be extended to cover all stages of materials lifecycle, and aligned with sectoral policies, such as those targeting trade of secondary materials. Further efforts in gathering data and designing indicators will also help strengthening policy development. Finally, enhancing international co-operation will be crucial in the context of increasingly globalised value chains.

1. Introduction

Global demand for materials has been growing over the past century, following a 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[1]), and it is projected to double again by 2060 (OECD, 2019[2]). Due to the growing volumes of materials use, environmental impacts are projected to more than double in the decades to come, with adverse consequences for human health, ecosystems and the economy.

Raw materials are often classified in four main categories: non-metallic minerals, biomass, fossil fuels and metals (OECD, 2019[2]). Non-metallic minerals – including construction minerals (e.g. sand, gravel, crushed rock) and industrial minerals (e.g. salts, fertilisers, pesticides) – are largely associated with construction activities and represent one third of total materials use. Biomass – which includes wood resources, food, and feed – is the second most-used material category at the global level and plays a crucial role in the agricultural sector. Fossil fuels – such as coal, oil and natural gas – are important energy carriers and represent the third most-used materials category. Finally, metals – such as iron, copper and gold – are largely used in manufacturing activities.

Three main socioeconomic factors drive the use of material resources. First, a growing global population and the progressive convergence in living standards across countries lead to higher consumption, thus increasing materials use. Furthermore, as economies develop, investments in construction and infrastructure increase, with a consequent higher demand for materials. Second, technological improvements can decrease the material intensity[1] of production, thus reducing the materials input required to produce a given economic good. Third, changes in the sectoral composition of the economy (hereafter, structural changes) contribute to further reduce the material intensity of the economy. Indeed, as income levels rise, aggregate demand shifts towards less resource-intensive sectors, such as services and leisure activities. Overall, technological advancements and structural changes have the potential to counterbalance the increasing demand for materials use, partially decoupling[2] materials use from economic growth.

While some improvements in materials intensity are projected to take place autonomously, these will not be sufficient to offset the global increase in materials use. Consequently, unless countries put further effort in increasing resource efficiency,[3] 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.

During the last decade, an increasing number of national and local governments started developing policies and strategies to stimulate the transition towards a more resource efficient and circular economy.[4] Overall, the principles of resource efficiency and materials circularity – including resource

[1] The material intensity of an economy measures the amount of materials input per dollar of economic output.

[2] Decoupling occurs when an environmental pressure grows at a slower pace than its economic driving force (OECD, 2019[6]). In the context of material consumption, relative decoupling takes place when the growth rate of material consumption is lower than the growth rate of the economy. Absolute decoupling occurs when material consumption decreases while the economy keeps growing.

[3] While there is no commonly agreed upon definition of resource efficiency, this concept refers to the economic efficiency and the environmental effectiveness with which an economy or a production process is using natural resources (OECD, 2019[6]). Resource productivity, another indicator that can be used to track progress in using resources, describes the effectiveness with which an economy or production process uses material resources (OECD, 2019[6]).

[4] The circular economy can be broadly defined as an economic system that (i) maximises the value of materials and products circulating in the economy; (ii) minimises material consumption, with a particular focus on virgin materials, toxic and

productivity, material recovery, sustainable materials management and the "3Rs" (i.e. reduce, reuse, recycle) – have started to guide national, sectoral and even local policies, which have increasingly focused on the entire lifecycle of materials and products. Additionally, governments have started combining solutions such as Extended Producer Responsibility (OECD, 2016[3]), Green Public Procurement, and a variety of regulatory, information and market-based policy instruments. These efforts have also been encouraged and supported by a variety of international and multilateral initiatives, in the framework of the OECD, the European Union, the United Nations, and the G7 and G20. Nonetheless, while national, international and local authorities are progressively scaling up their commitment, further efforts are needed to achieve a more resource-efficient and circular economy.

Drawing on recent OECD work, this paper provides an overview on materials use and resource efficiency trends and policies. In particular, Section 2 describes past materials consumption trends based on the recent report *Environment at a Glance* (OECD, 2020[4]), and on the previous report *Material Resources, Productivity and the Environment* (OECD, 2015[5]), with the support of the OECD Environment Statistics database (OECD, 2019[1]). Sections 3 and 4 outline projections of material use and their environmental impacts in the coming decades in absence of further policy action, based on the OECD's *Global Material Resources Outlook to 2060* (OECD, 2019[6]). Sections 5 describes the current state of circular economy and resource efficiency policies across the world, drawing on the recent report on *Waste Management and the Circular Economy in Selected OECD Countries* (OECD, 2019[6]) and on the *Progress report on the implementation of the Recommendation of the Council on Resource Productivity* (OECD, Forthcoming[7]). Finally, Section 6 proposes five policy recommendations, building on the OECD's *Policy Guidance on Resource Efficiency* (OECD, 2016[8]).

2. Past trends in material consumption

Over the last century, the driving forces described above – population and income growth – determined 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%.[5] As a result, at the global level, yearly material consumption grew from 37 billion tonnes in 1990[6] 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[2]).

At the same time, the productivity of materials has improved, with a significant reduction in the material intensity of the global economy (OECD, 2020[4]). 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. The most remarkable improvements have taken place in the OECD area, where – partly due to the outsourcing of resource-intensive activities to other countries –

hazardous substances, and specific waste streams; (iii) prevents waste generation; (iv) reduces hazardous components in products and waste (OECD, 2020[4]). Previous OECD has highlighted the lack of a precise agreed upon definition of circular economy, and identified three mechanisms that improve the circularity of an economy: closing material flows (i.e. recovering materials from waste streams for recycling or reuse), slowing material flows (i.e. keeping materials and products in the economy for longer), and narrowing material flows (i.e. using resources materials and products more efficiently) (OECD, 2019[18]; McCarthy, Dellink and Bibas, 2018[19]).

[5] Population data are from the UN World Population Prospects (United Nations, 2017[20]), while GDP per capita figures are from the World Bank's World Development Indicators (World Bank, 2019[16]).

