MATERIAL RESOURCES, PRODUCTIVITY AND THE ENVIRONMENT:

KEY FINDINGS

Material Resources, Productivity and the Environment

Key Findings

1. Establishing a resource efficient economy is central to greening growth

Natural resources are fundamental to the economy and human well-being

Natural resources provide essential inputs to production (Table 1). Apart from production, the extraction, processing and ultimate disposal of materials are an important source of income and jobs in many countries. These activities also impact the environment to a greater or lesser extent. Natural resources are also part of the ecosystems that support the provision of services such as climate regulation, flood control, natural habitats, amenities and cultural services that are necessary to develop man-made, human and social capital.

The use of materials from natural resources in production and consumption processes has many environmental, economic and social consequences that extend beyond borders and affect future generations. They have consequences on:

- The rates of extraction and depletion of renewable and non-renewable **natural resource stocks**, and the extent of harvest and natural productivity of renewable resource stocks.
- The **environmental pressures** associated with the extraction, processing, transport, use and disposal of materials (e.g. pollution, waste, habitat disruption); and their effects on environmental quality (e.g. air, climate, water, soil, biodiversity, landscape) and ecosystem services and human health.
- International **trade and market prices** of raw materials and other goods, and the productivity and competitiveness of the economy.

The way natural resources and materials are managed through their life-cycle affects all of these activities.

Table 1. Economic and environmental significance of selected materials and products

Selected Material/Product	Environmental Significance	Economic Significance
Aluminium	♦ Lightweight (transportation fuel efficiency) ♦ Infinitely recyclable ♦ Energy intensive production (GHG emissions) ♦ Solid waste (red mud)	♦ Widely used esp. in transportation, construction, electricity generation ♦ Increasing global demand ♦ Price volatility ♦ Consumption strongly coupled with economic growth
Copper	♦ Infinitely recyclable ♦ Energy-intensive production ♦ E-waste	♦ Widely used esp. in electrical transmission and construction ♦ Increasing global demand ♦ Price volatility
Iron and Steel	♦ Infinitely recyclable ♦ well-developed scrap markets ♦ Energy-intensive production	♦ Most widely used and traded metal in the world ♦ Increasing global demand ♦ Price volatility
Rare Earth Elements	♦ Used in clean energy and energy efficiency technologies ♦ Recycling extremely challenging ♦ Chemically-intensive processing ♦ E-waste	♦ Used in wide range of high-tech electronics ♦ Lack of substitutes ♦ Increasing global demand, recent supply chain issues ♦ Price volatility
Phosphorus	♦ Eutrophication ♦ Waste (phosphogypsum) and emissions (fluorine) ♦ Recyclable (with losses)	♦ Food security ♦ Supports agricultural production
Paper	♦ Renewable / recyclable (with losses) ♦ Carbon sequestration, habitat (forests) ♦ Potential source of energy (wood biomass) ♦ Energy- and water-intensive production	♦ Demand growing esp. in emerging economies ♦ Wide variety of products

Current trends in material demands present environmental and economic challenges…

The last decades have witnessed unprecedented growth in demands for raw materials worldwide, driven in particular by the rapid industrialisation of emerging economies and continued high levels of material consumption in developed countries. International commodity markets have expanded, with increasing mobility of production factors and closer linkages among countries and regions. This has been accompanied by highly volatile commodity prices and growing competition for some raw materials.

Did you know…

OECD countries account for:

- a third of all material resources consumed worldwide;
- over two-thirds of wood harvesting;
- nearly half of global exports of raw, semi-finished and finished materials.

By 2050, the world economy is expected to quadruple and the global population to grow from 7 billion today to over 9.2 billion. The *OECD Environmental Outlook to 2050* shows the additional strain that this will place on the earth's material and energy resources and the environment. A growing population with higher average income requires more food, more industrial products, more energy and more water. This creates formidable challenges for sustainable economic and environmental development.

…and create opportunities for new markets and greener growth

Confronting the scale of these challenges requires ambitious policies to stimulate a significant increase in resource efficiency, particularly through technical change and innovation. The drive for improved resource efficiency will create new products, markets and employment opportunities.

Establishing a resource efficient economy is central to green growth. It requires putting in place policies to improve resource productivity and sustainably manage natural resources and materials, building on the principle of Reduce, Reuse and Recycle (the 3Rs). To be successful, such policies need to be founded on a good knowledge base of the material basis of the economy, international and national material flows, and the factors that drive changes in natural resource use and material productivity over time, across countries and in the different sectors of the economy.

