MATERIAL RESOURCES AND WASTE
— 2012 UPDATE

THE EUROPEAN ENVIRONMENT

STATE AND OUTLOOK 2010

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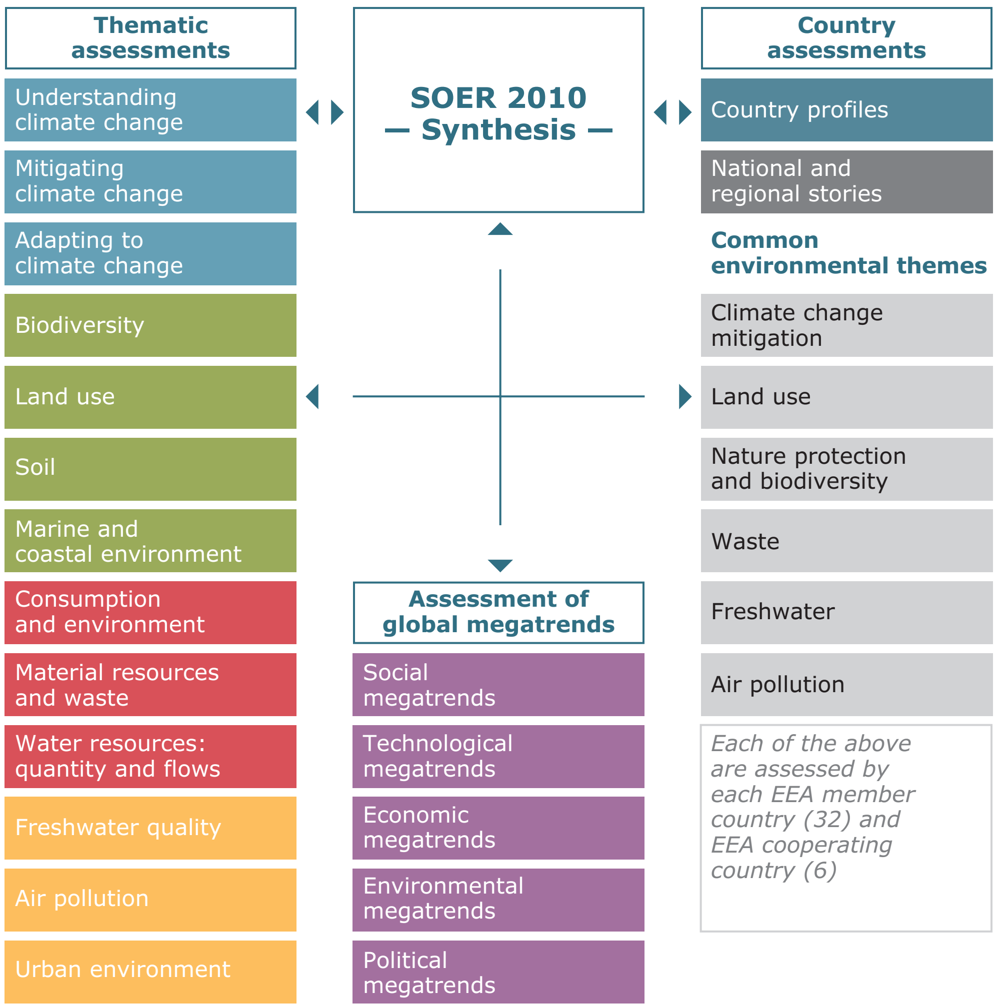

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Material resources and waste

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Summary

The European economy uses huge amounts of natural resources to function. Demand for materials is so intense that between 20 and 30 % of the resources we use are now imported. At the other end of the materials chain, the EU economy generates more than five tons of waste per person every year. With the boom in international trade, EU consumption and production damage ecosystems and human health far beyond Europe's borders.

Economic growth, technological progress and the way Europeans produce and consume resources all impact the environment. For the EU-27 Member States, the average annual use of material resources is nearly 15 tonnes per person. The bulk of this ends up as materials accumulated in the economy; the rest is converted into emissions or waste. More than five tonnes of waste per capita are generated each year. Forecasts predict that Europe will increase its use of materials as countries recover from the economic recession that started in 2008.

Europe has become more efficient in managing material resources. Yet in the long term, our consumption of materials continues to increase in absolute terms. Furthermore, despite long-term improvements, growth in the productivity of materials in the EU has been significantly slower than growth in the productivity of labour.

The overall trend in waste generation, including hazardous waste, is upwards albeit most recent figures show a decline that is probably connected to the economic downturn in Europe. On the other hand, waste management has improved. For example, 38 % of municipal waste in 2010 was recycled or composted compared to 17 % in 1995 in the EU plus Norway and Switzerland. Some 60 % of packaging waste is now recycled, and 12 out of 19 countries recycle or recover more than half of their construction and demolition waste. Nevertheless, for total waste, as of 2008 in the EU-27, Croatia, the Former Yugoslav Republic of Macedonia, Norway and Turkey together, disposal was still dominant (50 %) over recycling (45 %), whereas 5 % was sent to incineration.

The EU aims to become a 'recycling society' and a part of a greener economy which provides both better resource efficiency and improved security of supply. But Europe's economy is still heavily dependent on imported raw materials — 2011 imports amounted to about 1 600 million tonnes (about 3.2 tonnes per person), with fuels and lubricants accounting for most of this amount. The Europe 2020 Strategy adopted by the European Council in June 2010 aims at improving resource efficiency to achieve sustainable and inclusive growth.

Targets set in the recent past have not always been met: the EU was expecting to become 'the most resource-efficient economy in the world' and 'substantially reduce waste generation', according to the Sixth Environment Action Programme (6EAP) adopted in 2002. The adoption in 2010 of the Europe 2020 strategy, which identified resource efficiency as one of its flagship initiatives, provides new stimulus to develop an economy which is competitive, inclusive and provides a high standard of living with much lower environmental impacts. These goals can only be achieved when there is a considerable change in production and consumption patterns.

In addition, Europe needs to curb illegal shipments of waste, tackle illegal or sub-standard landfilling, and fully implement its waste legislation. Full implementation of the EU Landfill Directive can, for example, have secondary benefits for climate change through reductions in greenhouse gas emissions of 62 million tonnes of CO_2-equivalent in 2020 compared to 2008.

1 Introduction

Why do we care about material resource use and waste?

Natural resources — in the form of materials we extract (such as fossil fuels, metal ores, and construction and industrial minerals), water, the soil and land we use, and renewable materials and biomass we harvest — are essential for well-functioning economies and cohesive societies.

This assessment considers resource use in the most macroeconomic sense, focusing on physical flows of materials in the economy, as defined in Eurostat's Material Flow Accounting framework (MFA). Throughout the text, the terms 'material resources' or 'materials' will be used whenever referring to MFA-based use of resources expressed in tonnes (see Box 1.1 for details). The use of energy, added for comparison and covered only to a limited degree here, is expressed in energy units and not in terms of mass.

This assessment covers the EU-15, the EU-12 Member States and, where information is available, illustrates the situation in the Western Balkans and other countries for comparison.

The use of material resources and the generation of waste are two sides of the same coin (see Box 1.2). The two issues share many of the same driving forces — the materials we use and the concomitant wastes are closely linked to how we produce and consume goods. The massive international trade in material resources and, on a much smaller scale, the trade in waste both require life-cycle thinking and a global perspective to take into account burden shifting across borders. Also policy responses often reinforce one another, as demonstrated by the Sixth Environment Action

Box 1.1 Measuring the use of material resources and generation of waste

To monitor economy-wide material flows, Eurostat has developed a number of indicators (expressed in tonnes) that describe the throughput and stock additions of material resources in a national economy. While these material flow analysis (MFA) based indicators are considered to be pressure indicators, they have proved to correlate closely with environmental impact potentials at the macroeconomic system level.

The two MFA indicators frequently used in this assessment are Domestic Extraction Used (DEU) and Domestic Material Consumption (DMC). DEU totals all biomass, fossil fuels, metals, industrial minerals and construction minerals that are extracted in a country and used in the economy. Direct Material Input (DMI) measures the input of materials into the economy, that is DEU plus physical imports — products, materials, commodities, etc. Methodological work is underway to express imports not as the weight of physical imports but as Raw Material Equivalents, accounting for 'embedded' resources needed in their production.

DMC accounts for materials used by a country and is defined as all materials entering the national economy, that is DMI minus materials exported (including materials embedded in exported products). In economic terms, DMC reflects consumption by a national economy. Water is not included in the MFA figures, as it would dwarf all other resources combined.

Material productivity, a measure of how efficiently an economy uses resources, is generally expressed as gross domestic product (GDP) per unit of DMC. Many factors determine material productivity, including the structure of the economy — basic industry or raw material processing versus hi-tech manufacturing, the share of the service sector, the scale and patterns of consumption, the level of construction activities, and the main sources of energy, for example the high share of nuclear energy in France or use of hydro energy in Norway versus reliance on coal in other countries.

Domestic material consumption has recently emerged as a key indicator of how an economy uses resources. The ratio between GDP and DMC has been adopted as a provisional lead indicator under the EU's Verdana 'Roadmap to a resource efficient Europe' (EC, 2011a). There remains a need, however, for broader and more disaggregated analysis to convey the relative significance of various materials and the related impacts. Furthermore, it is worth noting that Economy-wide material flow accounting (EW-MFA) is limited to material resources, leaving aside other important issues. As a result, the 'Roadmap to a resource efficient Europe' provides that the GDP:DMC indicator should be complemented by ' a "dashboard" of indicators on water, land, materials and carbon and indicators that measure environmental impacts and our natural capital or ecosystems as well as seeking to take into account the global aspects of EU consumption. On a third level, thematic indicators will be used to monitor progress towards existing targets in other sectors' (EC, 2011a).

Waste statistics for total waste — waste from the whole economy — have been available in a harmonised format since 2004 as a result of the Waste Statistics Regulation for all EU Member States, Croatia, Turkey, Iceland and Norway. In addition, EU Member States provide data on some more specific waste streams such as municipal waste, packaging waste, end-of-life vehicles and waste electrical and electronic equipment as required by other EU waste-related directives. Longer EU-wide time series are available only for a few waste streams.

Programme's (6EAP) aim of decoupling resource use and waste generation from economic growth. Full-cost resource pricing, promoting resource efficiency and innovation, ensuring policy coherence and closing resource use and waste loops are just some of the common threads of both policy areas (see Table 4.3).

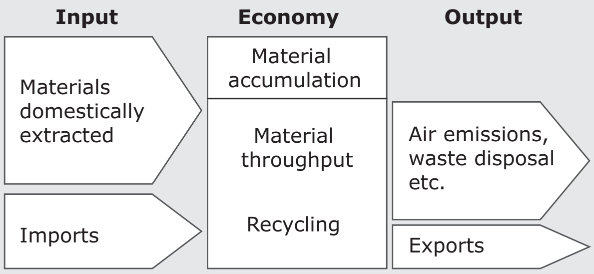
Use of material resources

At the current rate of use, the world's natural resource base is in danger of over-exploitation and eventual collapse. The global trends that drive resource use and related environmental pressures include the rapid growth of the world population, high levels of resource and energy consumption in the developed world, intensive industrialisation of large emerging economies, increasing affluence and higher levels of consumption. Lastly, global trade in materials and commodities is easier than ever.

Some consequences of this growing demand are already clear: climate is changing due to the burning of fossil

Box 1.2 Material resource use and waste — two sides of the same coin?

Figure 1.1 Scope of economy-wide material flow accounts



Source: Eurostat, 2001.

There are many obvious areas where use of materials and management of waste are linked. They share many of the same driving forces such as population, affluence, levels of consumption, and the state of technology. In general, the higher the use of resources, the higher the emissions and the more waste generated.

Average annual use of materials in the EU amounts to under 15 tonnes per person (Figure 2.3). While the bulk of this ends up as materials accumulated in the economy — so-called additions to stock, such as buildings, infrastructure, accumulated goods — a significant amount is converted into emissions or waste. On average, over 5 tonnes of waste per person are generated each year in the EU (Eurostat data centre on waste, 2010).

In recent years, waste has increasingly been seen as a secondary raw material with an economic value and with a significant role in supporting the decoupling of resource use from economic growth. Many EU and national policies aim to promote resource efficiency and to close resource use and waste loops. For some materials, there are compelling economic and environmental reasons to recycle. Iron and steel scrap is one of the world's most recycled materials and amongst the easiest materials to reprocess. The amount of recycled iron and steel in the EU is equivalent to 56 % of its metal production output (Eurofer, 2007). Aluminium is another widely recycled material — with some 40 % of EU production based on recycled aluminium (EAA, 2009). This helps achieve great environmental and economic benefits as recycling aluminium uses only 5 % of the energy required in its virgin production. Recycling paper, plastics, construction materials, glass, and other metals usually has less dramatic but still significant energy savings and environmental benefits.

While well recognised at the macroeconomic level, in practice, the link between resource use, waste and economic efficiency was first addressed at the company level. Companies seeking to ensure regulatory compliance found that initiatives to increase recycling and minimise waste had a side benefit of improving overall efficiency and economic competitiveness. Substantial cost savings and improved performance could often be achieved at a fairly low cost — mainly through better process management — by reducing energy and water use and controlling wastage.

A whole environmental industry emerged to cater to these needs. A recent study for the European Commission estimated that in 2008 the eco-industry of the EU 27 had a turnover of EUR 319 billion, 2.5 % of EU GDP, and employed 3.4 million people. The largest sub-sector was waste management, 30 % of the total, and recycling of materials, added a further 13 %. The first-in-the-business advantage resulted in the EU's eco-industry having a good competitive position. Today it accounts for one third of the global environmental market and is particularly successful in the areas of waste management and recycling.

Re-use, recycling and recovery follow waste prevention in the EU Waste Hierarchy as laid down in the EU Waste Framework Directive, and good waste management typically results in lower resource use and fewer emissions. Greenhouse gas (GHG) emissions from the waste sector, mainly landfills and waste incinerators, in the EU-27 have decreased by 32 % between 1990 and 2009 (EEA, 2012), the highest reduction rate of all GHG-emitting sectors. In addition, the recycling of municipal waste in the EU-27 is estimated to have avoided around 32 million tonnes of CO_2-equivalent emissions in 2009 compared to 1990 by reducing the demand for virgin materials.

Some waste streams have a surprising economic value. For example, the platinum embedded in catalytic converters of scrapped cars exported from Germany to Africa amounts to about a third of annual platinum use in Germany (see Box 4.3). Although exports of waste are nowhere near the scale of global trade in raw materials, some waste streams and end-of-life products are receiving increased attention to minimise loss of resources. Policies often try to facilitate the recovery of materials from end-of-life products through better design, for example by setting recycling requirements for the automotive industry, or by implementing producer responsibility for end-of-life products.