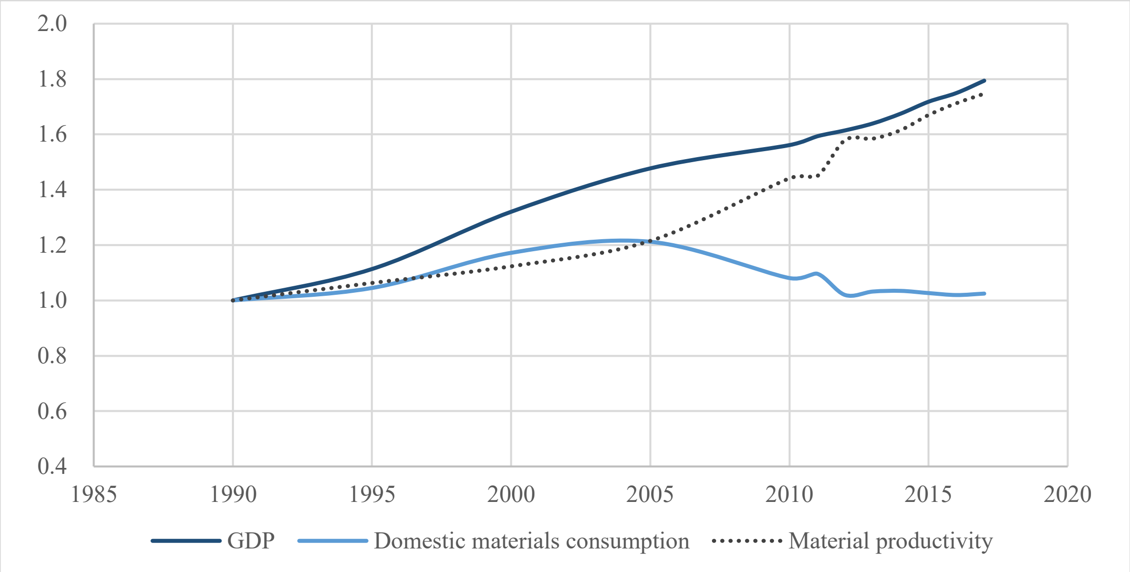
[6] All material consumption data referring to 1990 are likely to be underestimated, due to data availability constraints for both OECD and non-OECD countries. All figures on global and domestic material consumption and resource productivity are drawn from the OECD Environment Statistics "Material resources" database, which includes data from Eurostat and from UN Environment (OECD, 2019[1]).

decoupling of domestic material consumption has been recorded for all material groups (OECD, 2015[5]).

Altogether, in OECD countries, average resource productivity grew by 75% between 1990 and 2017 (Figure 1), while domestic material consumption (DMC)[7] per capita has decreased and stabilised over time. Today, in OECD countries, one tonne of materials generates on average USD 2 600, while in 2000 the same amount of materials generated USD 1 700 (OECD, 2020[4]). 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 towards non-OECD countries).

Figure 1. Material consumption, materials productivity and economic growth in OECD countries

Index with reference to 1990



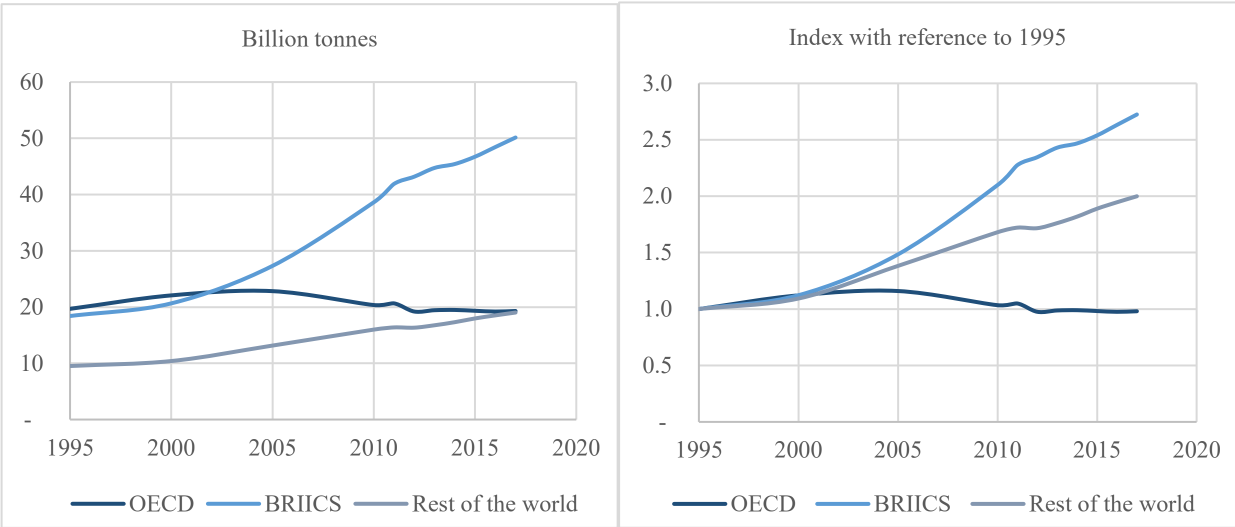
Note: Economic growth is measured in USD (2010 PPP), material consumption is measured in Domestic Material Consumption (DMC), and material productivity is measured as the ratio of GDP/DMC (i.e. USD per kg of domestic material consumption).

Source: OECD (2019), "*Material resources*", OECD Environment Statistics (database).

Adding to the changes observed in the OECD area, the unprecedented economic and demographic growth experienced by the BRIICS economies (i.e. Brazil, Russia, India, Indonesia, China and South Africa) has significantly changed the geography of material consumption and determined important differences in DMC trends across regions. While domestic material consumption in OECD countries decreased by 2% between 1995 and 2017, it almost tripled in BRIICS countries (Figure 2). Domestic material consumption has also been increasing in the Rest of the world, doubling between 1995 and 2017.

[7] Domestic material consumption (DMC) is an indicator that measures the mass of materials directly used in a national economy, including domestic extraction and imports, and excluding exports. Hence, DMC represents the apparent consumption of materials, without including the indirect flows of raw materials embedded in international trade.

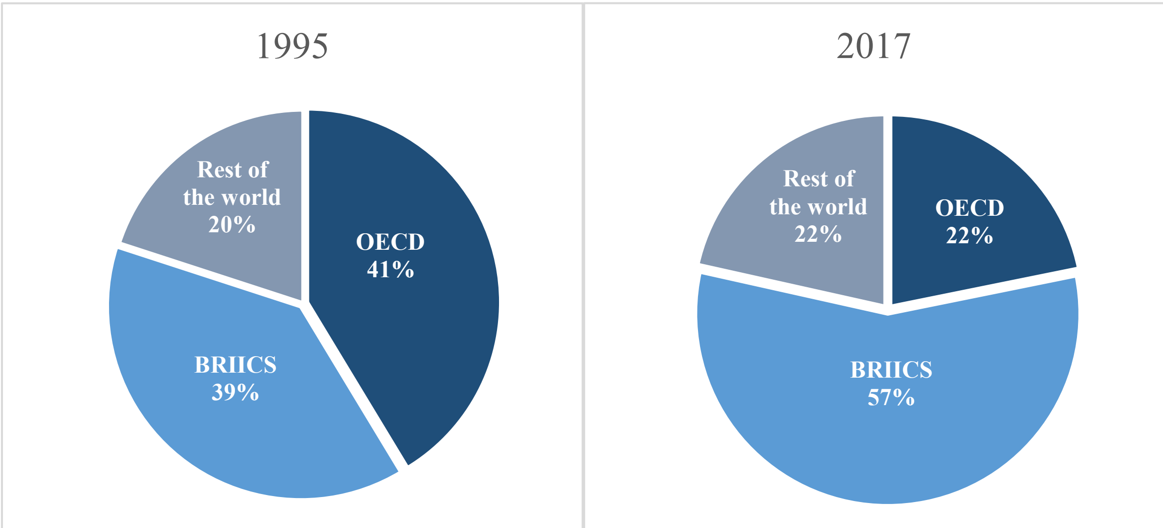
Figure 2. Material consumption by region



Source: OECD (2019), "Material resources", OECD Environment Statistics (database).