2. Worldwide use of material resources has been increasing steadily

Global trends

Global extraction of material resources continues to grow

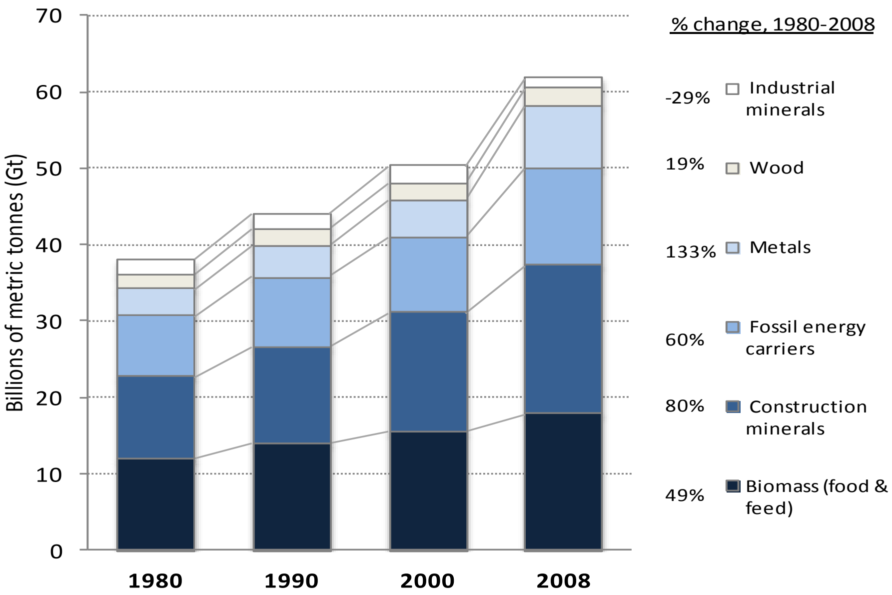
The amount of materials extracted, harvested and consumed worldwide increased by 60% since 1980, reaching nearly 62 billion metric tonnes (Gt) per year in 2008 (Figure 1), some 8-fold increase since the early 1900s. OECD countries accounted for 38% of domestic extraction of used materials (DEU) worldwide in 2008, while the BRIICS (Brazil, Russia, India, Indonesia, China and South Africa) accounted for 35%.[1] While more updated global figures are not yet available, material use likely remains around 62 Gt today and is projected to reach 100 Gt by 2030.[2]

Growth has been primarily driven by increased global demand for construction minerals, biomass for food and feed, fossil energy carriers. These three material groups account for 80% of total global material extraction.

Domestic extraction used (DEU) measures the flow of materials that originate from the environment and enter the economy to be transformed into or incorporated in products.

Domestic material consumption (DMC) provides a measure of the amount of materials directly consumed by economic activities within a country. DMC equals DEU plus imports minus exports.

Figure 1. Global material resource extraction



Source: SERI (Sustainable Europe Resource Institute) material flows database.

Materials originating from non-renewable natural resource stocks progressively dominate the material mix

Over the last century, resource extraction from non-renewable stocks has grown while extraction from renewable stocks has declined, reflecting the shift in the global economy base from agriculture to industry. Once accounting for some 75% of global material extraction, biomass today accounts for less than a third of total extraction. Non-renewable resource extraction now represents over two-thirds of global material extraction with construction minerals making up over 30% of global DEU in 2008, fossil energy carriers 20%, and metal and metal ores 13%. Industrial minerals account for around 2% of global extraction.

Although global material use has been increasing steadily overall, growth has varied across material groups.

Metals

Over the last 30 years, the strongest growth in raw material demand has been for **metal ores**. Global metal extraction more than doubled between 1980 and 2008, rising from 3.5 to 8.2 Gt or by 133%, a rate on par with global economic growth. But growth has not followed a steady upward trajectory: after declining in the early 1990s, the growth in metal extraction witnessed a significant upswing from around 2002. This acceleration was due to high demands from countries entering their energy- and material-intensive development phase, coupled with high levels of consumption in developed economies.

Construction minerals

Demand for **construction minerals** has expanded rapidly, increasing by 8.7 Gt or 80% from 1980 to 2008, though more slowly than world GDP. Economic growth and the associated expansion of the construction sector have a strong influence on demand. Demand construction minerals is also linked to changes in demographics (e.g. amount and type of housing needed) and average wealth (e.g. size of dwellings), as well country specific factors (i.e. geography, urban planning, consumer preferences). As with metal ores, global extraction of construction minerals began to accelerate in the early 2000s.

Fossil energy carriers

Global extraction of **fossil energy carriers** expanded by less than construction minerals, growing by 4.8 Gt or 60% between 1980 and 2008. Throughout the 1990s when real crude oil prices were relatively low, the extraction of fossil energy carriers stabilised and in some years even declined. But by the early 2000s, as in the case of metal ores and construction minerals, extraction began to trend upward again driven by the expanding global economy.

Biomass for food and feed

From 1980 to 2008, both the world population and the extraction of agricultural **biomass for food and feed** increased by 50%. Increasing income levels also bring changes in dietary habits. Meat consumption, in particular, tends to increase with

Wood and industrial minerals

Material extraction increases by two-thirds when unused materials are considered

income or wealth. More biomass (in terms of feed) is required to support a meat-based diet relative to a vegetarian diet.