All in all, addressing links between resource use and waste can accelerate a transition to a low carbon, more sustainable and more competitive economy. Improved resource efficiency, increased use of secondary raw materials, full-cost resource pricing and better policy coherence can help to reduce the use of primary raw materials and our import dependency, and improve environmental performance.

fuels, ecosystems and biodiversity are being lost, fertile land is taken up, and waste is generated in ever-growing quantities. In some countries, extraction of resources may also have negative social impacts due to land appropriations, population displacements and human rights violations.

Other consequences are not yet as apparent. Non-renewable resources are finite and some may be nearing the point of exhaustion — including strategic materials such as oil, natural gas and several metals. International competition for access to some resources — water, land, food, etc. — could result in tensions or open conflicts. We now prospect for resources in new, far away and fragile environments, such as the Arctic, tropical rainforests and the ocean floor. Ongoing efforts to replace some of non-renewable resources with renewables such as crop-based biofuels will add to pressures on productive land.

Access to resources has become a major strategic economic concern. Europe has the world's highest net imports of resources per person, and its open economy relies heavily on imported raw materials. The share of imports in EU-27 consumption of materials ranges from 42 % for natural gas, 56 % for coal and 88 % for oil, 50 % for copper, 65 % for zinc and about 85 % for tin, bauxite and iron ores, to 100 % for a wide range of hi-tech metals (see Figure 1.2).

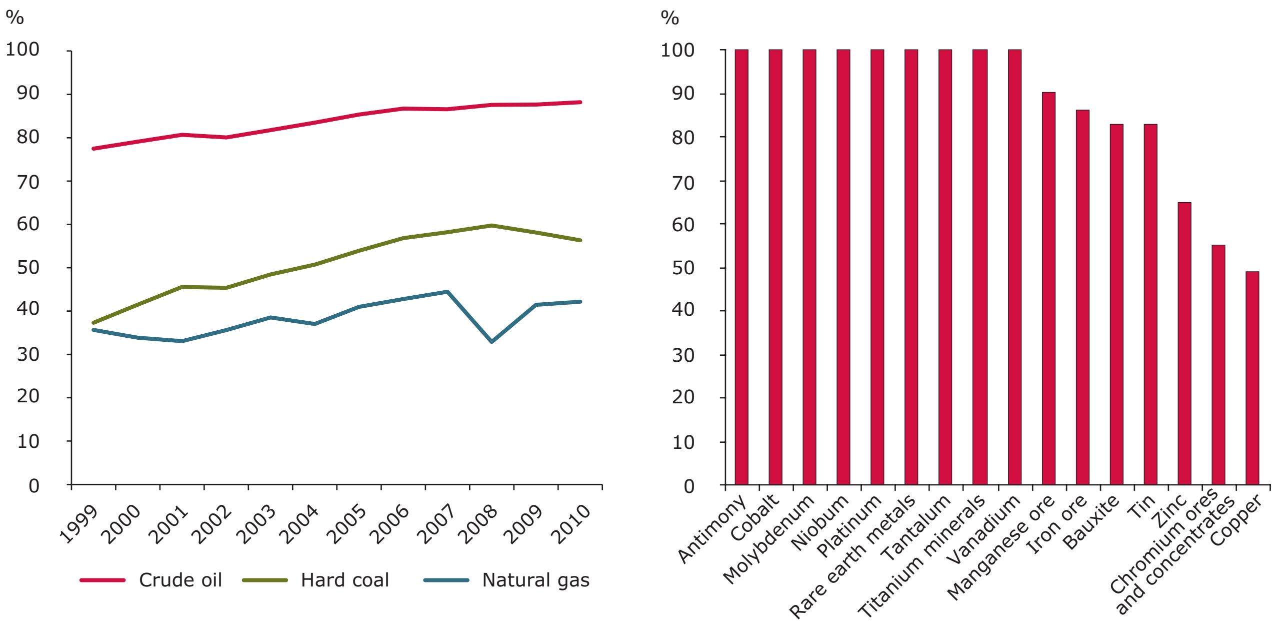
This growth in imports is happening at a time when commodity prices have been increasing — for example, the price of many metals doubled or even tripled between 2000 and 2010 (see Figure 1.3) — and international competition for access has intensified due to increasing demand and scarcity. Securing uninterrupted supply for materials for which there is no known substitute, which are critical to Europe's advanced economy, and where there is a high supply risk is a strategic challenge. The 2008 EU Raw Materials Initiative and the 2011 Communication on tackling the challenges in commodity markets and on raw materials seek to address this concern.

Most recently, all these elements were acknowledged in EUROPE 2020, a European strategy for smart, sustainable and inclusive growth, adopted in March 2010. One of the key priorities set for the next decade is sustainable growth, promoting a 'more resource–efficient, greener and more competitive economy.' The focal point for current policy discussions on resource efficiency is the European Commission's Communication on a 'Roadmap to a resource efficient Europe' adopted in September 2011 (EC, 2011a). The Roadmap addresses the challenges and opportunities for delivering a resource efficient Europe through economic transformation that is grounded in eco-innovation, change in consumption dynamics, ecological resilience, social cohesion, international and inter-generational equity. This also includes a governance set-up for monitoring progress based on knowledge, evidence and objectives, targets and indicators.

Waste generation and management

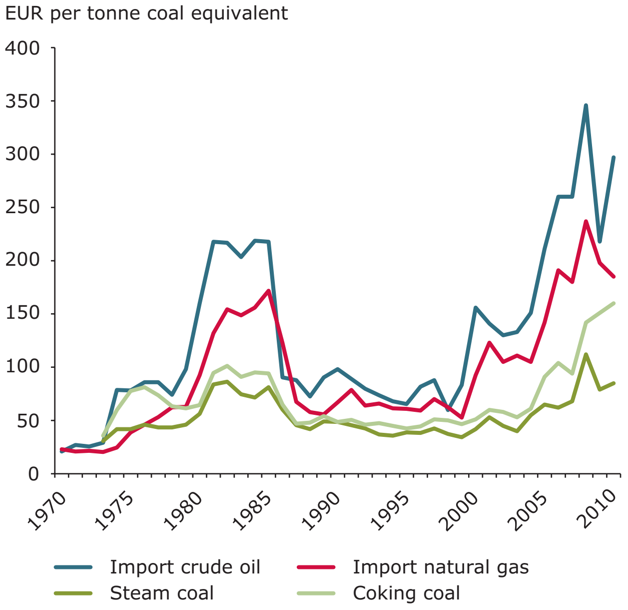
Waste is generated at all stages of the materials cycle: during extraction, for example mining waste; production and distribution, generating industrial waste, hazardous waste, packaging waste, etc.; consumption of products and services, generating, for example, municipal waste, waste electric and electronic equipment; and during waste

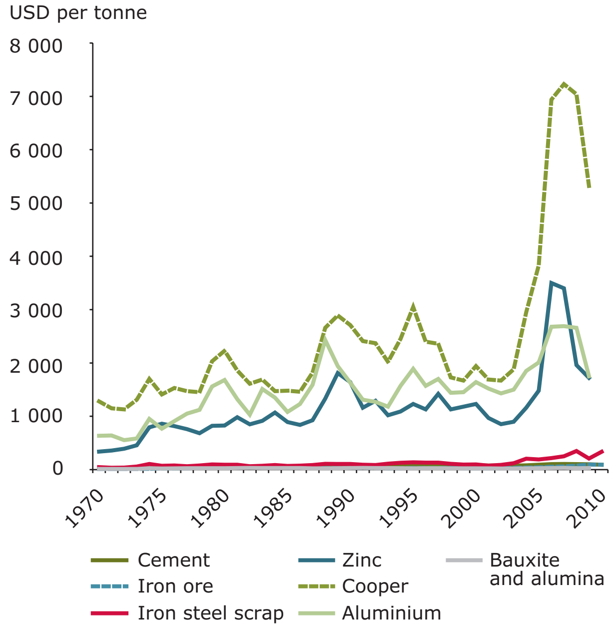
Figure 1.2 Share of imports in EU-27 consumption of selected materials (1999–2010)



Source: Eurostat statistics, 2010 (left figure); Raw Materials Initiative Annex, EU 2008 (right figure).

Figure 1.3 Trends in prices of commodities, 1970–2010



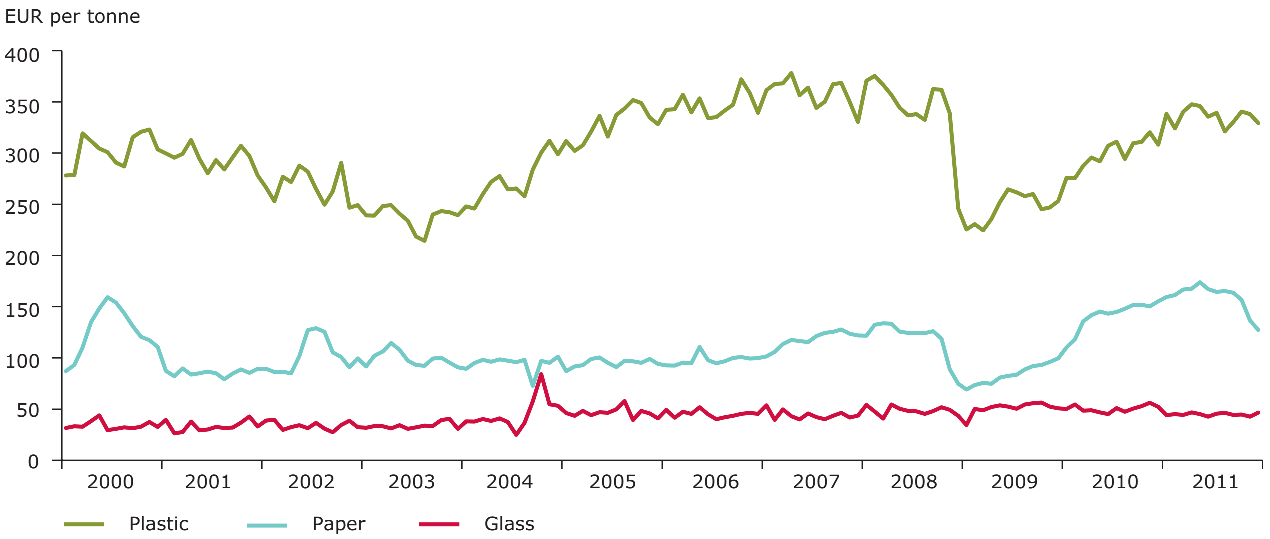


Source: Fossil fuels: Statistik der Kohlenwirtschaft e.V. (German data); metals and cement: USGS (USA data).

treatment, such as sorting residues from recycling facilities or incinerator slag.

As with use of material resources, the significance of waste can be seen from both an environmental and an economic point of view. Management and disposal of waste put pressures on both the environment, for example through the emission of pollutants and the demand for energy or land, and on human health, especially in the case of poor waste management. But waste is also a potential resource: materials in many waste streams can be reused, recycled, or recovered. By recycling or generating energy from waste, environmental impacts can be significantly reduced compared with using virgin materials. The economic value of some waste materials can be illustrated by prices they attract — for example, in recent years, the weighted average price of some traded plastic waste for recycling exceeded EUR 300 per tonne, higher than coal, wheat or iron ore (Figure 1.4).

Figure 1.4 Price developments for selected waste materials in the EU, based on prices for intra-and extra-EU exports, 2000–2011



Note: The prices are calculated as weighted averages of a number of sub-fractions of glass, paper and plastic waste for export both within and outside the EU.

Source: ETC/SCP based on Eurostat External Trade statistics.

Increasing re-use, recycling and recovery have made waste management more complex as a European and even global waste market has evolved, especially for recycling. This becomes evident when considering transboundary shipments of non-hazardous waste — for example the amount of waste metals, paper and plastics shipped from the EU to Asia increased by a factor of five to eleven between 1995 and 2007 (EEA, 2009a). Success has been achieved in some areas: for instance, recycled aluminium scrap and recycled iron and steel scrap now represent 40–56 % of the output of EU metal production (Eurofer, 2007; EAA, 2009).

The recycling sector is also growing in economic importance and makes a significant contribution to employment — in 2006, 150 500 people were employed in the EU's recycling sector. For comparison, the entire sector of mining and quarrying metal ores and of other minerals, excluding energy-producing materials, employed around 288 500 people in the same year (Eurostat, 2009a).

Global trade and in particular the large-scale importation of raw materials and outsourcing of production lead to the shifting of environmental burdens across borders. The resources used to produce exported goods and materials, as well as the associated wastes and other environmental pressures, remain in the producing countries. Put simply, this means that European consumption can cause environmental impacts beyond its borders, something that is not captured in the indicators commonly used today. These impacts are sometimes referred to as ecological rucksacks or footprints, for example carbon or water footprints. Wastes generated in other countries to produce products and material imported into the EU could thus be seen as the waste footprint of these imports. For some products, like computers or mobile phones, the waste footprint is much higher than the actual weight of the product itself. Thus, European consumers are responsible not only for material use but also for the generation of waste in other countries.

Policies

A continuous challenge for sustainable development is to increase the economic welfare and well-being of a society while reducing resource requirements and environmental impacts to a level consistent with the carrying capacity of ecosystems. The revised EU Sustainable Development Strategy (EC, 2006) acknowledged these challenges, identifying as one of its key objectives the need to:

'… safeguard the Earth's capacity to support life in all its diversity, respect the limits of the planet's natural resources and ensure a high level of protection and improvement of the quality of the environment. Prevent and reduce environmental pollution and promote sustainable consumption and production to break the link between economic growth and environmental degradation …'

The 6th EAP recognises that:

'… Europe is a densely populated and an economically advanced continent which means that we use more environmental resources than we produce. This needs to be addressed if the EU is to reduce its contribution to global pollution and resource depletion. At the same time, we are dependent on using the environmental resources of third countries and have a strong interest that these resources be used in a sustainable manner.'

Improving resource efficiency and better management of resources and waste are one of the four main aims of the programme. The 6th EAP states that the use of resources and generation of waste should be decoupled from the rate of economic growth, and the use of resources should not exceed the carrying capacity of the environment. The 6th EAP also specifically aims at reducing the overall generation of waste and its hazardousness and moving away from waste disposal towards re-use, recycling and recovery. The Thematic Strategy on the sustainable use of natural resources (EC, 2005a) and the Thematic Strategy on the prevention and recycling of waste (EC, 2005b) set out a number of measures designed to help meet these objectives, and the revised Waste Framework Directive (EC, 2008) implements these objectives and some of the measures into European Community law.

The policy focus on resource efficiency has recently been reinforced — resource efficiency has been identified as one of the seven flagship initiatives within the European Commission's Europe 2020 strategy (EC, 2010a). Its aim is to 'decouple economic growth from the use of resources, support the shift towards a low carbon economy, increase the use of renewable energy sources, modernise our transport sector and promote energy efficiency'. The Resource Efficiency Flagship Initiative (EC, 2011c) describes the scope for resource efficiency in the EU to include land, soil, air, water and biodiversity along with the more traditionally understood material inputs of, inter alia, energy carriers, metals and minerals. Moreover, efficiency of resource use will go beyond efficiency of production processes and waste reduction, to include changing the types of products, services and materials we demand and produce and the adoption of less resource-intensive and wasteful consumption patterns and behaviour.