Material consumption in BRIICS countries increased from 57% global material consumption in 2017, to 40% in 1995 (Figure 3). Conversely, in the same period, the share of global material consumption of OECD countries decreased from 41% to 22%. In this context, the growth of the Chinese economy has played a pivotal role. In fact, since its entrance in the World Trade Organization (WTO) in 2000, China has emerged as a centre for heavy industry and export manufacturing. In 2017, China represented 20% of the world's population, but it accounted for 40% of global material consumption.

Figure 3. The geographical shift in domestic material consumption

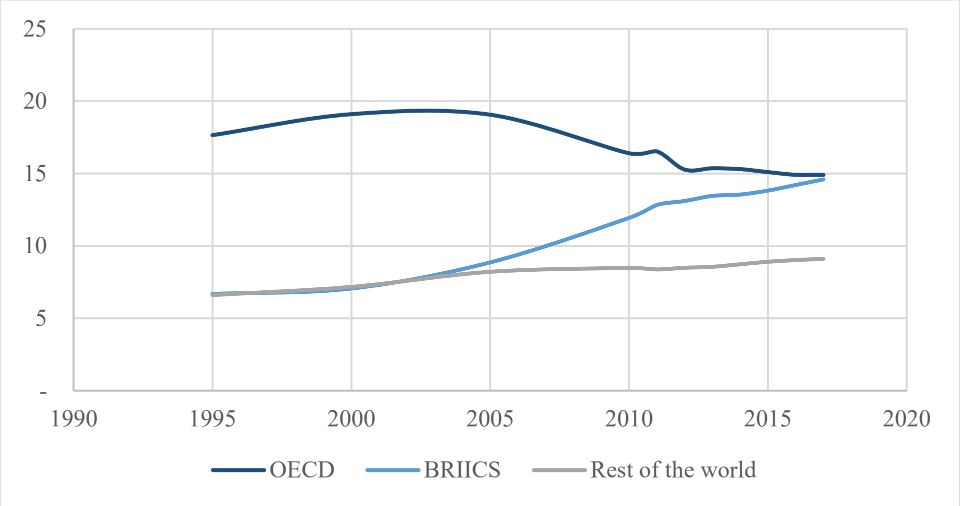


Source: OECD (2019), "Material resources", OECD Environment Statistics (database).

The significant growth of material consumption in BRIICS and emerging economies needs to be interpreted considering the size of their population and thus material consumption per capita figures. Indeed, historically, domestic material consumption per capita in OECD countries has been significantly higher, and, until recent years, an OECD citizen consumed on average 3 times more materials than a person living elsewhere in the world. As shown in Figure 4, the average domestic material consumption per capita in BRIICS countries has only recently converged to OECD levels, while it remains significantly lower in the Rest of the world.

Figure 4. Domestic material consumption per capita

Tonnes



Source: OECD (2019), "Material resources", OECD Environment Statistics (database).

While domestic material consumption is a useful indicator to quantify the amount of materials used by different countries, it does not capture the increasing substitution of domestic production with imported goods. In many cases, OECD countries have outsourced material-intensive production to non-OECD countries, and this shift is not reflected in domestic material consumption, as this metric does not account for the indirect flow of raw materials embodied in internationally-traded intermediate goods and final products. When considering the total material footprint[8] of OECD economies, – accounting for all raw materials needed to satisfy domestic final demand for materials – material productivity gains are more modest (OECD, 2015[5]). Altogether, the material footprint of the OECD region increased by 60% since 1990 (as compared to 2017) and, on average, countries with higher import rates and higher income levels show higher materials footprints (OECD, 2020[4]).

3. Projections of future materials use

In the absence of additional policies promoting resource productivity, the global trends described above are likely to continue. According to the OECD's *Global Material Resources Outlook to 2060*, materials use[9] is projected to nearly double by 2060, compared to 2017 levels (OECD, 2019[2]).

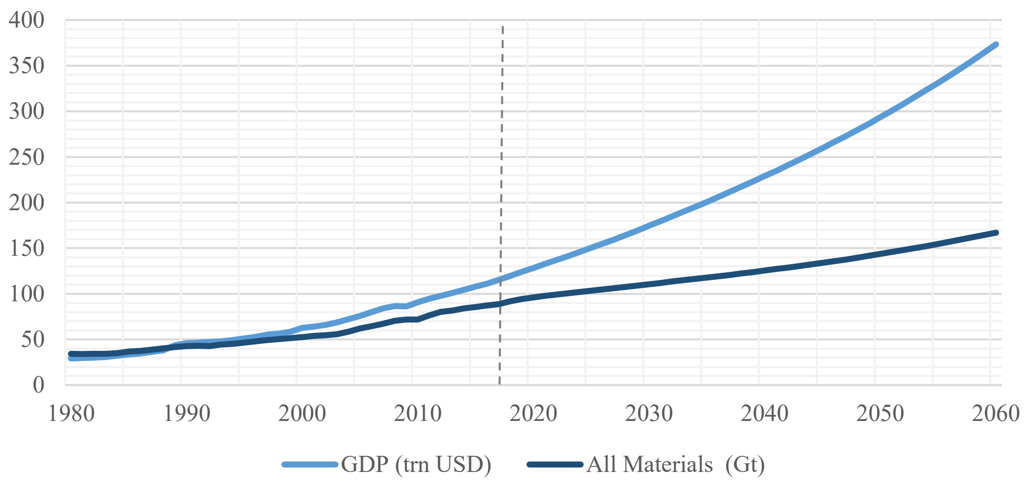
The projected growth in materials use is largely associated with the socioeconomic and technological changes that the global economy will face in the decades to come. Global income per capita is projected to reach 2017 OECD levels by 2060. Furthermore, the world's population is projected to continue growing, thus further increasing demand for energy, food and natural resources. Altogether, at the global level, daily materials use per capita is projected to increase from 33 kilogrammes (kg) in 2017 to 45 kg in 2060.

[8] The material footprint of an economy accounts for all raw materials extracted and used to meet the final demand of an economy, including materials extracted abroad and embedded in the production of imported products.

[9] This section refers to materials use, reflecting the language and variables used in the reference publication *Global Materials Outlook to 2060* (OECD, 2019[2]). Materials use accounts for domestically extracted and imported raw materials and excludes processed materials, downstream products (such as plastics, steel and textiles), recycled materials, and the indirect flows of raw materials embedded in international trade. Furthermore, figures on materials use only include extracted material resources that successfully enter the economy, without accounting for unused domestic extraction such as mining overburden, harvest residues and fisheries by-catch. Hence, *materials use* differs slightly from *domestic material consumption (DMC)*, as the latter also includes imported and exported materials in the form of semi-processed and processed products.