Wood harvesting and the extraction of **industrial minerals** experienced the slowest rates of growth. Wood harvesting grew by less than 20% between 1980 and 2008, significantly lower than population growth. Increased paper recycling and competition from digital media have likely contributed to flat demand for wood fibre. Growth in the extraction of industrial minerals was more volatile than other material groups, and declined by almost 30% between 1980 and 2008. However, figures must be interpreted with caution since this group consists of variety of minerals ranging from phosphate rock to diamonds.

Along with 62 Gt of material resources that were extracted and entered the economy in 2008, an additional 44 Gt of materials were extracted but **not used in the production process**. These materials – referred to as unused domestic extraction (UDE) – include mining overburden, harvest residues and fisheries by-catch.

Unused extraction is important, particularly for some materials; it accounts for around 70% of the total extraction associated with **fossil energy carriers** (due to the large volume of unused materials associated with coal extraction) and almost half for **metals**, but only 10% or less for biomass and construction minerals. With unused extraction taken into account, fossil energy carriers overtake both biomass and construction minerals as the dominant material resource extracted globally, accounting for over 40% of extraction in 2008.

Unused domestic extraction **has grown at a faster rate** than domestic used extraction, more than doubling between 1980 and 2008 compared to a two-thirds increase in DEU. Increased coal production, particularly in Australia, China, India and Indonesia from 2002 onwards is the likely factor behind this strong growth in DEU globally, as is increased metal ore extraction.

Trends in OECD countries

Material extraction and consumption in OECD countries are growing at a slower pace than at global level

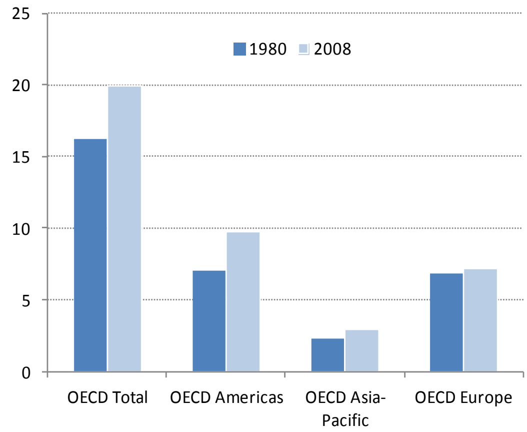
Material extraction and consumption in OECD countries have increased, but much more slowly than at the global level, except for metals. While the global use of material resources continues to increase, since 2000 there are signs of stabilisation in OECD countries as regards both material extraction and consumption; they levelled off at around 20Gt and 22Gt respectively, after stronger growth in the 1980s and 1990s (Figure 2).[3]

Since 1980, the growth has been driven primarily by the extraction of **construction minerals** which accounted for half of the increase, while **metal ore** extraction accounted for a quarter (Figure 3).

The use of construction minerals has increased across all OECD regions, while growth in metal ore extraction was mainly isolated to Chile and Australia. In Chile, copper ore extraction grew from 70 million tonnes (Mt) in the early 1980s to well over 500 Mt by 2008. In Australia metal ore extraction grew from under 200 Mt to over 600 Mt during the same period, with the extraction of iron ore, copper and zinc more than doubling. Precious metal extraction increased by a factor of 12.[4]

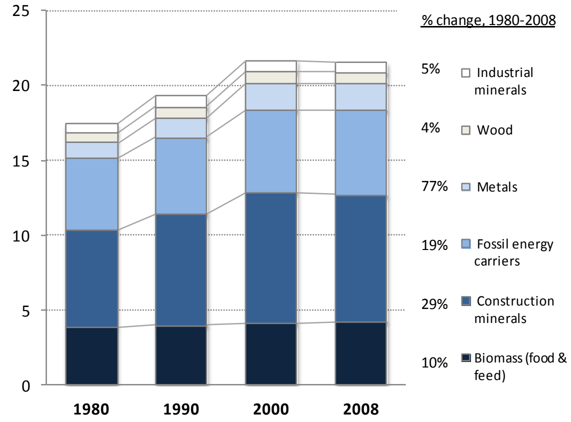
Roughly half of all material resource extraction in the OECD area takes place in the Americas (i.e. Canada, Chile, Mexico and the United States). OECD countries in Europe account for 35% of extraction while member countries in the Asia-Pacific are responsible for the remaining 15% of extraction. Among OECD countries, the United States is the single largest extractor of material resources with over 6.5 Gt extracted in 2008 – one third of all materials extracted in OECD countries. Australia, Canada, Mexico and Germany follow, each extracting between 1 and 1.5 Gt in 2008.

Figure 2. Domestic extraction used (DEU), by OECD region
(billion metric tonnes)



Source: OECD material flows data.
Notes: Figures do not include Estonia or Slovenia.

Figure 3. Domestic material consumption (DMC), by material group,
(billion metric tonnes)



Domestic material consumption (DMC) in the OECD area has largely followed the same trends as DEU, growing by 23% between 1980 and 2008 and, since the early 2000s, stabilising around 22 Gt per year.

The composition of material extraction and consumption are similar, with the exception that fossil energy carriers accounting for a slightly larger share of consumption than extraction in OECD countries, due to significant imports. In terms of regional shares in the OECD area, OECD Europe's share of consumption is slightly higher than the region's share of extraction, while the inverse if true for the OECD Americas region. The OECD Asia-Pacific region's share of consumption is the same as its share of extraction.