The resource efficiency agenda is therefore wide-ranging in its scope and ambitions. It calls for coherence across a number of policy domains and seeks a wide range of investments in infrastructure, buildings and industrial capital as well as in innovation, skills, information and research in support of the future competitiveness of Europe.

2 Trends, impacts and outlooks for use of material resources

This section reviews the patterns and trends in the use of material resources in Europe, contrasting them where relevant with the global situation. Total use of material resources increased continuously until 2008, when the global recession led to a substantial drop in the use of material resources. Furthermore, the EU has become the largest net importer of resources in the world, effectively shifting environmental burdens elsewhere. Securing uninterrupted access to resources will become a strategic economic challenge for some critical materials. The methodological problems with measuring the environmental impacts of resource use do not seem to have a ready solution. This is doubly important given that all projections envisage continued growth in global resource use as the world economy recovers.

2.1 State and trends

Global differences in use of material resources

Extraction of resources is distributed unevenly across the world's regions. Of the estimated total of about 58 billion tonnes of materials extracted and used (DEU) in 2005, Asia accounted for 43 %, North America for 19 %, Europe and Latin America for 13 % each, and Australia and Oceania for 3 % (SERI et al., 2009). The total would be almost twice as high if unused overburden were added, that is materials such as mining waste which are extracted to gain access to the resources but which do not enter the economic sphere.

Consumption of resources is also unbalanced. An average European citizen uses about four times more resources than one in Africa and three times more than one in Asia (Figure 2.1). The EU-27 uses on average less resources per capita than many industrialised countries — about half that of Australia, Canada or USA, but there are large differences between individual countries within the EU (Figure 2.3).

One of the key drivers of material resource use in Europe is economic growth — including the changing structure of the economy, with a growing share of services and the rising import of resources, increasing affluence, and growing levels of household consumption. In contrast to most other regions of the world, population growth in Europe is only a minor factor.

The use of materials is intimately connected with economic growth — a 39-year time series available for the EU-15 shows that domestic material consumption (DMC) decreased only during periods of recession or slow economic growth. As a result of the 2008 recession, DMC declined by 14 % between 2007 and 2009. A similar pattern can be seen in global per person use of materials, which more than doubled between 1900 and 2005, and increased especially sharply since the late nineteen forties (Figure 2.2). There is also a striking correlation between material use and consumption of energy.

How many material resources are we using?

In absolute terms, Europe is using more and more materials, and except for the short-term declines due to economic recession noted above, this trend has run for several decades (Figure 2.4).

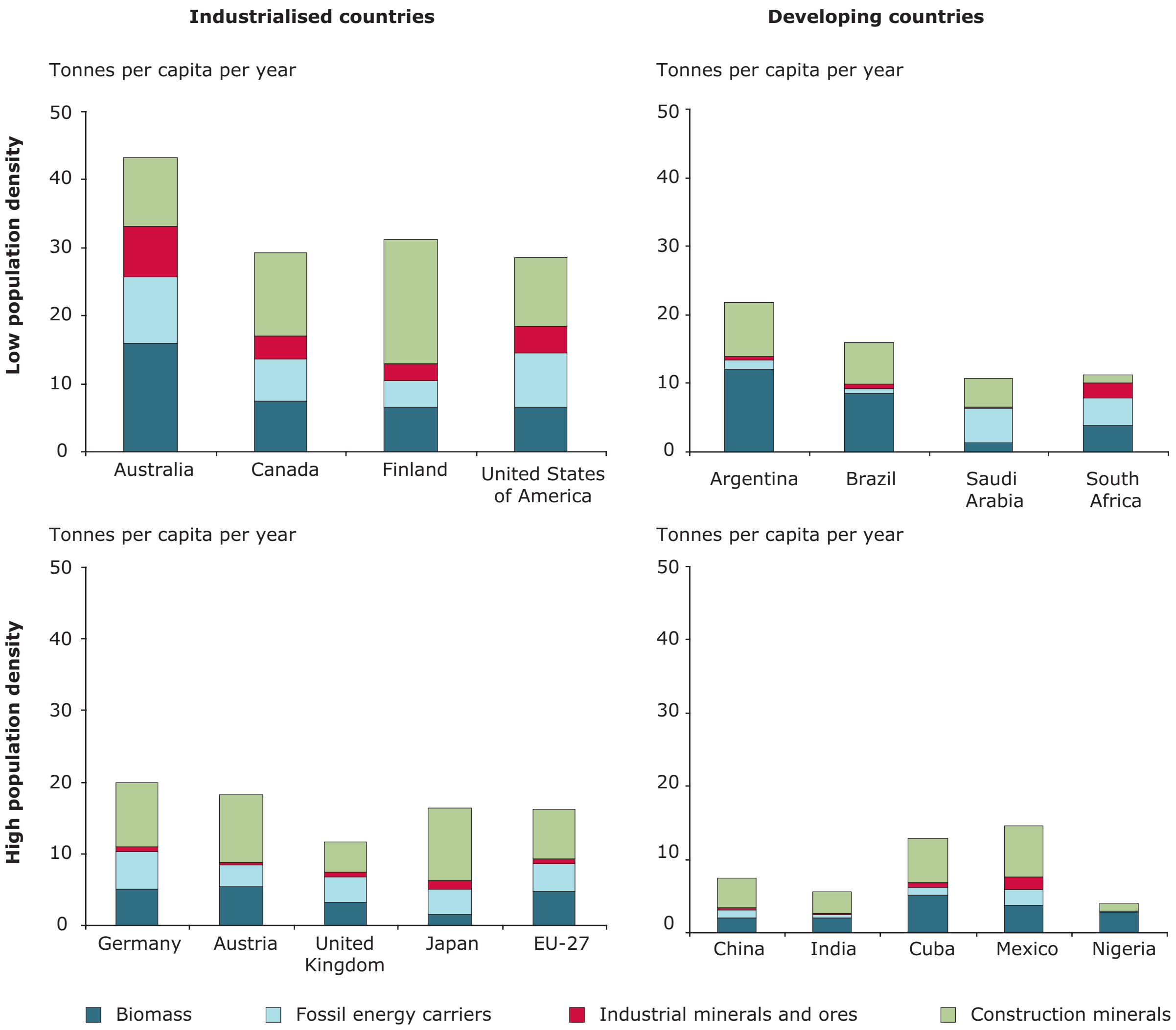
Use of material resources in the European Union as a whole declined by 3 % between 2000 and 2009. After peaking in 2007 at 8.3 billion tonnes (nearly 17 tonnes per capita), use of resources decreased to 7.3 billion tonnes measured as DMC (equivalent to just under 15 tonnes per person) in 2009. Of the 2009 total of 7.3 billion tonnes, minerals accounted for 50 %, fossil fuels for 24 %, biomass for 23 % and metals for 3 %.

While total DMC declined by 10 % between 2000 and 2009 in the EU-15, the EU-12 figures increased by 28 % for total DMC, by 6% for biomass and by 82 % for minerals. The substantial increase in the EU-12 is most likely the result of large scale infrastructure projects and a construction boom that started in the late 1990s and intensified after countries joined the EU in 2004/2007.

The use of resources declined between 2000 and 2009 in twelve out of twenty seven EU countries. However, only in Germany, Hungary, Italy and the United Kingdom the decline was part of a long-term trend rather than resulting from the 2008 recession.

Individual countries in Europe show remarkable differences in both material use per person and material productivity. In the 31 European countries for which 2009 data were available, per person resource use varied by a factor of thirteen: from 3.8 tonnes DMC/person in Malta to just over 50 tonnes in Ireland. While this in itself is not necessarily a reason for concern — factors

Figure 2.1 **Comparison of consumption of materials in selected countries (tonnes of DMC per capita, 2000)**



Note: Industrialised countries include all developed countries and transition markets; developing couintires include developing and least developed countries (based on the classification of UNSD, 2006). All countries with a population density higher than 50 persons per km^2 are considered high density; all others are considered low density (based on data from FAO, 2005).

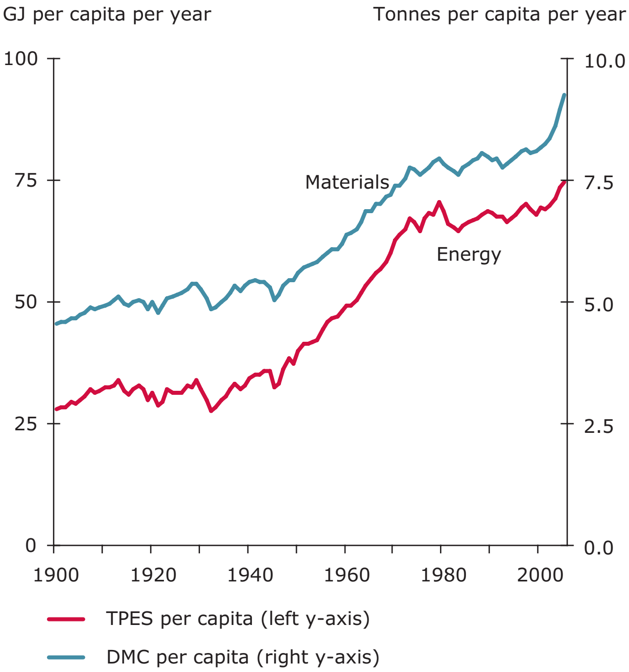
Source: Krausmann et al., 2008.

playing a role include climate, population density, existing infrastructure, availability of raw materials versus reliance on imports, composition of the power generation sector, the rate of economic growth, and the structure of the economy — the continued long-term growth in the absolute amounts of resources used despite technological progress is more troubling. Material productivity varied by a factor of nine between countries (see Figure 2.5).

The fastest growth in the per person use of materials occurred in the EU-12 Member States, half of which experienced growth exceeding 25 % over the period 2000–2009. Material resource use declined only in the Czech Republic, Hungary, Latvia and Slovenia. The growth seems to have been driven by infrastructure investments and intensive economic growth stimulated by EU accession. In contrast, among the EU-15 nine countries experienced a decline in the use of resources in the same period — from 31 % in Italy to 10 % in Belgium — while Austria, Ireland and Sweden experienced a double-digit increase.

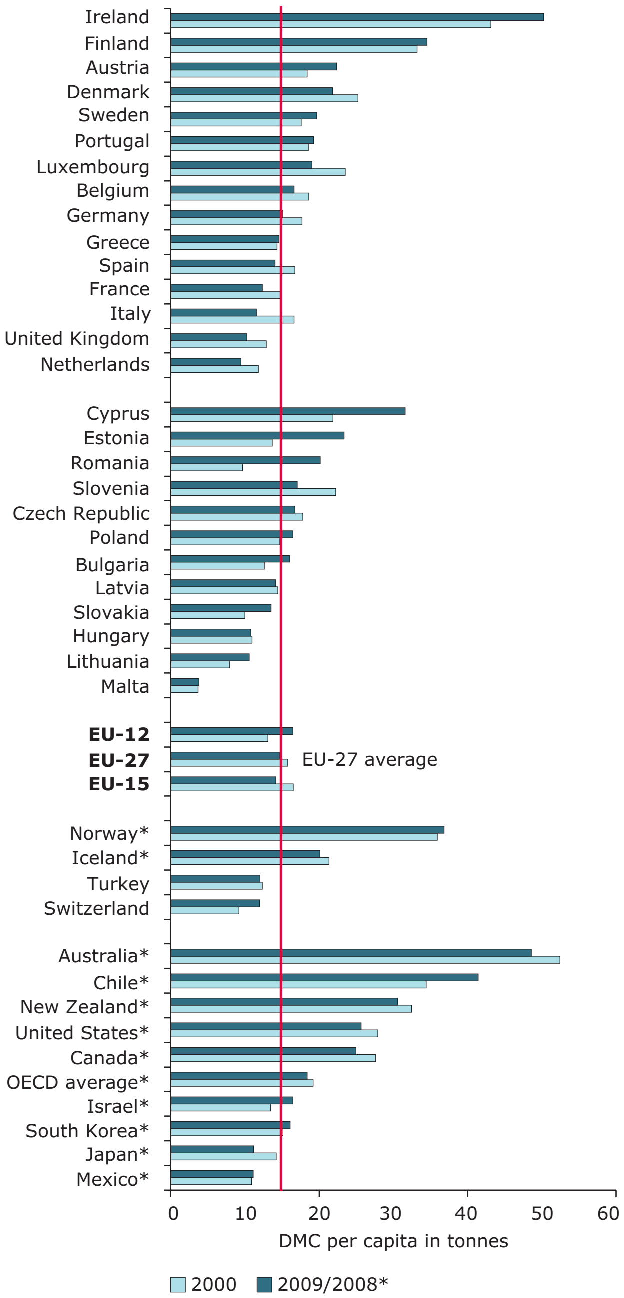
While some of these decreases may be genuine reductions in the use of materials, increasing imports of resources

Figure 2.2 Global per capita consumption of material resources and energy, 1900–2005



Source: Krausmann et al., 2009.

Figure 2.3 Use of resources per person by country, 2000 and 2009



Source: DMC data from Eurostat Database, Material Flow Accounts, and OECD, Population data from Eurostat Database, Population, and The Conference Board — Total Economy Database, 2012. www.conference-board.org/data/economydatabase/.

mean that the emissions and waste produced in the country of origin are not taken into account. The trend in resource consumption may be completely different once this adjustment is made.

For comparison, in the period 2000–2008 Japan experienced a 22 % decrease in per person resource use, much of this reduction being driven by national policies and targets adopted in 2001. Canada, USA, Australia, New Zealand, Iceland, and Switzerland also reduced per person resource use between 2000 and 2008, although similarly to Europe, resources 'embedded' in imports are not fully taken into account.

How efficiently are we using material resources?