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 5). 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[2]). 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 5. Partial decoupling between economic growth and materials use in the coming decades



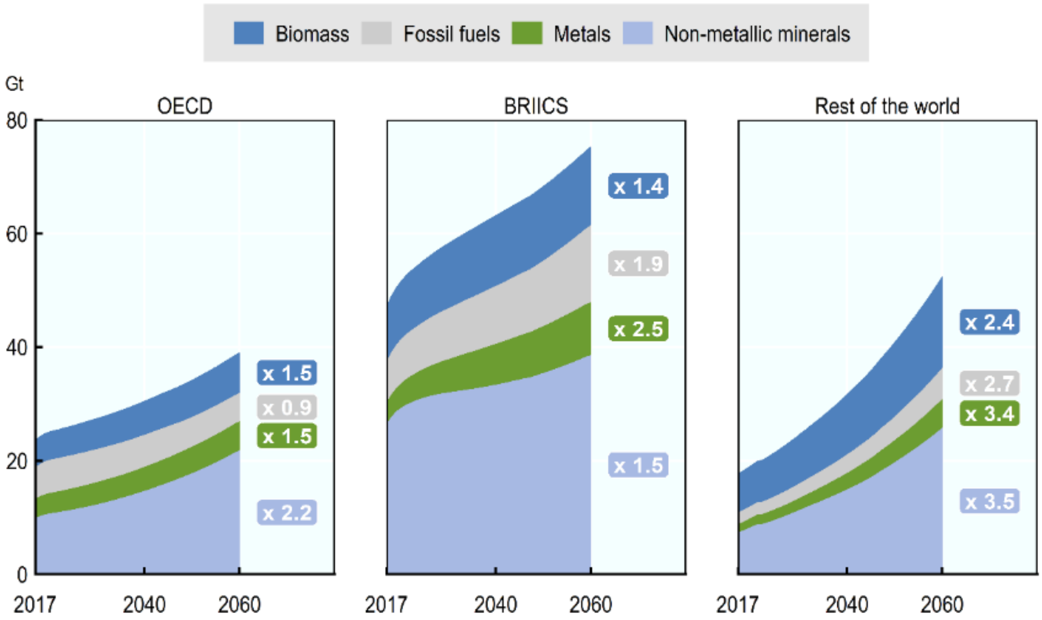
Note: the dotted vertical line indicates a change from historical data to projections.
Source: (OECD, 2019[2]).

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.

The existing differences in materials use levels across countries and regions are projected to decrease. In particular, while the share of global materials use by OECD and some BRIICS countries is projected to decrease over time, other emerging economies are projected to gain increasing importance. The economies gaining the largest grounds in global materials use are projected to be India (from 9% to 14%) and Sub-Saharan Africa (from 3.5% to 10%). Indonesia, the Middle East and ASEAN countries are also projected to increase their materials use over time. In this context, China is projected to remain a dominant driver of global materials use. In fact, despite its declining growth rates, in 2060 the country is projected to still account for one quarter of global materials use.

Overall, materials use is projected to increase for all resource categories, doubling by 2060 for most materials (see Figure A.1 in Annex). 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. At the same time, the use of metals is projected to grow the most, especially in BRIICS countries and the Rest of the world (Figure 6). 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. Construction activities are projected to expand in every region; but particularly in Sub-Saharan Africa and India.

Figure 6. Materials use trends by category and region



Source: (OECD, 2019[2]).

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[2]).

The environmental impacts[10] of materials use are projected to more than double by 2060 (OECD, 2019[2]). Furthermore, as the nexus between materials and other natural resources - such as land, water and biodiversity - is very close, increasing pressures on one resource are likely to intensify pressures on others (OECD, 2016[8]).

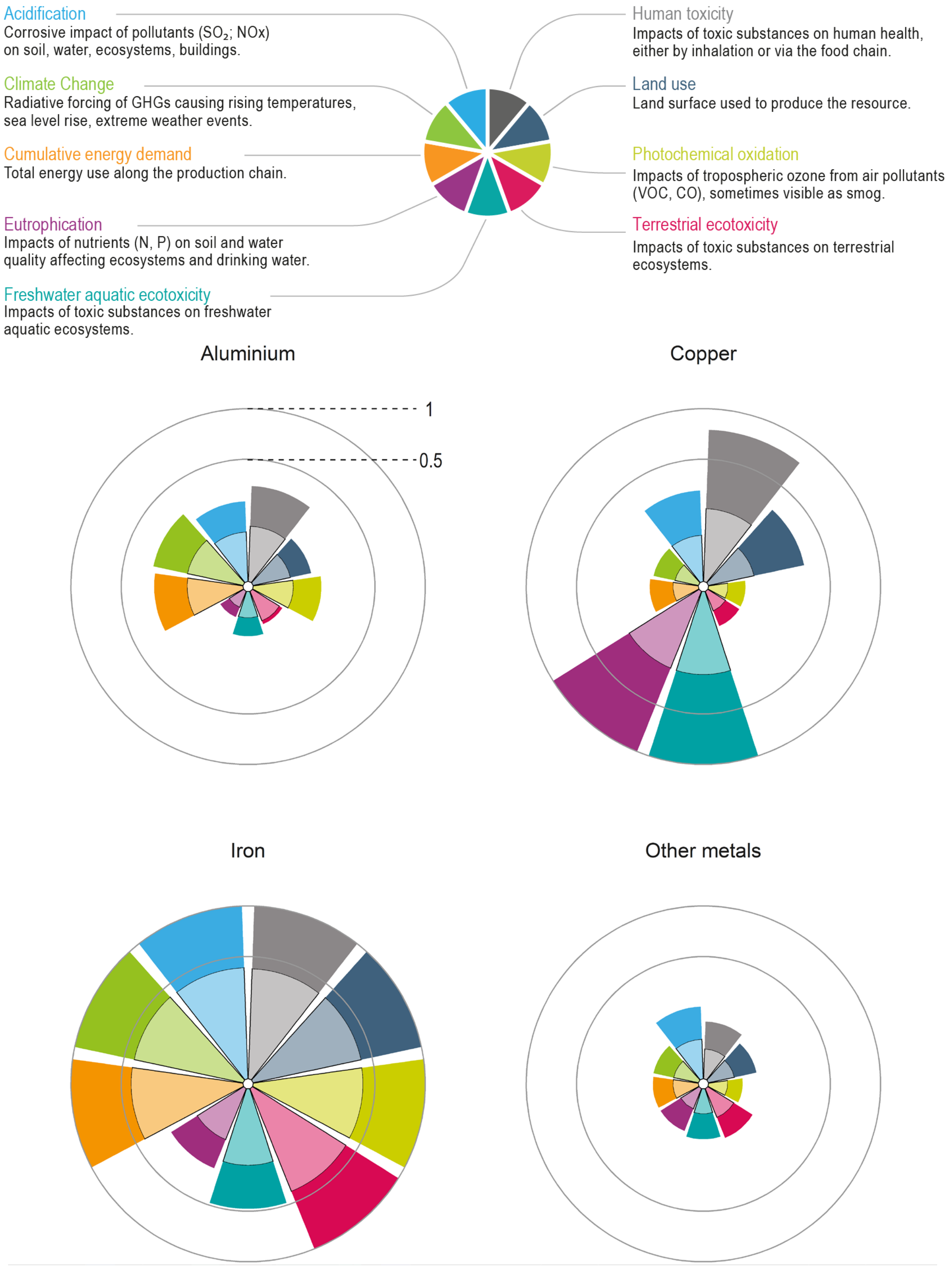
Environmental impacts vary significantly across materials. According to OECD projections, the use of iron, copper, concrete and aluminium is projected to have highest impacts on the environment (OECD, 2019[2]). However, environmental impacts are projected to double and reach significant levels for most materials. Figure 7 shows the projected environmental impacts linked to the use of concrete, copper, iron, and other metals – i.e. aluminium, lead, manganese, nickel and zinc.