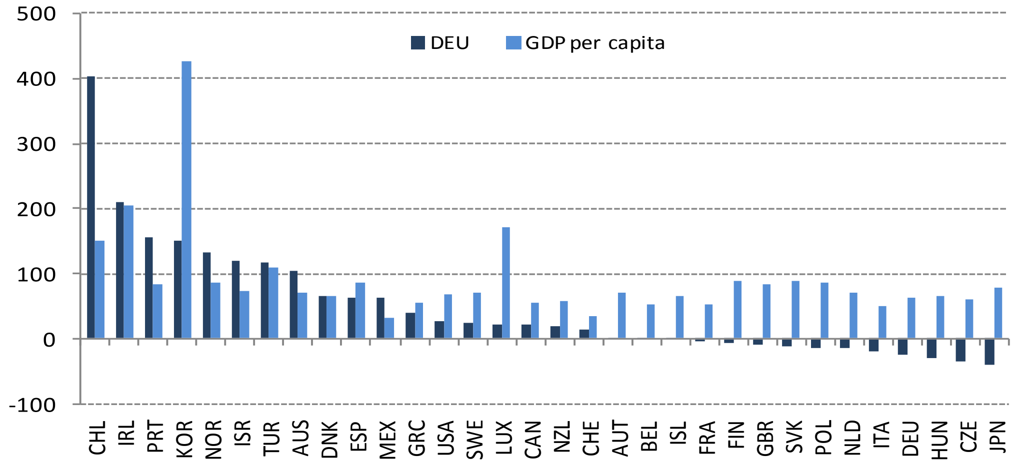
While material extraction in OECD member countries is stabilising, it is rising in countries experiencing rapid economic expansion and where incomes are rising, such as the BRIICS. Most of these countries experienced a strong upswing in material extraction starting the early 2000s, while China's surge began much earlier.[5] With the exception of South Africa all of the BRIICS experienced large increases in material extraction when average income rose.

Conversely in OECD countries, where average incomes are higher, material extraction is growing less quickly. But there appears to be **two distinct trends for OECD countries** with average incomes exceeding 20 000 USD (Figure 4).

- Material **extraction remains flat or decoupled from average income growth**, likely linked to an increasing share of value added generated in the economy from the services sector, while material-intensive manufacturing is being outsourced to non-OECD countries (Figure 5). The decoupling is absolute when population is decreasing faster than material extraction per capita. With the exception of Japan, all of the member countries in this group are located in Europe.
- Material **extraction continues to increase with GDP per capita**. This group is generally characterised by, but not limited to, large resource-rich countries with relatively low population densities.

Figure 4: Change in domestic extraction used (DEU) and per capita GDP,

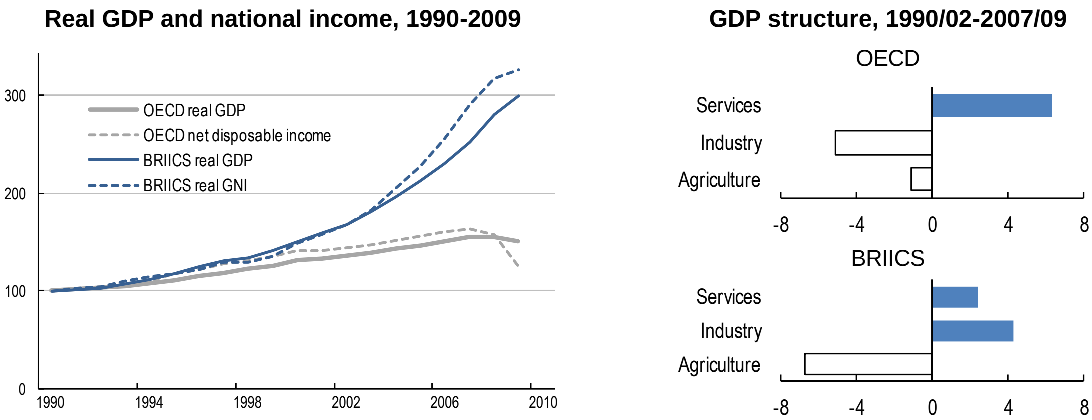
(Change, % 1980-2008)



Source: OECD, World Bank.

Note: Figures do not include Estonia or Slovenia. GDP is in 2005 USD and PPPs.

Figure 5. GDP and national income growth, OECD, BRIICS, 1990-2009



Source: OECD 2011c, OECD National Accounts; The World Bank World Development Indicators.

Material extraction in OECD doubles when unused materials are considered

The volume of unused materials extracted in OECD countries reached 22 Gt in 2008, a level that is roughly equivalent to the volume of used extraction. Close to 80% of unused extraction is related to **fossil energy carriers** (70% of which is from coal extraction in Australia and the United States), followed by **metals** which account for 14%. Relatively small volumes of unused extraction are associated with biomass and construction and industrial minerals.