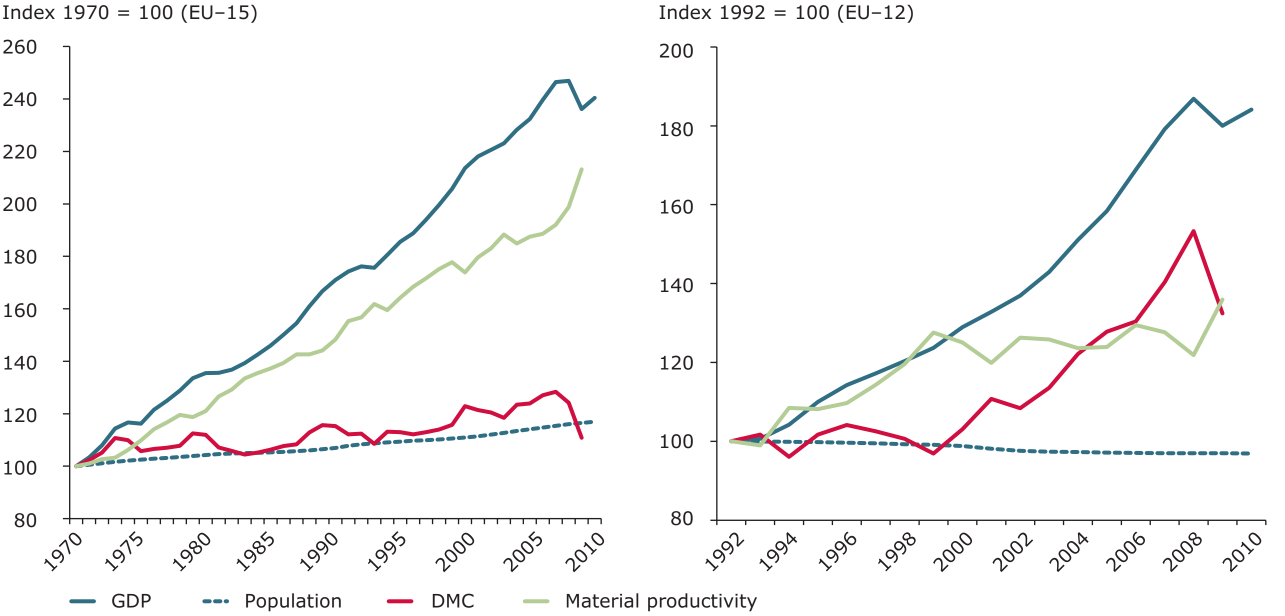
The 6th EAP and the resource efficiency roadmap call for 'breaking the linkages between economic growth and resource use' and resource use in Europe has indeed decoupled from economic growth (Figure 2.4). Between 2000 and 2009 resource efficiency (expressed as GDP/DMC) in the European Union improved by over 15 %. The increase was almost twice as high in the EU-15 as in the EU-12.

Nevertheless, in a long-term perspective, in most countries enhanced resource efficiency only produced a relative decoupling of resource use from economic output. In other words the economy grew faster than use of materials.

Only Germany, Hungary, Italy and the United Kingdom seemed to experience a long-term absolute decline in use of resources.

Growing imports of raw materials and semi manufactured products to replace domestic production may also have contributed to this decoupling effect (for more on this, see a later section on global trade in resources).

Figure 2.4 Use of material resources and material productivity, EU-15 (1970–2009) and EU-12 (1992–2009)

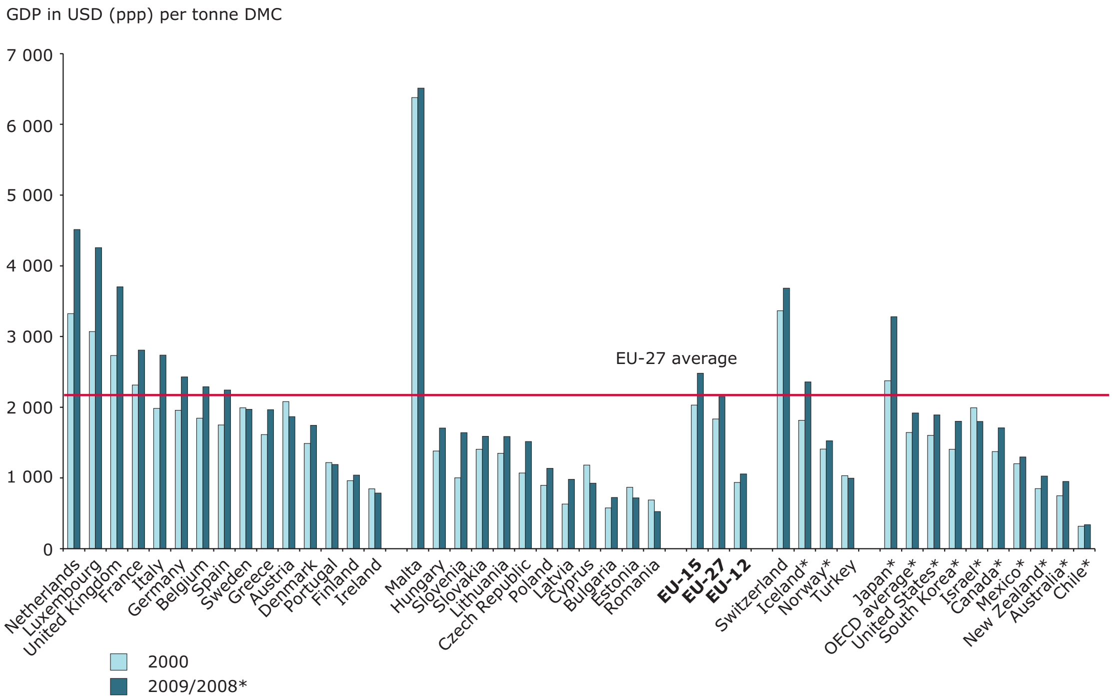


Source: GDP data from The Conference Board — Total Economy Database, 2012, www.conference-board.org/data/economydatabase/; Population data from Eurostat Database on Population; DMC data for 1970-1999 (EU-15): IFF database; DMC data for 1992–1999 (EU-12): WI database; DMC data for 2000–2009: Eurostat Database on Material Flow Accounts.

The positive sign is that materials productivity in Europe — GDP generated per tonne of DMC — has improved. Effectively, our economies are creating more and more wealth out of the resources that they use.

Of some concern is the fact that while material productivity in the EU-15 has grown steadily over recent decades, material productivity in the new EU-12 Member

Figure 2.5 Material productivity by country, 2000 and 2009



Source: GDP data from The Conference Board — Total Economy Database, 2012, www.conference-board.org/data/economydatabase/; DMC data from Eurostat Database on Environmental Accounts, and OECD.

States — which is less than half the EU-15 figure — peaked in 1999 and has since remained fairly flat.

As shown in Figure 2.5, in 2009 (the most recent year for which data are available), material productivity in the EU-27 was highest, in descending order, in Malta, the Netherlands, Luxembourg, United Kingdom, France, Italy, and Germany. All the other countries were either close to — Belgium and Spain — or below the EU-27 average of USD 2 151/tonne DMC. For comparison, in 2009 material productivity in Switzerland was about USD 3 700/tonne, and in Japan USD 3 300/tonne. USA, South Korea, Canada, Norway, and Mexico had lower resource productivity than the average for the EU-27, but higher than the average for the EU-12.

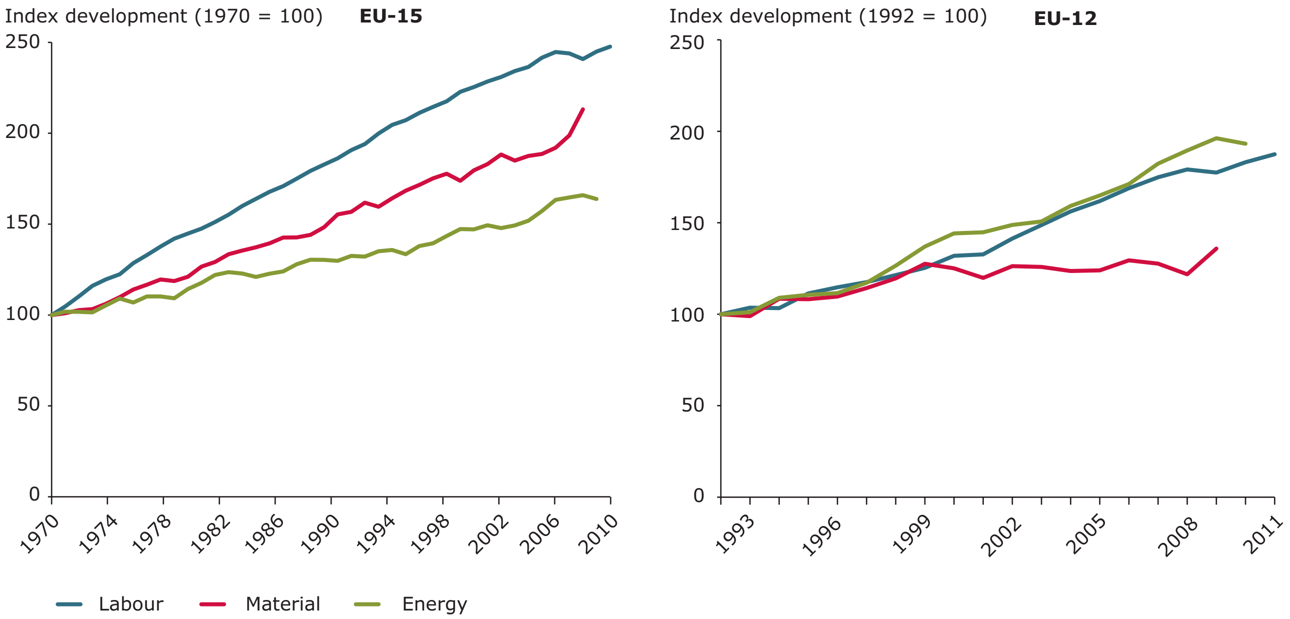
While the average growth in material productivity between 2000 and 2009 was 17 % for the EU-27 as a bloc, it was almost twice as high in the EU-15 than in the EU-12. Looking at individual countries, the growth was highest in Slovenia, Latvia, Czech Republic, Luxembourg, Italy, the Netherlands and United Kingdom, each experiencing growth in excess of 30 % growth over the period 2000–2009. Seven countries experienced a decline in material productivity although only in Romania, Cyprus, Estonia and Austria did the decline reach double digits.

Perhaps more worryingly, at USD 2 482/tonne DMC, average material productivity in the EU-15 was in 2009 more than twice that in the EU-12, at USD 1 057/tonne DMC. While this reflects structural differences between the economies, the gap in material productivity between the EU 12 and the EU 15 has not changed significantly since the early 1990s. In 2009, material productivity in the EU-12 was only 44 % of the average figure for the EU-15, compared with 41 % in 1992 and 46 % in 2000. With the exception of Malta, material productivity in the new Member States was well below the EU-27 average.

Furthermore, despite long term improvements in resource efficiency, growth in the productivity of materials in the EU has been significantly slower than growth in the productivity of labour and to some degree also energy (Figure 2.6). During the period 1970–2009, productivity per unit of labour in the EU-15 increased by 141 %, while productivity per unit of material resources increased by 113 % and productivity per unit of energy by 66 %. In the EU-12, where a much shorter time series is available, productivity of materials increased by 36 % between 1992 and 2009, while productivity of energy and labour increased by 96 % and 77 % respectively.

These trends can be partly explained by the changes in the structure of economies. In the case of the EU-12, the rapid growth in energy productivity may have been caused by the closure of energy-inefficient heavy industries, a switch to fuels with higher energy content and the privatisation

Figure 2.6 Growth in the productivity of labour, energy and materials, EU-15 and EU-12



Source: GDP data and labour data from The Conference Board — Total Economy Database, 2012, www.conferenceboard.org/data/economydatabase/; DMC data for 1970–1999 (EU-15): IFF database; DMC data for 1992–1999 (EU-12): WI database; DMC data for 2000–2009: Eurostat Database on Material Flow Accounts; TPES data from IEA Database.

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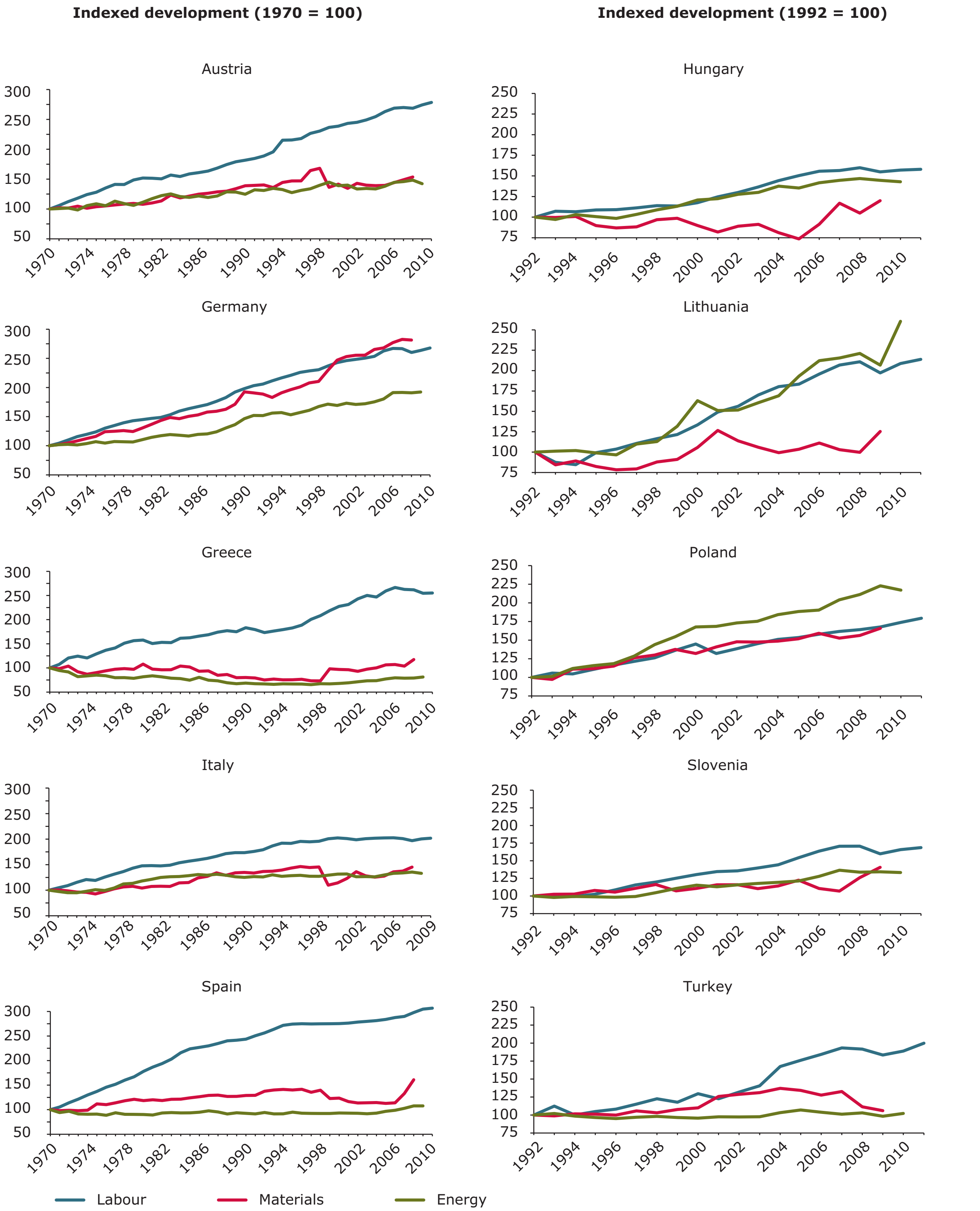
Figure 2.7 **Trends in the productivity of labour, energy and materials for selected EU Member States and Turkey**



Source: GDP data and Labour data from The Conference Board — Total Economy Database, 2012, www.conferenceboard.org/data/economydatabase/; DMC data for 1970–1999 (EU-15): IFF database; DMC data for 1992–1999 (EU-12):WI database; DMC data for 2000–2009: Eurostat Database on Material Flow Accounts except Turkey: OECD database; TPES data from IEA Database.

of energy utilities that together resulted in lower overall energy consumption.