These results are explained by the increase of the volume of materials use as well as changes in the environmental impacts caused by each unit of material used over the coming decades change (Van der Voet et al., 2018[9]). The environmental impacts per kilogram of material used are projected to increase for some refined metals, such as 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). Conversely, the environmental impacts of other metals – such as aluminium, iron, and manganese – are projected to remain constant or decrease over time. The drivers of these changes include the decarbonisation of the grid for aluminium and decreasing ore grades for other metals. Furthermore, an increasing – although still limited – use of recycled materials will contribute to diminish environmental impacts, as on average impacts are lower for secondary than for primary materials.

[10] The environmental impacts displayed in this section 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 the individual material making up a product. Therefore, the figures presented are likely to be an underestimation.

Figure 7. 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[2]).

5. The current policy landscape

The transition to a more resource efficient and circular economy has gained significant attention in recent years. To tackle the challenges posed by unsustainable materials use, governments have developed and implemented a variety of strategies, policy frameworks and policy instruments, at the local, national and international level.

Strategies and policy frameworks for resource efficiency

At the international level, several multilateral initiatives have emerged to spur policy action on resource efficiency and circularity (OECD, 2016[8]; OECD, Forthcoming[7]). In 2008, the G8 Environment Ministers signed the Kobe 3R Action Plan, which established the "3Rs" paradigm (reduce, reuse, recycle), and the OECD Recommendation of the Council on Resource Productivity encouraged countries to prioritise policies that improve resource efficiency and limit the environmental impacts resulting from resource use (OECD, 2008[10]). In 2013, the G7 Alliance on Resource Efficiency was established, laying the foundations for the adoption of the Toyoma Framework on Material Cycles and the 5-year Bologna Roadmap. In 2017, G20 governments established the G20 Resource Efficiency Dialogue. Meanwhile, during the past decade, the European Union has established a variety of action plans, roadmaps, and platforms to steer the European economy towards more resource-efficient and low-carbon trajectories. Altogether, these initiatives have contributed to affirm the importance of resource productivity, sustainable resource management, and the circular economy.

At the national level, many countries have established strategies and roadmaps to stimulate the transition towards a circular economy. In most cases, these strategies and roadmaps include policies that increasingly focus on the entire lifecycle of products, addressing several sectors and value chains at once. These have been introduced, for example, in China, Denmark, Finland, France, Greece, and the Netherlands. Furthermore, various sub-national initiatives have emerged to foster the circular economy at the local level. These include circular economy strategies at the municipal and regional level, such as those adopted by the cities of London and Amsterdam, the government of Scotland, the Spanish regions of Catalonia and Extremadura, and the Belgian Flanders and Brussels Capital Regions (OECD, Forthcoming[7]).

At the national and local level, a growing number of jurisdictions have also set up quantitative policy targets for resource efficiency and sustainable materials management. Whereas targets and indicators differ significantly across countries,[11] they are often expressed as improvements in resource efficiency or material productivity, landfill reductions and material recovery rates. Policy targets have been established, for example, in Belgium, Colombia, Czech Republic, Finland, Germany, Japan, Mexico, and Portugal (OECD, 2019[2]; OECD, 2012[11]; OECD, Forthcoming[7]).

Although the principles of a circular economy – including resource efficiency and productivity, material recovery, sustainable materials management and the "3Rs"– are increasingly present in legal and policy frameworks all over the world, the development of comprehensive policy frameworks for resource productivity is still rare. Comprehensive policy frameworks for the circular economy are already in place in Japan, Korea and the Netherlands, setting up quantitative targets, as well as incentives for sustainable business practices and performance monitoring systems. Other countries – such as Colombia, Israel, and Switzerland – are also working towards building national policy frameworks for the transition to the circular economy (OECD, 2019[6]). In other jurisdictions, such as Norway and the European Union, circular economy approaches are increasingly integrated and mainstreamed in existing legal and policy frameworks (OECD, 2019[6]).

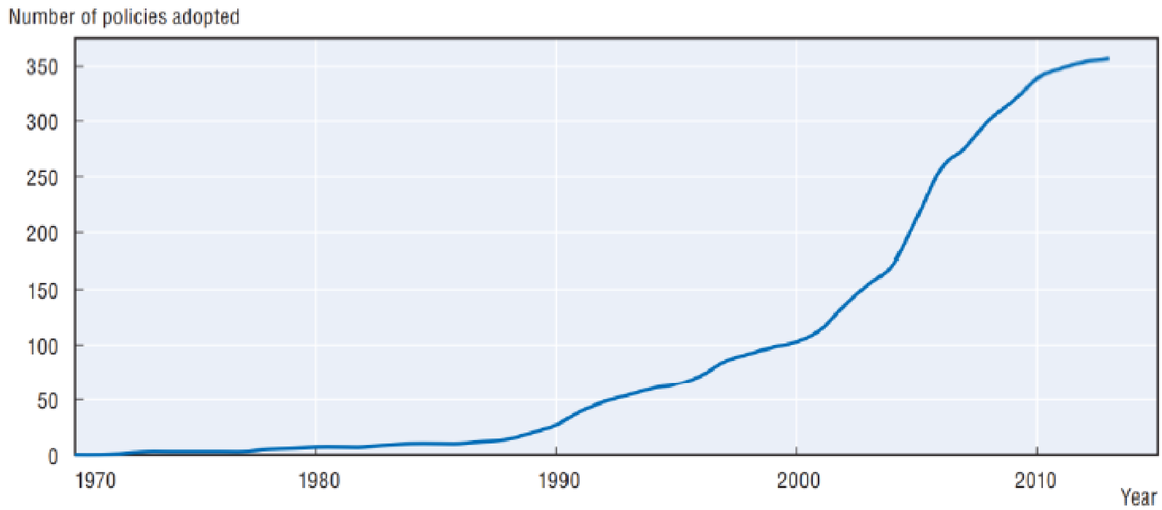
[11] Some circular economy targets focus on resource productivity and materials intensity; some focus on reducing materials use and improving materials circularity; and others focus on waste streams.

Policy instruments for resource efficiency

To implement these overarching plans, 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[3]; OECD, 2001[12]). 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 – extended producer responsibility 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 8) and they are currently in place in the majority of OECD countries. Whereas in most cases EPR focuses on packaging, electronic and electric equipment, batteries, tyres and end-of-life vehicles, in recent years OECD 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, Belgium and the Netherlands are currently looking into more advanced fee modulation that incentivizes eco-design and recycled content, while penalising non-recyclable products. Meanwhile, an increasing number of emerging economies – such as Colombia, China and India – have also started taking up EPR schemes.

Figure 8. Cumulative EPR adoption at the global level



Source: (OECD, 2016[3]).