Counter to the global trend, over the 1980-2008 period unused extraction in OECD countries has grown at the same rate (23%) as used extraction. While it might be expected that unused extraction in OECD countries would decrease over time with improvements in extraction and processing technologies, a number of factors influence the generation of unused materials. For **minerals and metals** unused extraction actually tends to increase over time. Higher grade deposits or those that are easily accessible are usually found and extracted first. As those deposits are depleted, more must be extracted or extraction must go deeper in order to get the same amount of valuable materials from lower grade deposits. This seems to be the case in the OECD area; since 1980 the volume of unused materials associated with metals extraction has grown almost 2.5 times faster than used extraction.

3. Material productivity is improving but decoupling remains weak

Productivity gains have been achieved in recent years...

Despite continued growth in the volume of materials being consumed worldwide and in OECD countries, there are first signs of decoupling from economic growth (Figure 6). The global economy today generates 50% more economic value with one tonne of raw materials than it did in the 1980s, rising from USD 0.70 per kilogram (2005 USD and PPPs) in 1980 to USD 1.05/kg by 2008. Over the same time domestic material productivity of OECD economies improved by 70%, rising from USD 1.00/kg to over USD 1.70 USD/kg.

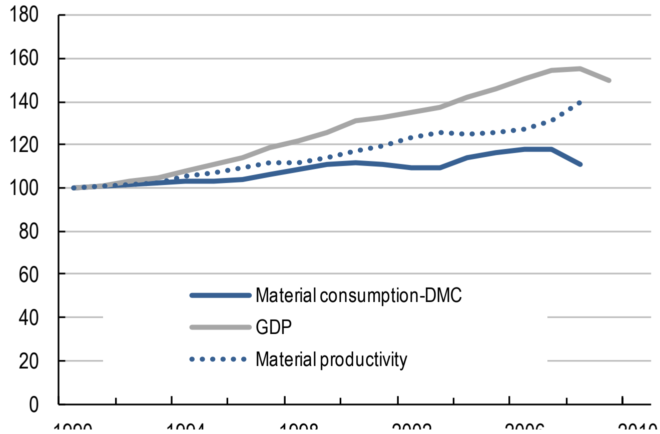
The largest improvements have come in recent years. Relative decoupling has occurred overall in the OECD area. across all material groups and all regions, but there are only a handful of instances of absolute decoupling.

What is resource productivity? Resource productivity refers to the effectiveness with which an economy uses materials extracted from natural resources (physical inputs) to generate economic value (monetary outputs). The OECD puts "resource productivity" in a welfare perspective, including a qualitative dimension (e.g. the environmental impacts per unit of output produced with a given natural resource input).

Decoupling is breaking the link between "environmental bads" and "economic goods". Absolute decoupling occurs when environmental degradation is decreasing while the economy is growing. Decoupling is relative when environmental degradation is growing, but at a slower rate than the economy.

Figure 6. Domestic material consumption versus GDP, OECD, 1990-2009

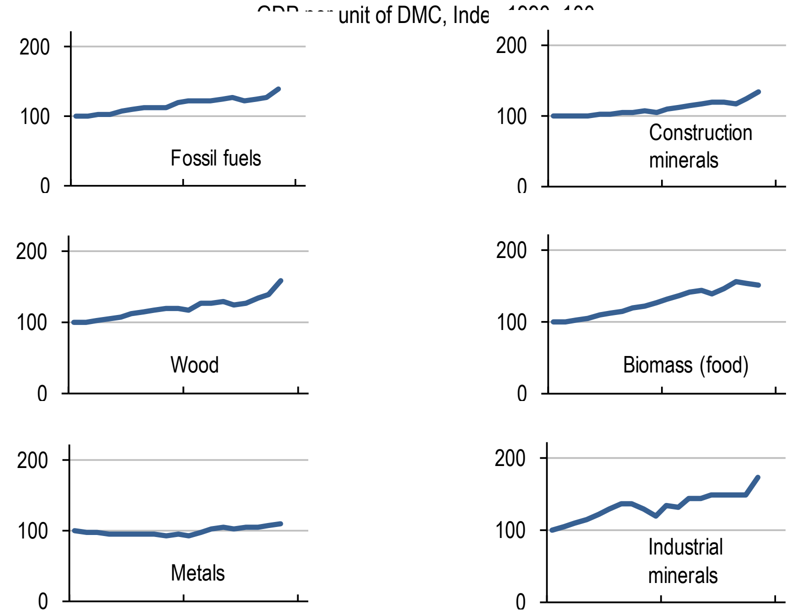
Index 1990=100



Source: OECD Material Flow database

The strongest decoupling occurred in **wood, industrial minerals and construction minerals**, of all which saw consumption decrease between 2000 and 2008. The weakest productivity gains were in **metal ores** (Figure 7), where extraction has remained strongly linked to economic growth. This trend is not isolated to OECD countries; metal extraction is increasing worldwide and is growing particularly rapidly in the BRIICS.

Figure 7. Material productivity by material group, OECD, 1990-2009



...but per capita material consumption remains high...