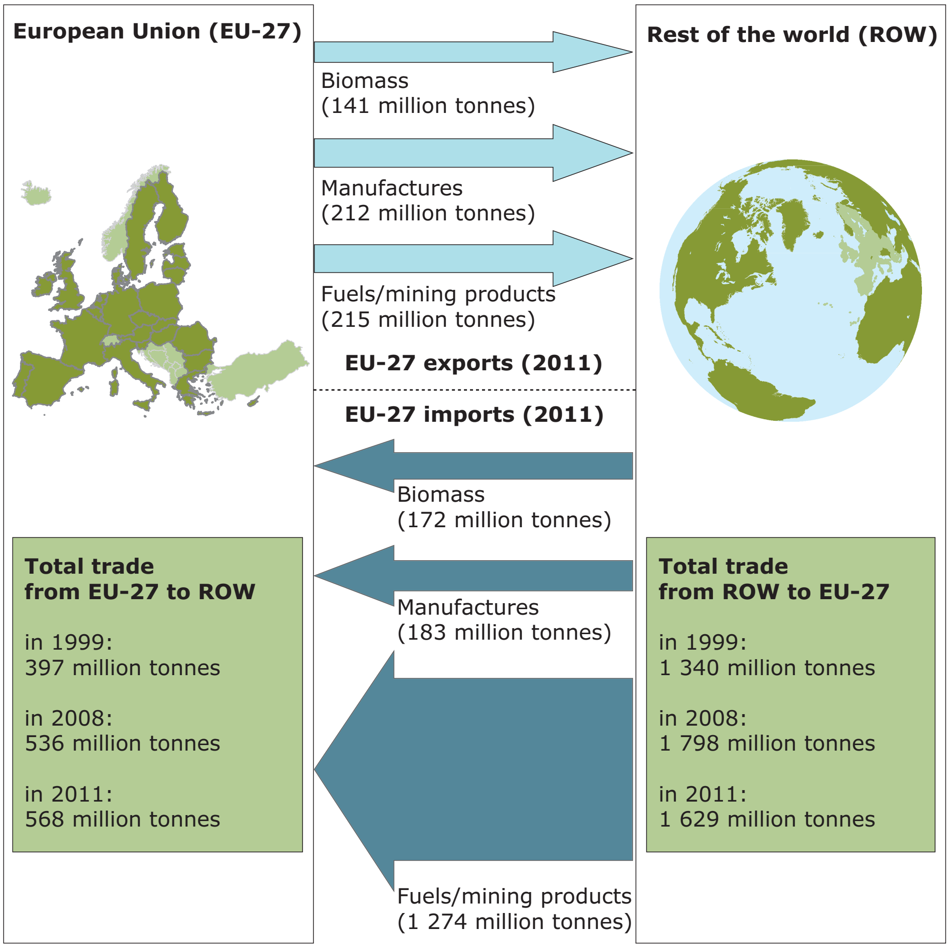
On the whole, however, the main driving force seems to have been the relative pricing of labour, material and energy and the prevailing tax regimes, which make labour more expensive. Despite the high potential for improving materials and energy productivity, most macro-economic restructuring and fiscal reform programmes in recent years have tended to focus on reducing labour costs. As Figure 2.6 demonstrates, improving materials (and energy) efficiency deserves more attention as a key to reducing costs and increasing competitiveness.

One should also be aware though of large variations between individual countries. While detailed analysis of the situation in each country is beyond the scope of this assessment, Figure 2.7 shows that there was a wide range of diverging trends, although in most cases labour productivity experienced the highest growth.

Global trade in resources

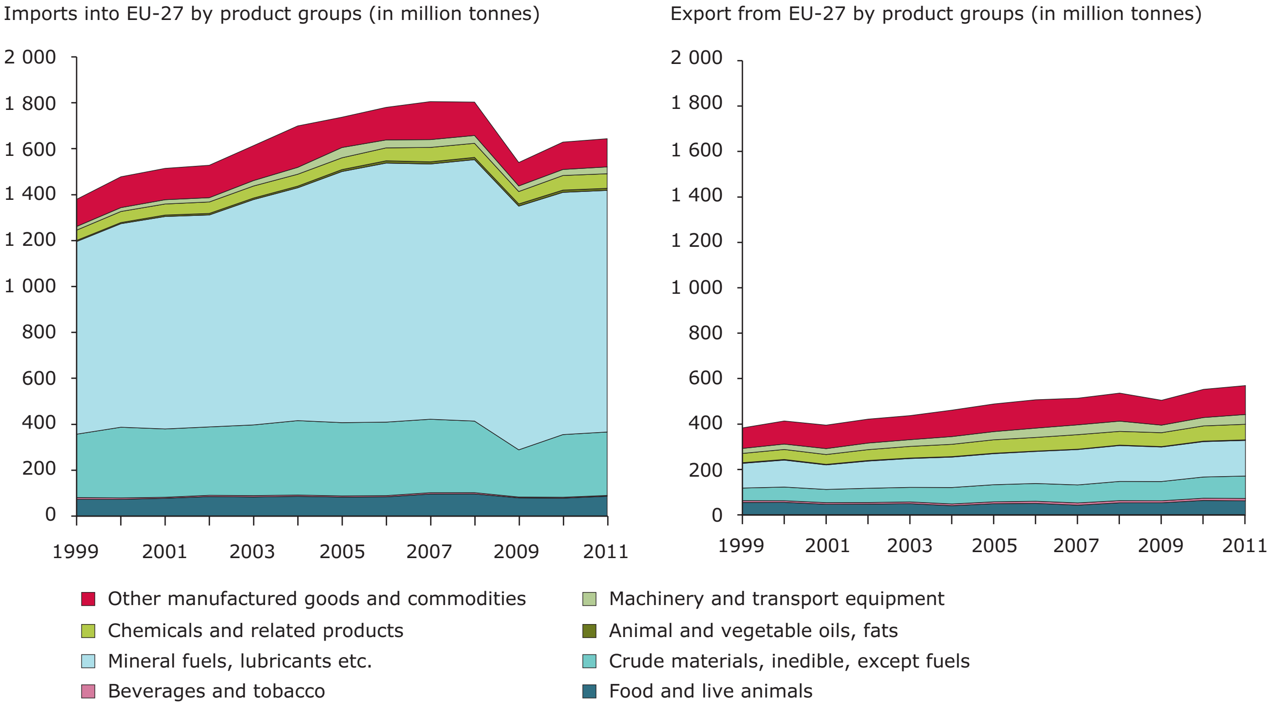
A significant share of the raw materials and semi-manufactured input materials needed for the functioning of European economies is now imported from other parts of the world as, on the whole, activities in heavy industry, extraction (except for construction minerals) and basic metal production have declined in Europe over recent decades. As shown in Figure 2.8, there is a massive asymmetry in trade in fuels and mining products between the EU-27 and the rest of the world. In terms of weight, in 2010 the EU imported over three times more materials than it exported (six times more in the case of fuels and mining products), and this ratio has changed little since 1999.

Figure 2.8 EU-27 physical trade balance with the rest of the World, 2011



Source: Eurostat Comext statistics.

Figure 2.9 Changes in physical foreign trade of EU-27, by product group, 1999–2011



Source: Eurostat Comext statistics.

It is worth noting that the high EU dependence on imported resources is a long-term structural trend. EU-27 imports in tonnes increased by 19 % during the period 1999–2011. After the slight decline in 2008, due to the global economic crisis, exports picked up again and have grown since 2009. As shown in Figure 2.9, the most significant material categories in imports are fuels and lubricants, and other crude materials. For the most part, this high dependence on imports is the result of macro economic restructuring — the decline of basic and heavy industries, rising domestic costs of production, the availability of cheaper products from abroad, and the removal of trade barriers.

While the relative decoupling ([1]) discussed earlier (Figure 2.4) is undoubtedly good news, some of it may have been achieved as a result of increased imports, substituting for domestic production. In absolute terms, Europe is increasingly relying on materials extracted and processed abroad.

The substitution of domestic production by imports takes some strain off the European environment, and contributes to a relative decoupling in terms of mass balance. Simply put, much of the extraction and heavy production takes place elsewhere and no longer shows up on national material flow balances. Eurostat is trying to address this gap by calculating raw material equivalents for imports that will take this into account. An example of importing a mobile phone illustrates the problem well. The physical unit that appears in statistics is a handset weighing some 100 grams. However, according to Nokia, between 500 and 1 000 components make up a mobile phone, and production of some of those components requires high amount of resources.

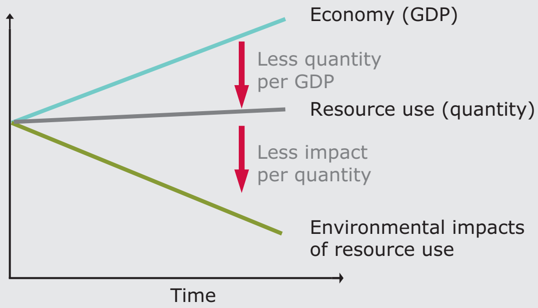
While this reliance on imports may be economically advantageous — or even inevitable for materials that are not available in Europe — it has also led to a shift of environmental burdens abroad, whereby the environmental degradation associated with extraction and manufacture takes place in the producing country. Furthermore, transport activities on such a global scale contribute significantly to energy use and GHG emissions. Environmental damage may be further aggravated by the fact that some exporting countries have lower social and environmental standards than the EU. The pressures embodied in traded resources can be significant — for

([1]) A distinction is made between 'relative decoupling' where both variables are growing but one at a slower rate than the other, and 'absolute decoupling' — where one of the variables actually decreases while the other grows.

Box 2.1 Double decoupling of resource use, economic growth and environmental impacts

In recent years, the concept of 'double decoupling' has gained prominence in the resource policy debate. A distinction is made between decoupling resource use from economic growth — fewer resources used per unit of GDP — and decoupling resource use from the environmental impacts it causes — lower impacts per unit of quantity. Opinions vary on the relative significance of the two components. The International Resource Panel concludes in its recent report on decoupling that 'sustainable resource management strategies will be required that promote resource and impact decoupling, with an emphasis on absolute resource use reductions in developed economies and relative decoupling in developing economies (…)' (UNEP, 2011).

Figure 2.10 Double decoupling



example, each tonne of imported metal can leave behind many tonnes of hidden flows — ecological rucksacks — ranging from four tonnes for every tonne of steel, to 400 000 tonnes for one tonne of platinum.

2.2 Impacts

Quantifying environmental impacts

Environmental problems associated with the extraction and production of material resources include impacts on land, water, and air; the movement of massive amounts of materials and related high use of energy as well as toxic emissions and generation of waste on a large scale. High use of natural resources increases pressures on both the source function of ecosystems — for example maintaining the availability of supplies and ensuring sustainable yields — and on their role as sinks — absorbing pollution or neutralising discharges. Frequently there are also social impacts of resource use, most often affecting the poor through competition for land, access to water, or forced relocations. All in all, it is generally accepted that there are physical limits to continuing global economic growth based on the current patterns of resource use.

The relationship between resource use and environmental impacts is not well understood and documented and there are many uncertainties in assessing reserves and the regeneration dynamics of natural resources. The overall consumption of material resources is known only for some countries although Eurostat's MFA indicators have been compiled for quite some time and the OECD has carried out similar work for its member states.

Nonetheless there is considerable experience in quantifying the use of natural resources. Pressures can be expressed in terms of quantities of pollutants discharged, weights or volumes of resource extracted or material consumed, volumes of fish or timber harvested, or, at the most aggregated level, material flows in tonnes. However, converting these pressures, which are sometimes referred to as impact potentials, into environmental impacts is much more challenging.

Quantifying the environmental impacts of resource use is notoriously difficult, due to the lack of robust methodologies and operational indicators. Tools and methods to measure these impacts are still at an early stage of development. A report by the International Panel for Sustainable Resource Management (UNEP, 2010) reviewed existing studies aiming to answer the questions what economic sectors, what products and consumption clusters, and what materials have the highest impacts. The different studies seem to concur in identifying agriculture and food consumption, as well as the use of fossil fuels among the most important drivers of environmental pressures.

Preliminary research also suggests that, as a general rule, the higher the use of materials, energy and land, the higher the potential impact on the environment. However, except for impacts directly related to resource extraction, there are only a few instances where a causal relationship between a specific resource use and its environmental impacts can be demonstrated. These include global warming and the acidifying effect of the consumption of fossil fuels as well as some health-related impacts of metal refining.

Some experts point out that opposing forces are at play. We are becoming more effective in reducing emissions and controlling pollution from point sources. On the other hand, much of the European resource base is now located abroad, where environmental standards may or may not be similar to those in the EU and, in any case, these

Box 2.2 'Not all tonnes were created equal' or environmentally-weighted material consumption (EMC)

MFA-based indicator Domestic Material Consumption (DMC) is often used as a proxy for environmental pressures of resource use. According to this 'weight-based' approach, the most environmentally-significant categories of material resources are:

- sand and sandstone;
- biomass (crops, animal products and wood);
- oil, natural gas and coal;
- cement.

However, such a mass-based approach does not address the large differences in environmental impacts between different materials. This is not a trivial difference — the impacts of a tonne of mercury or arsenic are several orders of magnitude higher than those of a tonne of sand or wood.

The indicator Environmentally-weighted Material Consumption (EMC) developed by Leiden University's Institute of Environmental Sciences (CML) attempts to add the environmental impact dimension to figures on material flows. EMC combines, for main material streams, figures on mass flows with life cycle assessment (LCA)-based information on 11 categories of environmental pressures: abiotic resource depletion, land use, global warming, ozone layer depletion, human toxicity, terrestrial ecotoxicity, aquatic ecotoxicity, photochemical smog formation, acidification, eutrophication, and radiation. According to an EMC-based ranking, the most environmentally-significant materials include:

- animal products and crops;
- plastics;
- coal and oil;
- iron and steel.

However, a few words of qualification are necessary. The ranking above, not all that different from the one based on MFA, assigns equal weight to each of the 11 pressure categories. In reality, for each individual pressure category the conclusions on the relative importance of each material can be dramatically different. For example, when looking at land use, animal products and crops account for almost 90 % of the total. With respect to global warming, coal, oil and gas for energy production make up some 60 % of the total. Meanwhile, for human toxicity, the most important materials turn out to be plastics, hard coal, iron and steel, zinc and lead. The question of how to aggregate all 11 scores per material into a single picture is yet to be satisfactorily answered. Furthermore, the 11 pressure categories are by no means an exhaustive set — missing factors include among other things biodiversity loss and disruption of hydro-geological conditions.