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. The potential of green public procurement is particularly high in OECD countries, where government procurement accounts for one third of public expenditures and for 12% of GDP (OECD, 2016[8]). Green public procurement has also a particularly high potential in sectors where public purchasers represent a large share of the market, such as construction, health services and public transport. GPP is widely used by a variety of OECD countries – including the Czech Republic, Estonia, Japan, the Netherlands and Norway (OECD, 2019[6]). In addition, the EU Circular Economy Action Plan (European Commission, 2020[13]) facilitates the integration of circular economy principles in green procurement for all EU Member countries.

Market instruments, such as taxes, subsidies, and tradable permit schemes, are widely used to incentivise the transition to a circular economy (OECD, Forthcoming[7]). 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 cap-and-trade schemes, such as the tradable landfill permits implemented in the United Kingdom, and from pay-as-you-throw (PAYT) schemes. Overall, economic instruments for the circular economy are in place in several countries, including Belgium, Colombia, Hungary, Norway, Poland, and Switzerland. However, in most cases, resource tax rates are too low to effectively increase resource productivity (OECD, 2012[11]; OECD, Forthcoming[7]).

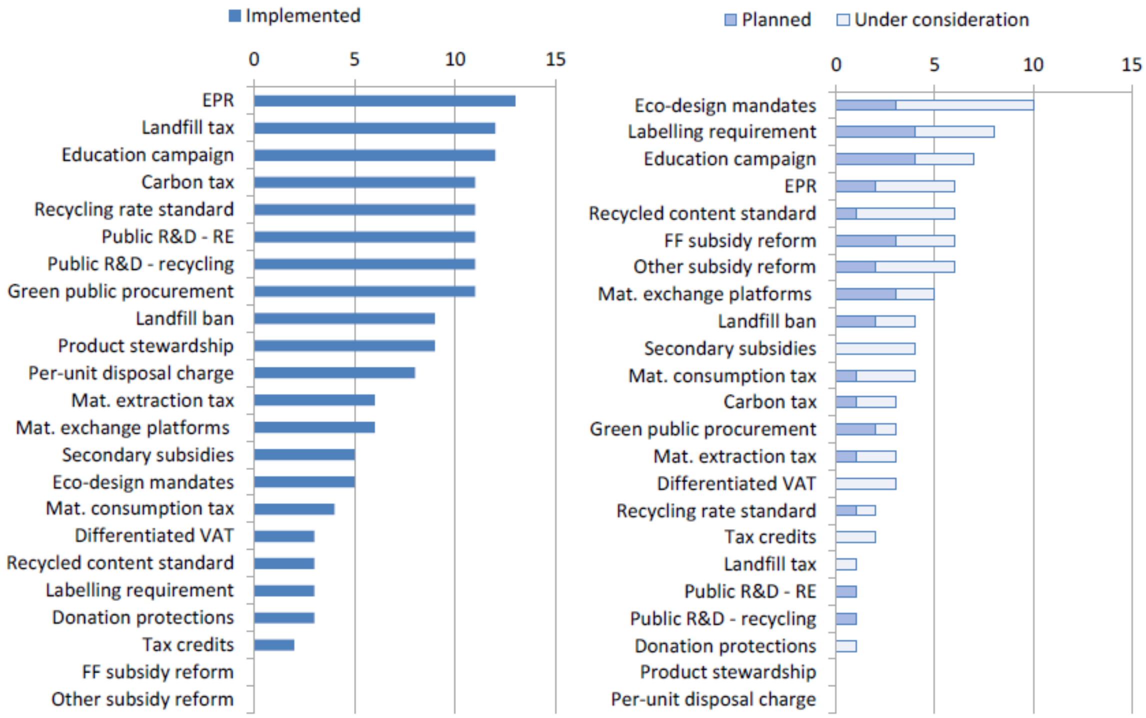
Among regulatory instruments, recycling targets, product standards, recycled content requirements, lifetime warranties, bans and restrictions and deposit-refund systems (DRS) play a fundamental role in the transition to a more circular economy. In recent years, minimum quality standards (e.g. for product design) and legal requirements on the reparability of products have catalysed increasing political attention. For example, EU legislation on end-of-life vehicles has banned the use of hazardous materials in car manufacturing (e.g. ban on the use of cadmium, chromium, lead, and mercury) to improve automobile recyclability (OECD, 2019[6]). Similarly, the government of Scotland has introduced standards for reuse quality and for recognition of remanufactured products. In addition, recycling targets are key instruments driving recycling rates in many OECD countries.

Public information, consumer education, and awareness raising campaigns are other pivotal tools to foster behavioural change, which is a key ingredient of successful circular economy policies. In this context, environmental labelling and information schemes (ELIS) can play a key role in supporting firm-level efforts to improve resource efficiency across value chains and in steering 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. In addition, education and awareness campaigns have been implemented, among others, in Colombia, Israel, Korea, Poland, and Slovenia, often in close co-operation with local governments, businesses and the civil society (OECD, 2019[6]). Other policy tools to steer resource productivity include 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. Figure 9 provides an overview of the state of planning and implementation of policy instruments targeting resource efficiency, sustainable materials management and the circular economy in OECD countries.

Figure 9. Resource efficiency and circular economy policies across OECD countries

Number of policies



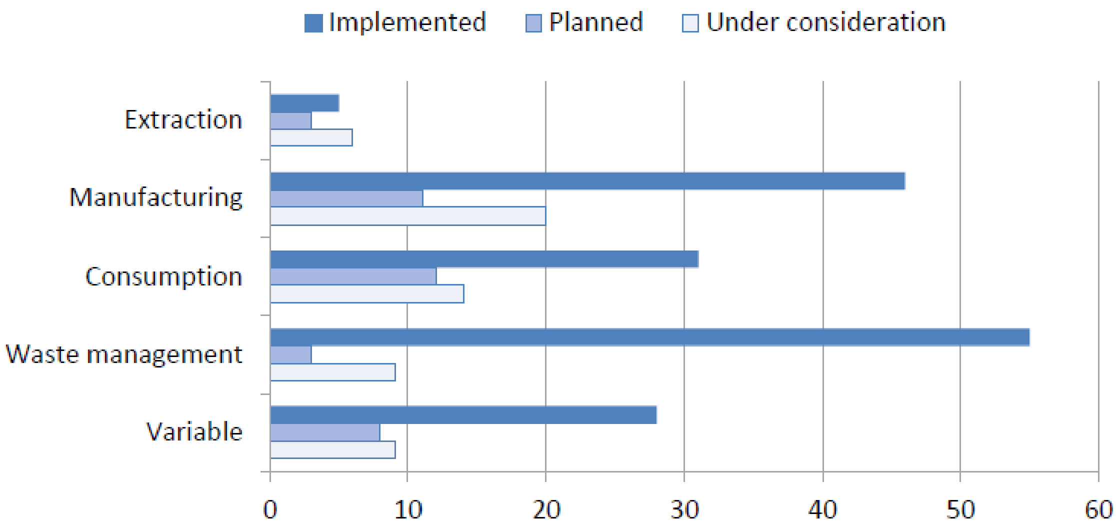
Note: "Implemented" policies are defined as those that are already enacted, "Planned" policies as those that are likely to be implemented in the near future, and policies "Under consideration" as those that are relevant but not associated with any specific plan for implementation in the near future.