Per capita material consumption in OECD countries remains at high levels. The average person living in an OECD country consumed roughly 50 kg of materials per day in 2008, twice the world average of 25kg per day per capita, and over 2.5 times more than a person living in a non-OECD country. This including 10 kg of biomass (vs. 7kg global average), more than 20 kg of construction minerals (vs. 8kg global average), and about 13 kg of fossil energy carriers (vs. 5kg global average).

Within the OECD area, per capita material consumption is highest in the Americas (over 21 tonnes per person), followed by the Asia-Pacific (16.5 t) and Europe (15 t) (Figure 8). Though all regions have witnessed declining per capita consumption in recent years, OECD Europe is the only region where the decline has been consistent since 1980.

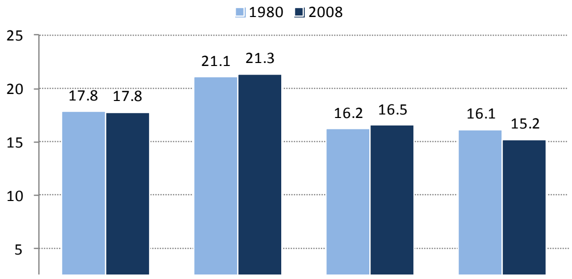
The amount of material each person consumes on average varies widely across and within countries.

- In general, per capita consumption tends to be **highest** in countries that are less densely populated and rich in natural resources (e.g. Australia, Chile, Ireland, New Zealand, and Norway). In these countries, per capita material consumption ranges between 30-50 tonnes per person per year.

  The **lowest** levels of per capita consumption tend to be found in countries that are densely populated and relatively natural resource-poor (e.g. Japan, United Kingdom, Italy, and Switzerland).

By contrast, within the BRIICS, per capita consumption was the lowest in India (around 4 tonnes/person) and the highest in China (13 tonnes/person) in 2008.

Figure 8. Domestic material consumption (DMC),
(tonnes per person)



... and progress is moderate once "hidden" material flows in trade are considered

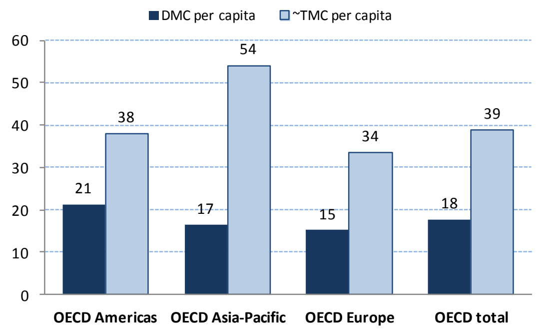
Progress in material productivity can be attributed to policy measures and technological change, as well as to structural changes, including the substitution of resource intensive domestic production by imported goods.

As OECD economies become more service-based, their reliance on imports is increasing with resource-intensive production often being displaced to non-OECD economies. Imports make up 25% of material inputs in the OECD area (about 30% in Europe and in Asia-Pacific; less than 15% in the Americas), but only 5% on average in the BRIICS economies.

This dislocation between production and consumption allows importing countries to enjoy the consumption of imported goods, while the environmental costs of producing those goods remain in the exporting country. Total material consumption (TMC) includes estimates of such indirect or "hidden" flows of materials (e.g. waste and materials that remain unused in the environment, such as mining overburden or harvest residues) required to make a product.

If such indirect or "hidden" material flows associated with trade are taken into account, gains in material productivity in countries that are net resource importers are more modest (see Figure 9). Including hidden flows, OECD countries account for roughly half of global material requirements.

Figure 9. Estimated per capita total material consumption (TMC), 2008
(tonnes per person per year)



Source: OECD material flows data, OECD.stat,
Notes: Figures for TMC are partial estimates and do not include excavated soil from construction, dredged sediment or erosion from agricultural land.

4. From waste to resources: Closing the loop in a circular economy

About a fifth of the materials extracted worldwide ends up as waste

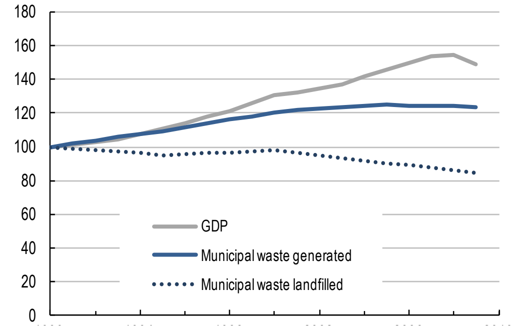
The amount of solid waste generated by economic activity is rising in line with growing consumption of material resources. Many valuable materials are disposed of as waste and, if not recovered, are lost to the economy. It is estimated that about one fifth of the raw materials extracted worldwide ends up as waste. This corresponds to over 12 billion tonnes (Gt) of waste per year. OECD countries account for about one third (4 Gt) and the BRIICS nearly 60% (7Gt) of global waste generation.

While OECD countries offer a mixed picture on total annual waste generation, with some countries showing a decrease and others an increase, a generally positive trend can be observed in municipal waste (representing roughly 10% of total waste).