All in all, to use EMC to its full potential, further work is needed on compiling material balances, the selection of impact factors, and reaching an agreement on the weighting scheme to produce an aggregate indicator.

environmental burdens do not show up on the account of the final consumer.

Furthermore, due to the gradual exhaustion of high-quality ore deposits, we are increasingly turning to less concentrated ores the extraction of which causes higher impacts per tonne of processed material. The situation is similar for the fossil fuels that we now extract from deposits which would have been considered uneconomic two decades ago. All this also requires more transport and more energy and there is a clear — if rarely acknowledged — problem: all this extra energy use will accelerate climate change.

Various initiatives are under way to better quantify the environmental impacts of resource use and to measure progress in decoupling environmental impacts from economic growth. In addition to work on Environmentally weighted Material Consumption (EMC) (Box 2.2), a basket of indicators or accounting approaches has been identified which aim to monitor the environmental impacts of resource use. These include the Ecological Footprint (EF) that compares human demand with the Earth's ecological capacity to regenerate, Human Appropriation of Net Primary Production (HANPP), Land and Ecosystem Accounts (LEAC), and the EMC. JRC/IPTS is working on a set of LCA-based impact indicators. However, at present, these are still far from robust or comprehensive.

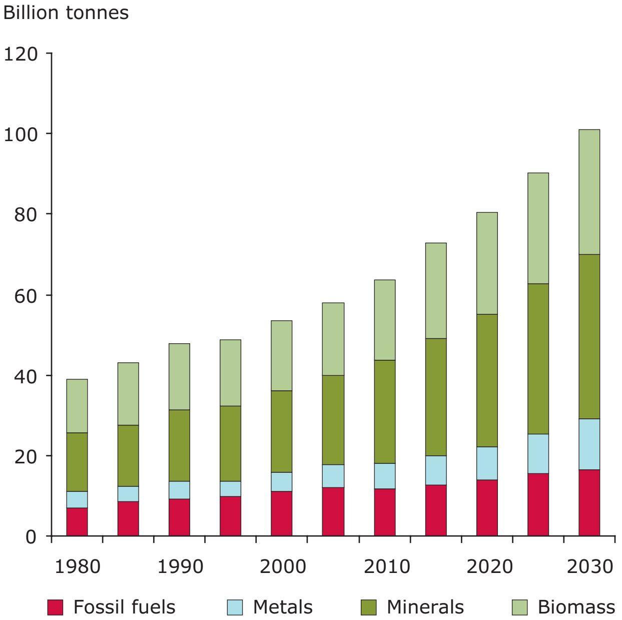
Overall, there is little to suggest that global environmental impacts from Europe's resource use are going down.

2.3 Outlook 2030

All projections published before 2007 envisaged continuing growth in the global use of resources. This trend has been evident since 2000, resulting from the rapid economic growth of large emerging economies, their growing population, the increasing affluence of a significant part of their population, and more widespread global trade.

According to a business-as-usual scenario prepared in 2009 (SERI and GWS, 2009), global extraction of resources is expected to increase from 58 billion tonnes in 2005, to

Figure 2.11 Global resource extraction 1980–2030, by category



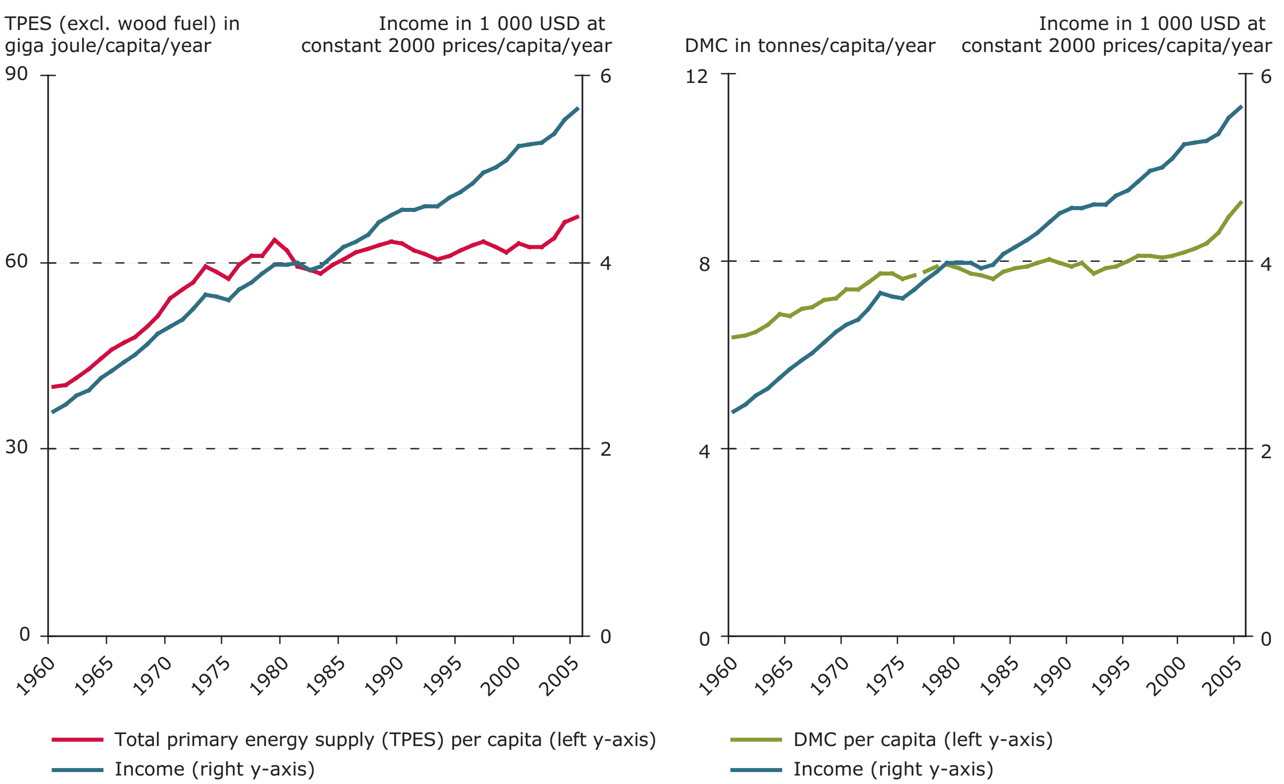
Source: SERI et al., 2009.

more than 100 billion tonnes in 2030, a 75 % increase over 25 years. For comparison, resource extraction between 1980 and 2005 grew by about 50 % (Figure 2.11).

The basic assumptions behind this scenario were that resource consumption in industrialised countries would not decline significantly compared with today's levels, that scarcity of resources would not worsen, and that strong growth in global population and increase in per person resource consumption in developing countries would be the main factors driving the overall increase in the global use of resources.

In contrast to this global trend, European economic growth during recent decades has been accompanied by a rather modest increase in the total amount of resources used (Figure 2.3). Past predictions of Europe's future use of materials generally envisaged a fairly slow growth, as economies move towards a higher share of services, specialise in higher value-added production, and increasingly import resources and semi-manufactured products from elsewhere.

Figure 2.12 Global trends in per capita income and resource and energy use, 1960–2005



Source: Krausmann et al., 2009.

However, the global recession that began in 2008 placed a big question mark over these assumptions. Due to the significant time lag in the availability of data on material flows, it is not possible to estimate in a timely fashion the decline in Europe's use of resources that resulted from the economic crisis. However, it is likely to be significant judging by the steep decline in DMC figures in 2008 and 2009. On the other hand, a subsequent recovery in international transport and the growth in the physical amount of imports into the EU-27 in 2009 and 2010 (Figure 2.9) suggests that the consumption of materials has picked up again.

There are calls to take advantage of the current economic turbulence to shift the global economy towards more resource efficient patterns — through greening the economy and promoting more resource efficient economic development and business models. While the timing is auspicious and hopes that these goals can be achieved are high, historic data show that following an economic decline or slow down, subsequent periods of growth have tended to be accompanied by an increase in the use of resources and energy (Figure 2.12). Hence, even the serious economic downturn in 2008 and 2009 may well turn out to be just a temporary break in a long term upwards trend in energy and resource use.

However, some new factors are at play, which were not so prominent in the past. Firstly, Europe's dependence on imported raw materials and the intensifying international competition for access to the finite amount of resources are already recognised as a strategic concern. Secondly, prices of many resources have increased significantly over recent years, although it remains to be seen whether this is a long term trend. Lastly, global trade in materials and commodities is easier than ever. Improving the efficiency of resource use — a flagship initiative of the Europe 2020 strategy, will not only help to address some of these economic and strategic concerns, but could also be a step towards achieving targets for reducing GHG emissions (Box 2.3).

On the other hand, the magnitude of the challenge cannot be overestimated. Any significant long-term reduction in European resource use will require a sharp increase in resource efficiency in the processing and manufacturing sectors, a shift towards less resource-intensive services, a decrease in the energy intensity of economies, and an increase in the use of renewable resources. While some of these can be achieved through gradual technological improvements, long-term sustainability of our production and consumption may need to be critically reviewed (see EEA, 2010d).

Box 2.3 Resource use and climate change scenarios in Germany

Input-output calculations for Germany (Acosta-Fernandez and Bringezu, 2009) show that reducing raw material use in the 12 most resource-intensive industries by 10 % would result in a reduction in the country's Total Material Requirement by nearly 20 % and a 15 % reduction in national GHG emissions.

3 Trends, impacts and outlook for waste

The amount of waste generated and the way it is managed influence the environmental impacts arising from waste. This section, therefore, analyses trends in waste generation and waste management. A large body of waste legislation has been introduced in the EU with the aim of reducing the environmental impacts of waste, often targeting specific waste streams of concern, for example hazardous waste, biodegradable municipal waste, packaging waste, end-of-life vehicles, waste electric and electronic equipment, construction and demolition waste, sewage sludge, mining waste, and waste batteries. Some of these streams are analysed in more detail in this section.

3.1 Trends

Waste generation is growing or stabilising

The EU-27 Member States plus Croatia, Norway and Turkey in total generated some 2.6 billion tonnes of waste in 2008, or roughly 5.4 tonnes per person, of which around 3.7 % is hazardous (Eurostat data centre on waste, 2011; data reported according to the Waste Statistics Regulation). The data situation has improved with the new Waste Statistics Regulation (Regulation (EC) No 2150/2002). However, as longer time-series are not yet available, no trend on generation of total waste can be derived. Data that is available, covering 15 European countries, however, show an increase of 2 % over the period 1996–2004 (EEA, 2007).

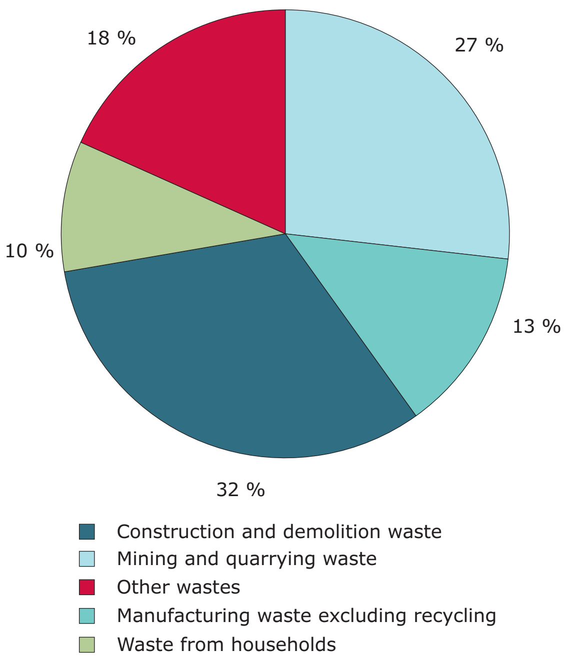
In general, 32 % of the waste generated in the EEA countries is from construction and demolition activities, 27 % from mining and quarrying, and the rest from manufacturing, households and other activities (Figure 3.1). Almost two thirds of the total is mineral waste, mainly from mining, quarrying, construction and demolition (Figure 3.2).

EU-wide time-series data are available only for a few selected waste streams such as hazardous waste, municipal waste and packaging waste that are therefore used to assess the development of waste generation.

The annual generation of **municipal waste**, mainly from households but including similar wastes from such sources as commerce, offices and public institutions in the EU-27 has reached 502 kg per person in 2010 (see Figure 3.3).

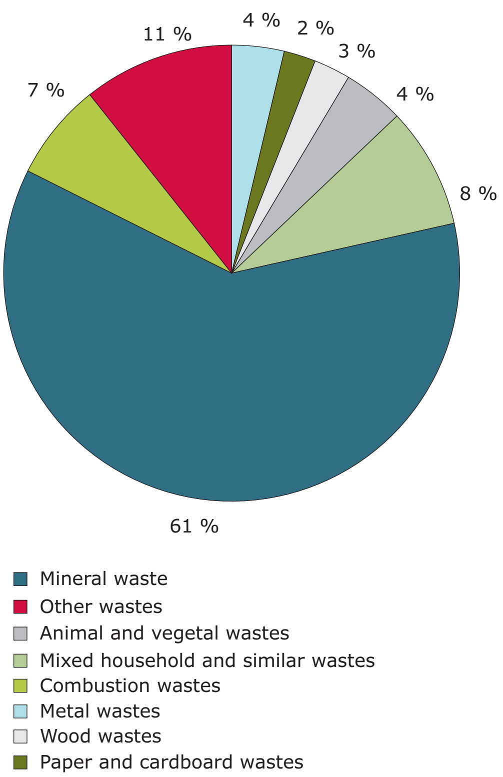
In the past, growing consumption and the trend towards smaller and more households (see EEA, 2010d) have been strong drivers of municipal waste generation but it now seems that these factors are decoupling from municipal waste generation: municipal waste generation per person in the EU-27 stabilised between 1999 and 2007 while consumption expenditure in constant prices increased by 16.3 % per person and the number of people per household decreased by 5.6 % (Odyssee database). However, mainly as a result of the small growth in population, the total amount of municipal waste generated in the EU -7 over the same period increased slightly to 258 million tonnes. In 2010 municipal waste generation declined to a level of 252 million tonnes (Eurostat data centre on waste, 2012).

Figure 3.1 Total waste generation in the EU-27, Croatia, Norway, Switzerland and Turkey in 2008 by source



Source: Eurostat data centre on waste, 2012.

Figure 3.2 **Waste streams in the EU-27, Croatia, former Yugoslav Republic of Macedonia, Norway and Turkey in 2008 by type of waste**



Note: Some of the percentages of the different waste types shown would be larger if the mixed wastes could be identified. For example, mixed household and similar wastes includes some paper and cardboard.

Source: Eurostat data centre on waste, 2012.

The aggregated picture, however, conceals large differences between countries both in the per person generation of municipal waste and in overall amounts. Municipal waste generation per person increased in 17 countries between 2003 and 2010 and fell in eleven, whereas for the remaining countries 2010 levels are nearly the same as in 2003 (see Figure 3.3). The largest increases were in the Western Balkan countries, followed by Iceland and Norway, and the largest decreases in Spain which can be partly explained by a change in data collection. The differences between countries are driven by differences in consumption, although comparability of data is affected by different collection methods, for example some countries include waste from small businesses and public sources such as municipal offices, schools etc.