Source: 2017 OECD questionnaire on "Policy Instruments for Sustainable Materials Management, Resource Efficiency, and the Circular Economy".

To date, only a few OECD countries have implemented policies that cover the entire materials lifecycle and value chain. The majority of existing policies focuses on the manufacturing, consumption and end-of-life stages of materials lifecycle (Figure 10), while policies targeting upstream material flows are significantly lower in numbers (OECD, 2019[6]; OECD, Forthcoming[7]). Policy mixes would benefit from an increasing focus on the earlier stages of product lifecycle, and in particular on upstream activities such as resource extraction, product design and waste prevention.

Figure 10. Resource efficiency and circular economy policy incidence on the value chain

Number of policies in OECD countries



Source: 2017 OECD questionnaire on "Policy Instruments for Sustainable Materials Management, Resource Efficiency, and the Circular Economy".

6. Policy recommendations

Whereas policy responses to address resource efficiency and the circular economy have already emerged, 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. Drawing on the OECD's *Policy Guidance on Resource Efficiency* (OECD, 2016[8]), the remainder of this paper highlights four key policy recommendations: (i) Promote resource efficiency throughout the full lifecycle of products, (ii) Align sectoral policies with resource efficiency objectives, (iii) Strengthen policy development through better data and indicators, and (iv) Enhance international co-operation.

1) Promote resource efficiency throughout the full lifecycle of products

As advised by the Recommendation of the Council on Resource Productivity (OECD, 2008[10]), 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 product lifecycle risks to shift the burden to other stages, without reducing the overall environmental impacts (OECD, 2016[8]; OECD, Forthcoming[7]). 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 tackle this challenge include extended producer responsibility schemes, green public procurement, and multi-stakeholder partnerships. Whereas EPR schemes have been widely adopted in many countries, further efforts are needed to broaden their scope (e.g. 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 all along materials lifecycle. Finally, establishing and incentivising partnerships with businesses and other stakeholders involved in different stages of the value chain can significantly 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, and some sectors are already undertaking efforts towards this goal (e.g. textiles and electrical and electronic equipment).

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 incentivizing the production and use of more durable products, thus minimising raw materials extraction and waste. 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 (Laubinger, Lanzi and Chateau, 2020[14]).

2) Align sectoral policies 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) lead to weaker markets for secondary materials and lower opportunities for material reuse and recovery, thus weakening existing resource efficiency efforts in other domains (see Box 1 for a discussion of trade restrictions on metals).

To manage this challenge, 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. Most notably, cross-cutting policies – such as innovation, investment and education strategies – should integrate resource efficiency objectives. In particular, 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. Furthermore, assessing the set of skills required for the transition to the circular economy will help to adjust education and training programmes.

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.

BOX 1: THE CHALLENGE OF RECYCLING METALS

Many policy barriers hinder the recycling of metals and metal ores. In most cases, such barriers are generated by perverse policy incentives – such as export restrictions, bans and subsidies for primary metals and minerals – which incentivise extractive activities, thus preventing recycled materials to compete with extracted ones. According to the OECD Inventory of Export Restrictions on Raw Materials, more than half of the identified export restrictions are related to metal waste and scrap.

In the absence of additional policies to encourage the circular economy, recycling rates for metals are projected to remain constant and, in some cases, to decrease over time. In particular, by 2060, the production of recycled iron and steel is projected to remain constant, while the production of recycled aluminium, copper and other metals is projected to decline (OECD, 2019[2]).

Increasing the recyclability of metals and creating stronger incentives for recycling are fundamental steps to strengthen secondary materials markets. A variety of policy instruments could enhance metals recycling rates: grants, subsidies, tax incentives, R&D investment and other types of support to eco-innovation and eco-design. At the same time, countries could incentivise recycling practices using taxes on extraction or use of virgin materials, subsidies for secondary materials, and recycled content requirements. The implementation of such instruments would allow reducing the environmental impacts related to metals extraction and disposal, while at the same time creating new opportunities.

3) Strengthen policy development through better data and indicators

To attain resource productivity 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 the sustainable management of material resources 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. An additional challenge is posed by data availability, as information is often collected on the basis of definitions and methodologies that are inconsistent across countries, thus hindering data comparability.

To respond to this challenge, countries should carefully assess their data needs and develop data systems that ensure the availability, quality and consistency of information, either at national level or 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 development 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 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 the resulting environmental and socioeconomic impacts. In this context, governments could also engage in international efforts to help strengthening developing countries' data and analytical capacity.

4) Enhance international co-operation

Given the increasing globalisation of value chains and the transboundary nature of resource flows, international co-operation is necessary to ensure policy coordination and sustained benefits for all. International efforts can support resource efficiency and the transition to a circular economy in many ways.

First, 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.

Second, international co-operation can help to improve and harmonise environmental labelling and information schemes. Besides facilitating the multilateral recognition of a growing number of schemes, this would support manufacturers who aim to green their supply chain and ensure the adequate stringency of environmental standards. International co-operation could also help filling information gaps on resource efficiency and the circular economy (i.e. developing indicators and collecting 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 Aid (ODA). Development co-operation efforts are encouraged by the Recommendation of the Council on Resource Productivity (OECD, 2008[10]). In fact, ODA can contribute to effective capacity development and technology transfer. Aligning development finance with resource productivity goals would also allow reducing the burden generated by the increasing outsourcing of production from richer countries to emerging economies.

References

Chateau, J., R. Dellink and E. Lanzi (2014), *An Overview of the OECD ENV-Linkages Model: Version 3*, OECD Environment Working Papers, No. 65, OECD Publishing, Paris, https://dx.doi.org/10.1787/5jz2qck2b2vd-en. [15]

Ellen MacArthur Foundation (2013), *Towards the circular economy: Economic and business rationale for an accelerated transition*, https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf. [17]

European Commission (2020), *Circular Economy Action Plan: For a Cleaner and more Competitive Europe*, https://ec.europa.eu/environment/circular-economy/pdf/new_circular_economy_action_plan.pdf. [13]

Laubinger, F., E. Lanzi and J. Chateau (2020), *Labour market consequences of a transition to a circular economy: A review paper*, OECD Environment Working Papers No. 162, OECD Publishing, Paris, https://doi.org/10.1787/19970900. [14]

McCarthy, A., R. Dellink and R. Bibas (2018), *The Macroeconomics of the Circular Economy Transition: A Critical Review of Modelling Approaches*, OECD Environment Working Papers, No. 130, OECD Publishing, Paris, https://doi.org/10.1787/af983f9a-en. [19]

OECD (2020), *Environment at a Glance 2020*, OECD Publishing, Paris, https://doi.org/10.1787/19964064. [4]

OECD (2019), ““Material resources”” OECD Environment Statistics (database). [1]

OECD (2019), *Business Models for the Circular Economy: Opportunities and Challenges for Policy*, OECD Publishing, Paris, https://doi.org/10.1787/g2g9dd62-en. [18]