- Since 2000 the amount of municipal waste generated per year has stabilised at around 650 million tonnes; per capita generation has decreased by almost 4% (to 540 kilograms per capita in 2009, compared to 560 kg in 2000), but remains high compared to the rest of the world.
- Municipal solid waste is increasingly being diverted from landfills and kept in the economy through recovery or recycling (Figure 10). The share of material being recovered from municipal waste for recycling or composting has increased from 18% in 1995 to 33% in 2009 (Figure 11).
- Markets for secondary raw materials are expanding.
- Recycling rates have increased for many important materials, such as glass, steel, aluminium, paper and plastics, with some reaching levels over 80%. There are however many precious or specialty metals that are not recycled or for which recycling rates remain very low.

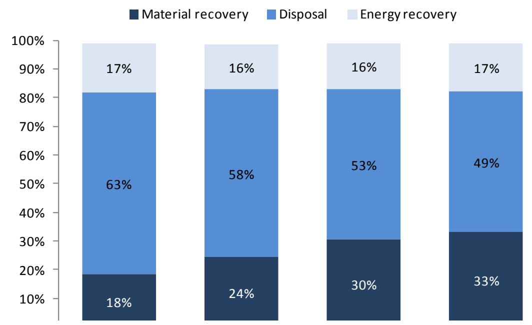
Recycling rates are high for a number of high volume materials but remain low for many high value materials.

Figure 10. Municipal waste generation versus GDP, OECD, 1990-2009



Source: OECD Environmental Data.

Figure11. Municipal waste management, recovery and disposal shares, OECD Countries

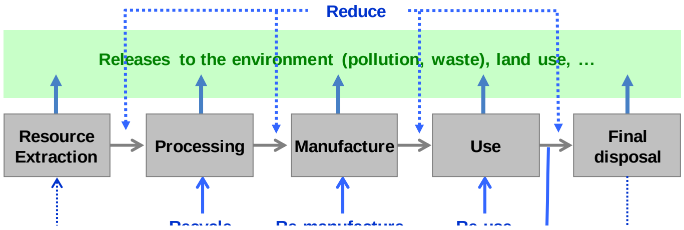


Urban mines: an important, undervalued source of raw materials

Raw materials are usually extracted or produced from natural resource stocks. Valuable materials can also be gained from the recovery and recycling of solid waste by diverting materials from the waste stream before final disposal. They can further be extracted from final waste disposal sites such as landfills. Valuable resources are also found in the built environment and in products and appliances in use. These "urban mines" are an important source of minerals and metals for industry (e.g. electric and electronic equipment), and a potentially important source of raw materials in the future.

Little is currently known about the size and the value of urban mines. Estimates quantifying the amount of raw material locked in the economy indicate that the size of future urban mines is significant. Reliable estimates have been made for only a few metals. For example, anthropogenic stocks of iron are estimated between 12 and 18 million tonnes or roughly 15-20% of global iron ore reserves in 2011. These estimates form a picture of the amount of material that could one day be available for reuse or recycling, free of technical or economic constraints.

The commercial material cycle and the 3Rs*: closing the loop



✶3R and circular economy initiatives aim at closing materials loops and extending the lifespan of materials through longer use, reuse and remanufacturing, and the increased use of secondary raw materials.

These initiatives also aim at material substitution: using materials with lower environmental impact, and replacing the environmentally most damaging materials.

The environmental consequences of the use of natural resources and materials occur at different stages of the resource cycle and affect the quantity and quality of natural resource stocks and the quality of ecosystems and environmental media. The type and intensity of these consequences depend on the kind and amounts of natural resources and materials used, the way these resources are used and managed, and the type and location of the natural environment from where they originate.

5. Better policies for greener growth

OECD countries will need to make significant additional efforts –both domestically and in the international context– to further improve the resource efficiency and material productivity of their economies at all stages of the material life-cycle, to avoid waste of resources, and to shift to a circular economy.

Decisions and actions taken to pursue these objectives typically cut across many policy areas, ranging from economy, trade, innovation and technology development, to natural resource and environmental management, and to human health. They include measures and investments to support technological change and innovations, and to promote integrated life-cycle-oriented approaches, such as 3R policies, and **sustainable materials management**.

They also include efforts in trade policies –including policies that regulate the trade of certain wastes or affect trade in raw materials–, international cooperation and capacity development. Some of the key challenges are linked to the transboundary dimension and complexity of most supply chains and the large number of economic actors that need to be involved in such policies.

Sustainable materials management (SMM) is defined as an approach to promote sustainable materials use, integrating actions targeted at reducing negative environmental impacts and preserving natural capital throughout the life-cycle of materials, taking into account economic efficiency and social equity.

The key principles that should be used when developing SMM policies and strategies are: the preservation of natural capital, the life-cycle perspective, the use of the full range of policy instruments and multi-stakeholder approach

6. Better information for better policies: Filling knowledge gaps

Countries will need to make additional efforts to monitor progress with regard to resource productivity and sustainable use of natural resources and materials, to measure natural resource stocks and flows, and to improve their knowledge on the associated environmental impacts.