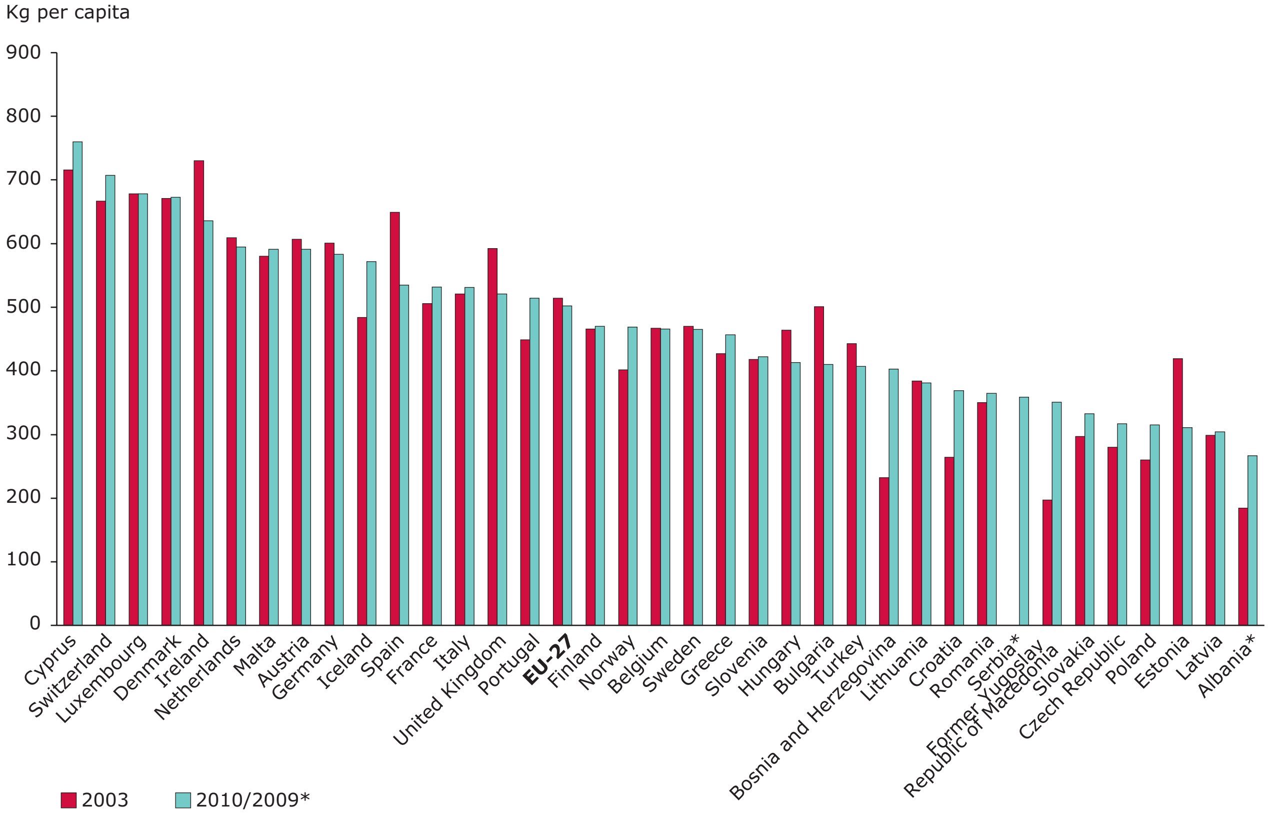
The generation of **construction and demolition waste,** 32 % of Europe's total waste, is closely related to economic activity in the construction sector. This waste consists mainly of inert materials such as bricks, tiles, asphalt, concrete, and to a lower extent others such as wood, plastics and metals, resulting generally in comparably low impacts on the environment per tonne of waste. However, construction and demolition waste is relevant because of its large quantity. National data shows that in 16 out of 20 EU and EFTA countries, construction and demolition waste amounts increased between 1995 and 2006 (different time-series) but again with large differences between countries (ETC/SCP, 2009a). The recent economic downturn is likely to have reduced the generation of construction and demolition waste but reliable time-series data is not yet available.

Packaging waste from households and commercial sources, which makes up some 3 % of total waste, is also increasing. In the EU-15, the four main constituents of this waste stream — glass, metals, paper and cardboard, and plastics — grew at half the rate of GDP between 1998 and 2007, showing a relative decoupling. Since 1997, more and more countries also reported on packaging made of wood, meaning that the total amount of packaging waste appeared to grow even more. Most recent available data show a slight decline in packaging waste in the EU-27, probably influenced by the economic downturn starting in 2008. There are large variations in the amounts of packaging waste between countries, ranging from 40 kg per person in Bulgaria to 232 kg in Ireland (EEA, 2010b).

The EU-27 Member States together reported the generation of 77 million tonnes of **hazardous waste** in 2009, an increase of 26 % since 1997 (see Figure 3.4). Between 1997 and 2009 generation increased by 62 % in the EU 15 but decreased by 20 % in the EU 12.

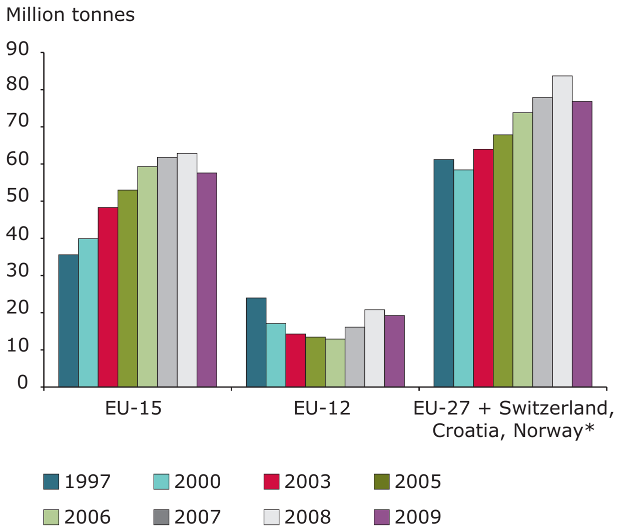
The decrease in the EU-12 until 2006 can be explained by the introduction of cleaner technology and the closing of mines. Also, some hazardous wastes were classified as non-hazardous compared with previous classification systems as a result of the introduction of the European Waste List (ETC/RWM, 2008). The increase in hazardous waste in the EU-15, however, is more difficult to explain. Amendment of the EU hazardous waste list in 2001 increased the number of waste codes and defining some wastes as hazardous that had only previously been registered in some countries. As a consequence, more hazardous waste became registered (EEA, 1999). The increase in municipal waste incineration is estimated to have contributed to an increase in hazardous flue gas cleaning residues of at least 600 000 tonnes in the period 1997–2006 — the calculation is based on the amounts of municipal waste incinerated. And the remediation of contaminated sites can generate substantial amounts of hazardous waste, as illustrated by the case of Switzerland where it amounts to one third of hazardous waste (see the SOER 2010 country assessment on Switzerland (EEA, 2010e)). In addition, it can be assumed that hazardous waste generation would be even higher if the growing number of products, including electronic

Figure 3.3 **Trend in generation of municipal waste in the EU, EFTA countries, Turkey and Western Balkan countries, 2003 and 2010**



Source: Eurostat data centre on waste, 2012; ZOI, 2011.

Figure 3.4 **Hazardous waste generation in the EU-15, EU-12 and in EU-27 plus Norway and Switzerland, Croatia, 1997 to 2009**



Note: 1997 without Croatia.

Source: Compiled by ETC/SCP based on countries' reporting to the European Commission and to the Secretariat of the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal.

appliances, imported to Europe had been produced in Europe itself as many of these have a substantial hazardous waste 'footprint'.

Overall, and taking into account the limited data, the trend shows growing or stabilising amounts of hazardous and non-hazardous waste in the EU. Most recent data show a decline in waste generation for several waste types. It remains to be seen if this trend continues.

Waste management is improving

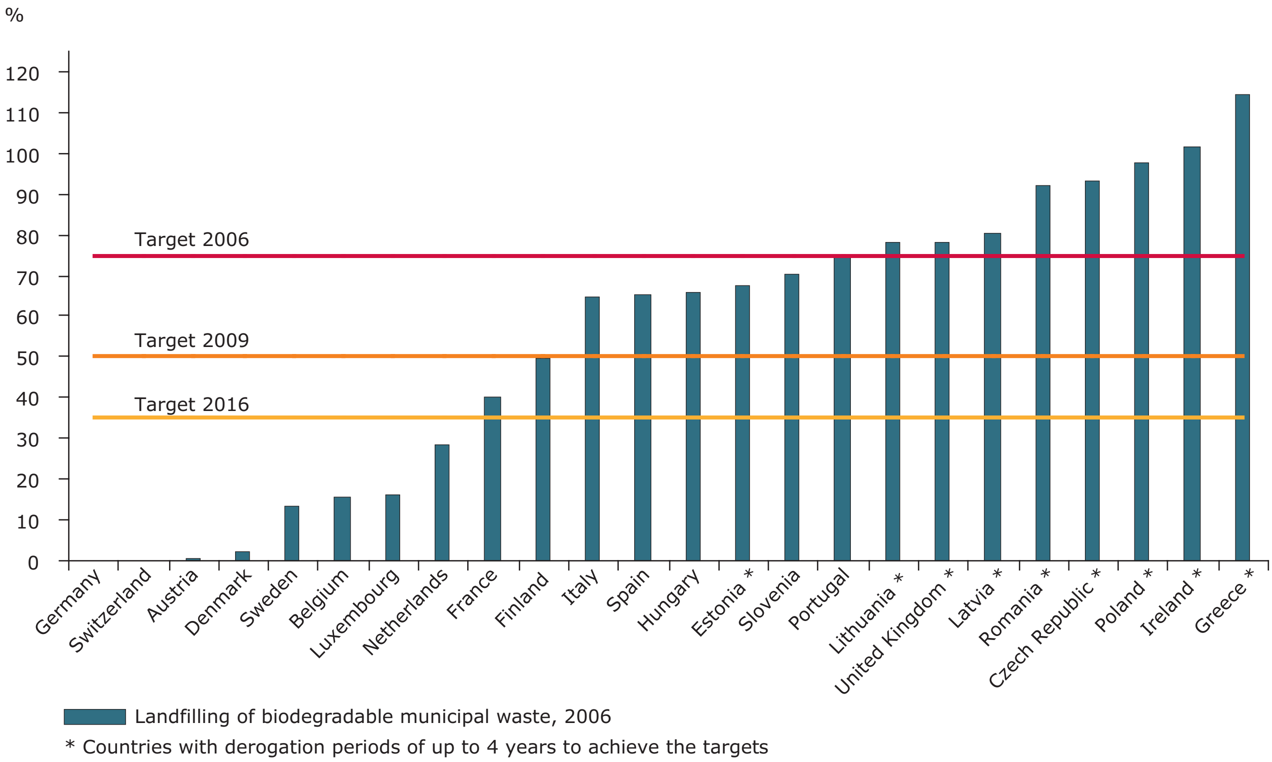
The EU has seen a significant change in waste management. Less is landfilled and more is recycled or incinerated with energy recovery. This development has been driven by EU and national legislation, for example, by establishing targets and instruments for waste recycling and recovery, landfill taxes and restrictions on wastes allowed to landfill, supported by rising prices for raw materials, recycled materials and fuels (see Figures 1.3 and 1.4). However, disposal remained dominant, 49 %, in the EU in 2008, with 46 % recovered and recycled and 5 % incinerated. The disposal rate ranged from more than 90 % in Bulgaria, Greece, Malta and Romania to less than 15 % in Belgium and Denmark. Bulgaria and Romania have high volumes of mining and quarrying waste that is mainly deposited (Eurostat, 2012).

Landfill rates for **municipal waste** decreased steadily from 62 % in 1995 to 37 % in 2010 in the EU-27. They also decreased sharply in Norway and went down to zero in Switzerland, but Turkey and the Western Balkan countries still landfill 80–100 % (Eurostat data centre on waste, 2011; BAFU, 2008; EEA, 2010f–k). Increased urbanisation and population densities appear to be socio-economic factors driving the diversion from landfill, but EU and national policies targeting municipal waste were also important drivers of this development (EEA, 2009b). Most EU Member States, Norway and Switzerland have increased their recycling rates, including composting, of municipal waste over the past five to ten years. Encouragingly, some EU Member States with lower recycling rates, such as Ireland, Italy, Portugal and United Kingdom, have shown a reasonably high growth rate of nearly 1 % per year since 2000. Recycling of paper and cardboard, bio-waste, glass, plastic, and metals are the backbone of municipal waste recycling in the EU (ETC/SCP, 2009a).

In order to reduce the environmental pressures from landfill, particularly methane emissions and leachates, the EU Directive on the landfill of waste (1999/31/EC) requires Member States to reduce landfill of biodegradable municipal waste to 75 % of the amounts generated in 1995 by 2006, to 50 % by 2009, and to 35 % by 2016. Seven EU Member States and Switzerland had already met the 2016 target in 2006, whereas eight countries, all with derogation periods, still need to reduce landfill of biodegradable municipal waste substantially in order to meet the 2006 target. No data are available for Bulgaria, Cyprus and Malta (see Figure 3.5).

Some countries face special challenges in the area of waste management. For example in the Western Balkan countries and some EU Member States, insufficient coverage of the population by waste collection services remains one of the most important waste problems, especially in rural areas (see Table 3.1).

Figure 3.5 Biodegradable municipal waste landfilled in 2006 (% of biodegradable municipal waste generated in 1995), compared to targets of the European Landfill Directive



Notes: 1) Landfill rates above 100 % can result from a growth in the generation of biodegradable municipal waste as the targets are related to the absolute amounts generated in 1995.
2) Percentages for Greece, Italy, Luxemburg and Portugal are based on total biodegradable waste landfilled.

Source: Compiled by ETC/SCP based on data reported to the European Commission by EU Member States, as summarised in Ecologic and IEEP, 2009; personal communication from the European Commission, the Danish EPA and the Polish Ministry of the Environment in 2010; BAFU, 2008; UN-CSD18-Estonia, 2010; EC, 1999.

Table 3.1 Coverage of population with solid waste management systems in selected countries

	Population with solid waste collection service		
	Urban areas	**Rural areas**	**Overall**
Albania	90–95 %	10–20 %	
Bosnia and Herzegovina	36 %		
Bulgaria			ca. 93 %
Croatia	92.8 %		
Kosovo	45 %		
Former Yugoslav Republic of Macedonia			77 %
Montenegro	80 %	Close to 0 %	
Romania	80 %	10 %	
Serbia	60–70 %	Close to 0 %	
Turkey			82 %

Source: REC, 2009; EEA, 2010i, 2010j, 2010l and 2010m; Turkish statistical office, 2010.