OECD (2019), *Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264307452-en. [2]

OECD (2019), *Waste Management and the Circular Economy in Selected OECD Countries: Evidence from Environmental Performance Reviews, OECD Environmental Performance Reviews*, OECD Publishing, Paris, https://doi.org/10.1787/9789264309395-en. [6]

OECD (2016), *Extended producer responsibility: Updated guidance for efficient waste management*, OECD Publishing, Paris, https://doi.org/10.1787/9789264256385-en. [3]

OECD (2016), *Policy Guidance on Resource Efficiency*, OECD Publishing, Paris, https://doi.org/10.1787/9789264257344-en. [8]

OECD (2015), *Material Resources, Productivity and the Environment*, OECD Publishing, Paris, https://dx.doi.org/10.1787/9789264190504-en. [5]

OECD (2012), *Sustainable Materials Management: Making Better Use of Resources*, OECD Publishing, Paris, https://doi.org/10.1787/9789264174269-en. [11]

OECD (2008), *Recommendation of the Council on Resource Productivity*, OECD/LEGAL/0358. [10]

OECD (2001), *Extended Producer Responsibility: A Guidance Manual for Governments*, OECD Publishing, Paris, https://doi.org/10.1787/9789264189867-en. [12]

OECD (Forthcoming), *Progress report on the implementation of the Recommendation of the Council on Resource Productivity*. [7]

United Nations (2017), *World Population Prospects*, Department of Economic and Social Affairs, Population Division (ST/ESA/SER.A/408). [20]

Van der Voet, E. et al. (2018), “Environmental Implications of Future Demand Scenarios for Metals: Methodology and Application to the Case of Seven Major Metals”, *Journal of Industrial Ecology*, Vol. Volume23/Issue1, pp. 141-155. [9]

World Bank (2019), *World Development Indicators*. [16]

Annex: Additional information on modelling tools

The main tool used for the projections presented in this paper is the OECD's computable general equilibrium (CGE) model ENV-Linkages (Chateau, Dellink and Lanzi, 2014[15]). The model gathers economic variables in a consistent framework, where all expenses are accounted for and compensated by an income. The balance among economic flows and economic sectors is represented at the macroeconomic level. The projections presented result from the balance of the different economic forces, such as the cost of inputs, labour and capital, as well as rents and wages.

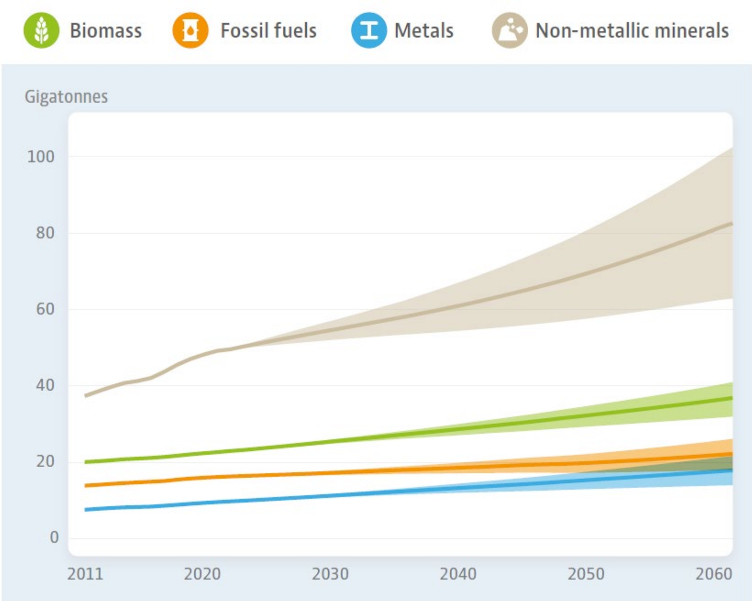
All the projections presented in this paper represent the baseline scenario, which estimates key trends in the absence of more stringent policies. However, the baseline scenario implicitly includes some government policies in the projected trends for the key variables. Consequently, this scenario provides a benchmark against which policy scenarios aimed at improving environmental management and resource efficiency can be assessed.

The baseline scenario presented in this paper builds on a consistent framework of expected future trends for several key economic and environmental variables, based on current trends and on a number of assumptions about the future. Consequently, while these projections provide a reliable estimation of future trends in materials use, projections need to be interpreted with caution.

The primary sources of uncertainty in the projections of future materials use depend on uncertainties in the socioeconomic drivers of materials use, in particular the extent of future population growth and the pace with which living standards will increase in different countries and regions. Taking into account the uncertainty related to these trends, materials use figures could be approximately 33 billion tonnes higher or lower every year until 2060 (Figure 11). Consequently, the actual figure for yearly global materials use in 2060 ranges between 134 and 200 billion tonnes. In addition, other drivers of materials use – such as the future evolution of recycling technologies, technological progress and digitalization – are also subject to large uncertainties.

Figure A.1. Uncertainty ranges for materials use projections

Billion tonnes



Source: (OECD, 2019[2]).

Considering the uncertainty surrounding future trends, the results of this paper need to be interpreted with caution. However, uncertainties should not deter action: while the exact size of future materials use is uncertain, demand for raw materials will grow significantly in the years to come.

Improving resource efficiency and the circularity of economies for a greener world

Global demand for materials has been growing over the past century, driven by a steady economic growth in OECD countries, the industrialisation of emerging economies and a growing world population. At the global level, materials use more than doubled between 1990 and 2017, and it is projected to double again by 2060. Due to the growing amounts of materials use, environmental pressures such as land degradation, greenhouse gas emissions and the dispersion of toxic substances in the environment are projected to more than double in the decades to come. In this context, improving resource efficiency and stimulating the transition towards a more circular economy has become crucial. In recent years an increasing number of governments have started implementing policies and strategies to meet this objective, but stronger efforts are needed to significantly improve the sustainability of materials management and the circularity of economies across the world.

The *OECD Environment Policy Paper* series

Designed for a wide readership, the *OECD Environment Policy Papers* distil many of today's environment-related policy issues based on a wide range of OECD work. In the form of country case studies or thematic reviews across countries, the Papers highlight practical implementation experience.

Visit our websites

www.oecd.org/environment/
www.oecd.org/environment/waste/recircle.htm
www.oecd.org/environment/indicators-modelling-outlooks/modelling.htm
www.oecd.org/environment/waste/

Join the discussions

@OECD_ENV

Contact (OECD Environment Directorate)

Shardul Agrawala, Head of the Environment and Economy Integration Division - *Shardul.Agrawala@oecd.org*
Peter Borkey, Resources Productivity and Waste - *Peter.Borkey@oecd.org*
Elisa Lanzi, Modelling and Outlooks - *Elisa.Lanzi@oecd.org*

This document has been produced with the financial assistance of the European Union. The views expressed herein do not necessarily reflect the official views of the OECD or of the governments of its member countries and can in no way be taken to reflect the official opinion of the European Union.

OECD BETTER POLICIES FOR BETTER LIVES

OECD Environment Directorate
July 2020