A considerable amount of work has been carried out over the past ten years to develop the methods to analyse material flows and to develop appropriate indicators to monitor progress. About two-thirds of OECD countries have developed initiatives in this area. In Europe, reporting on materials flows has become mandatory. This is supported by work on natural resource accounts, that generally focus on countries' economically and environmentally most important resources and materials, as well as by the adoption at UN level of the System of Environmental-Economic Accounting (SEEA) as an international standard.

There is however considerable scope for deeper analysis of particular resources and materials, and the interactions between these resources. Future work will need to strengthen the analysis of trade related flows and flows of secondary raw materials, their links with commodity prices and recycling markets, and their links with natural and anthropogenic stocks of materials.

The most important information gaps relate to the following:

- Material flows that do not enter the economy as transactions, but that are relevant from an environmental point of view, including unused materials and **indirect flows associated with trade**. One of the challenges in estimating the indirect flows stems from gaps in **physical data on international trade**.
- Flows of waste, recyclable materials and secondary raw materials. Distinguishing between primary and **secondary raw materials** is crucial for assessing resource productivity and decoupling trends.
- Urban mining is an area of growing interest, but with the exception of the some of the most common industrial metals, there are insufficient estimates of the size of **anthropogenic stocks** to form a reliable picture of their potential to contribute to future supply, and how it evolves over time and in relation to virgin stocks.

Future work will also need to further explore the environmental consequences of material resource use, as well as the economic and environmental opportunities provided by improved resource productivity. This implies:

- Developing methods to assess the **environmental impacts** of resource use throughout the life cycle of materials and the products that embody them, including impacts from resources that have been traded.
- Providing **industry-level and material-specific information** to indicate opportunities for improved performance and efficiency gains in production and consumption processes.
- Developing compatible databases for **key materials and substances**, including critical raw materials, environmentally harmful substances and substances that play a role in global biogeochemical cycles.

Continued efforts are being undertaken by the OECD to assist in the further development and use of material flow data and resource productivity indicators. This is done in collaboration with UNEP and its International Resource Panel, Eurostat and several research institutes.

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The report ***Material Resources, Productivity and the Environment*** (OECD, forthcoming 2013) is being prepared to provide data and indicators as a knowledge base for policy makers. It should be read in conjunction with ***Sustainable Materials Management - Making Better Use of Resources*** (OECD, 2012) which outlines policy principles and instruments for sustainable materials management and makes policy recommendations.

1 The OECD material flows database covers all 34 OECD countries and the BRIICS. The Sustainable Europe Research Institute's (SERI) material flows database (available at materialflows.net) has data on domestic extraction used (DEU) and unused domestic extraction (UDE) for 188 countries from which world totals were estimated. For consistency, OECD and BRIICS countries' global shares were calculated based on SERI data.

2 Projection by Wuppertal Institute based on business as usual scenario.

3 Figures do not include Slovenia or Estonia as historical data on the material flows of these countries prior to the early 1990s is limited.

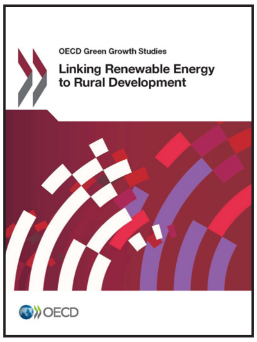
4 Precious metals include gold, silver and the six platinum group metals (iridium, osmium, palladium, platinum, rhodium, and ruthenium).

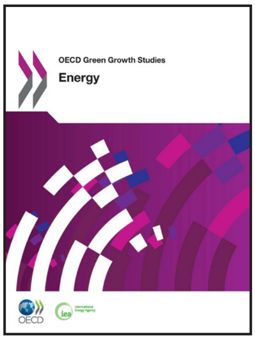
5 By the early 1990s China had overtaken the United States as the world's largest extractor of material resources. China's DEU was estimated in excess of 17 Gt in 2008.

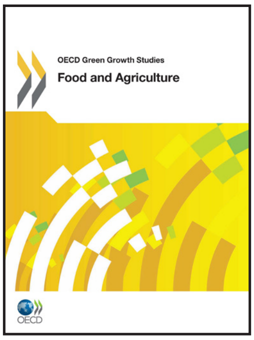
BETTER POLICIES FOR BETTER LIVES DES POLITIQUES MEILLEURES POUR UNE VIE MEILLEURE

Green Growth Studies

The new Green Growth Studies series aims to provide in-depth reviews of the green growth issues faced by different sectors. These are available to purchase at www.oecdbookshop.org or free of charge for subscribing institutions via www.oecd-ilibrary.org







Green Growth Papers

Green Growth Papers also complement the OECD Green Growth Studies series, and aim to stimulate discussion and analysis on specific topics and obtain feedback from interested audiences. The papers are generally available only in their original language, English, with a summary in the other if available. The OECD Green Growth papers are free of charge via www.oecd-ilibrary.org

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