Box 3.1 Pharmaceutical waste from households needs better management

Waste pharmaceuticals from households are usually leftovers or unused packages. Most EU and EFTA countries have introduced special collection systems for waste pharmaceuticals from households because pharmaceutically active substances pose a threat to the aquatic environment and therefore need to be disposed of safely. The amounts of pharmaceutical waste collected by these, however, vary considerably and do not correlate with the amounts of pharmaceuticals sold.

Awareness of citizens about the environmental effects and information on the best ways of disposal also seem to influence the amounts collected. Depending on the country, 3–10 % of this waste is assumed to be flushed through lavatories and sinks, particularly liquid pharmaceuticals. This form of disposal however threatens the aquatic environment as not all pharmaceuticals are eliminated during sewage treatment (EEA, 2010a; Vollmer, 2010).

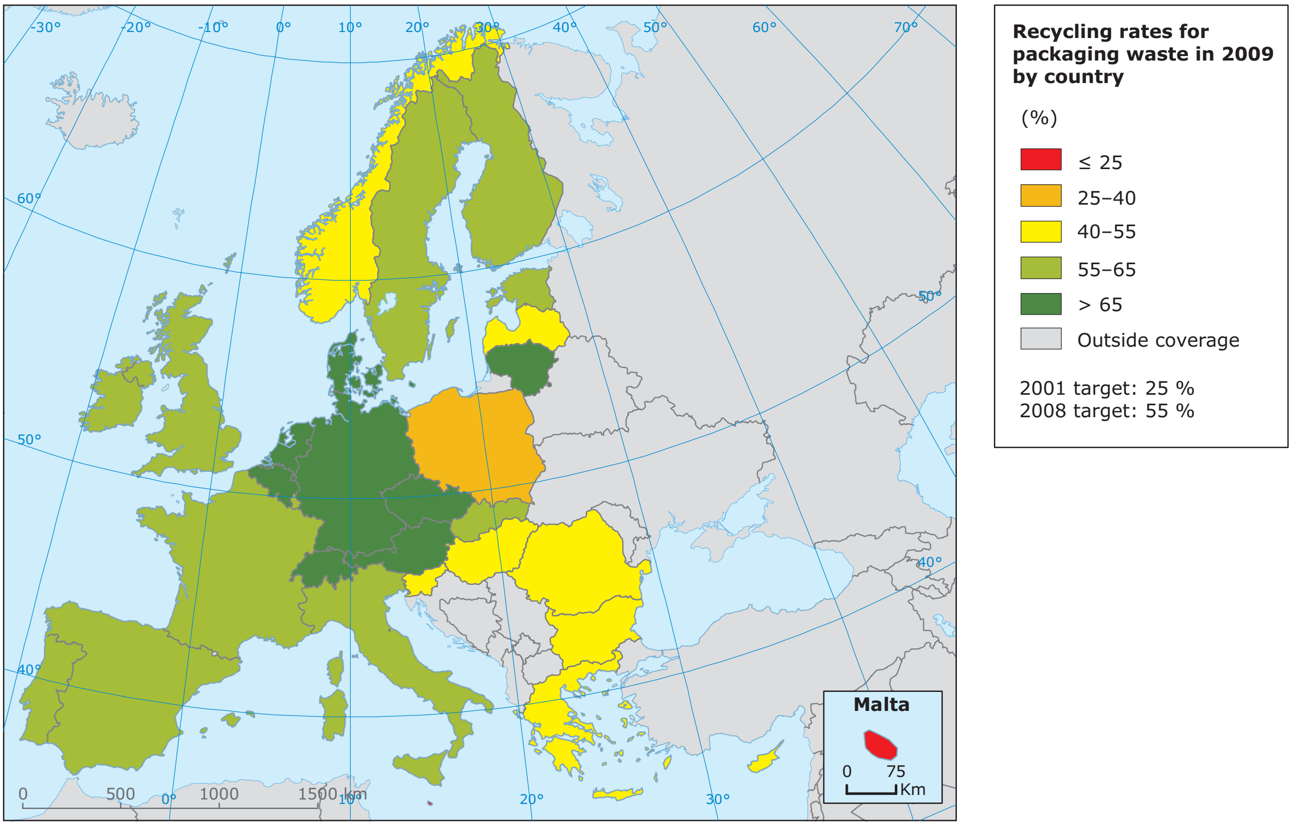
Some fractions within municipal waste need more attention because they pose a threat to the environment, one of which is pharmaceutical waste (see Box 3.1).

The new Waste Framework Directive (EC, 2008), issued in 2008, sets a target of 70 % for re-use, recycling and recovery of non-hazardous **construction and demolition waste**, to be met by 2020. Twelve out of 19 countries (EU, Norway and Switzerland) where data were available already recycle or recover more than 50 % of their construction and demolition waste, totalling an estimated 300 million tonnes (ETC/SCP, 2009a, BAFU, 2008). Concrete, bricks, tiles and asphalt are the most commonly recycled materials in this waste stream, but almost all countries with a very high level of recycling also recycle a significant quantity of soil that is excluded from the target (ETC/SCP, 2009a). The high recycling level for construction and demolition waste means that many virgin resources are saved. It can be assumed that the majority of the recovered products are recycled aggregates that replace virgin aggregates. The average annual use of aggregates is 7 tonnes per capita (EEA, 2008), and it is estimated that only around 7 % or about 250 million tonnes of the total used in 2006 were recycled aggregates (ETC/SCP, 2009b), indicating considerable room for improvement.

Packaging waste is an example where EU and national legislation has successfully increased recycling across the EU. In 2009, 62 % of all packaging waste in the EU 27 was recycled (Eurostat data centre on waste, 2012). In 2009, 20 of the EEA countries had met the 2008 target of the Packaging Waste Directive (2004/12/EC) to recycle at least 55 % of the packaging waste generated (Map 3.1). Recycling rates differ considerably according to packaging material, with highest rates for paper and cardboard and lowest for plastics. At the same time, the use of plastics as packaging material is increasing most rapidly — 40 % between 1997 and 2006 in the EU 15 compared to a 24 % increase of paper and cardboard and 0–2 % for glass and metals packaging (calculated using data from Eurostat data centre on waste, 2010).

EU wide information on the management of hazardous waste is sparse. In 2008, 36 % of the hazardous waste generated was disposed of, 33 % was recovered, 11 % incinerated and no information about the management of

Map 3.1 Recycling rates for packaging waste in 2009 by country



Note: No data available for Iceland, Turkey and the Western Balkan countries. 2007 data used for Malta, 2008 data used for Liechtenstein and Switzerland.

Source: Eurostat data centre on waste, 2012; BAFU, 2012.

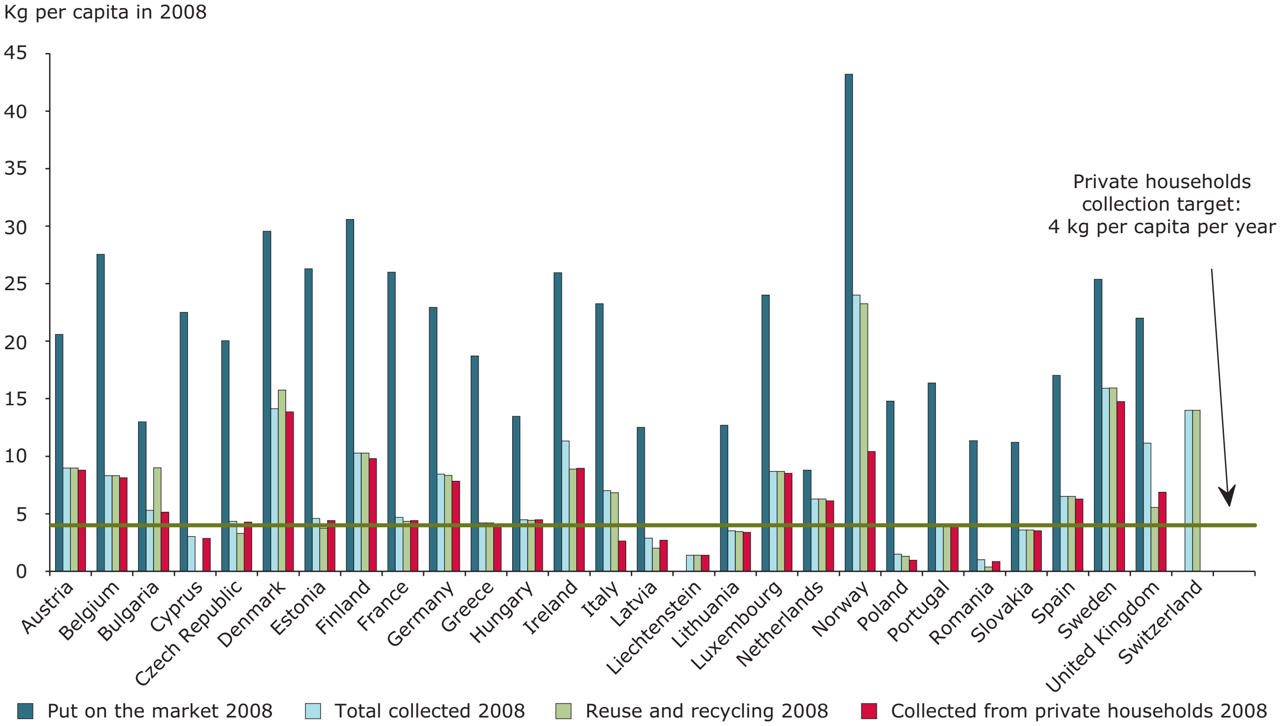
the remaining 20 % is available (calculations based on data from Eurostat data centre on waste, 2011).

Good management of **waste electric and electronic equipment** (WEEE), such as electric household appliances, computers, lighting equipment, telephones, etc. is particularly important because many of the hazardous substances included pose a threat to the environment and there is a high potential for resource savings as WEEE typically contains significant amounts of valuable metals. For example the electrical and electronic equipment put on the market in 2005 is estimated to contain around 450 000 tonnes of copper, 7 tonnes of gold, and 11 800 tonnes of ozone layer depleting CFCs (UNU et al., 2007). However, extracting valuable metals from the waste in a sustainable way involves higher collection and treatment costs than (illegal) export to sub-standard recycling that is driven by the value of the waste materials.

Separate collection of WEEE and its subsequent recovery and treatment in an environmentally sound manner help achieve not only reduction of environmental impacts, but also better resource efficiency. In order to address these issues, the EC Directive 2002/96/EC on waste electrical and electronic equipment (WEEE Directive) sets a collection target of 4 kg of WEEE per person and per year from private households. In addition, by 31 December 2006, manufacturers and importers were to achieve, for treated WEEE, recovery targets of 70–80 % differentiated for the respective categories, as well as material and substance reuse and recycling targets of 50–75 %. 20 countries out of 27 have met the 4 kg per person/year collection target, 9 more than in 2006. The remaining countries have either not met the target or not reported (Figure 3.6). However, as the amount of electrical and electronic equipment (EEE) put on the market in many countries is far above 4 kg per person/year, more ambitious targets have been proposed in the recast of the WEEE Directive.

Member States are currently still building or expanding systems for collecting WEEE. The collection rate achieved so far is only 33 % by weight of amounts put on the market in 2008 — the average of 27 European countries for which data are available. This is an improvement compared to 23 % in 2006 (based on reporting of 18 countries). There is evidence that considerably more than 33 % of WEEE is collected but not reported, and that a substantial part of this undergoes sub-standard

Figure 3.6 **WEEE put on the market, collected and recycled/recovered/reused in 27 European countries (kg/person), all figures relate to 2008**



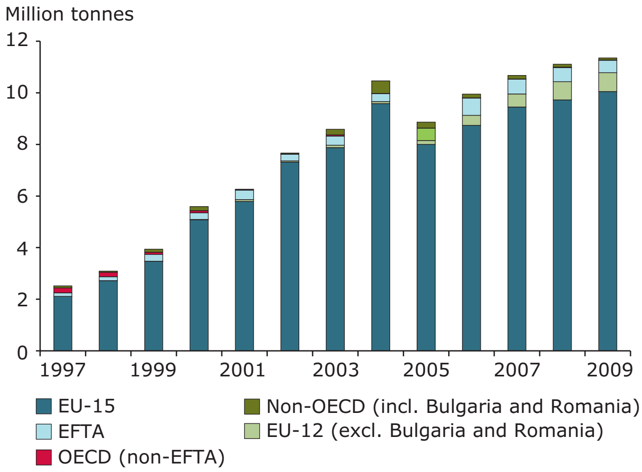
Source: Compiled by ETC/SCP based data from Eurostat data centre on waste, 2012.

treatment in the EU or is illegally exported. This non-reported collection and trade is driven by the material value of some WEEE fractions (EC, 2008b). However, where WEEE is collected separately, it is widely recycled: 21 countries achieved a reuse and recycling rate above 80 % and 3 others were in the 50-80 % range (Figure 3.6).

Transboundary shipments of waste

Waste is increasingly shipped across national borders. The vast majority of it that has to be notified (2) — because it is hazardous or has the potential to cause environmental damage — is shipped to other EU countries, a small part to other OECD countries and a limited amount (1–3 %) to non-OECD countries (see Figure 3.7). The reduction in 2005 is due mainly to reduced waste exports from the Netherlands (3). Around 80 % of the waste is exported for recycling and recovery, including energy recovery. Apparently, the EU is increasingly acting as a single market in relation to the treatment of hazardous and problematic waste. Waste from waste treatment operations, such as flue gas cleaning residues from waste incineration, contaminated wood from mechanical sorting,

Figure 3.7 **Shipments of notified waste from EU Member States to other EU and non-EU countries, 1997–2009**



Note: The 1997 and 1998 figures do not include export from EU-12.

Source: EEA, 2009a, Eurostat data centre on waste, 2011.

(2) Notification is a formal procedure where competent authorities have to be supplied with details of waste shipments before they take place. Shipments of hazardous waste, and some other wastes that have the potential to cause environmental damage, have to be notified according to EU Regulation No. 1013/2006, before 12 July 2007 to EU Regulation No 259/93.

(3) The reduction relates mainly to household waste, waste incineration residues and unclassified waste from the Netherlands. One important factor might be the enforcement of the landfill ban in Germany since Germany received considerable amounts of this type of waste from the Netherlands in 2004 and before, but not since 2005.

and also construction and demolition waste, account for a significant part of the exported waste, indicating that the increase in shipments is at least partly driven by the introduction of environmental requirements in the EU.

Relevant drivers for the shipments can be differences in prices and taxes for treatment or disposal, or lack of specialised treatment capacities. However, illegal shipments are an important concern in the EU, with an increase in the number of cases reported between 2001 and 2005 (EEA, 2009a). During inspection projects carried out in several Member States in 2008 and 2009, around 19 % of the inspected shipments turned out to be in violation of the waste shipment rules. These violations can be illegal shipments or shipments where the papers accompanying the shipment are not correct. In around half of these cases, the country of destination was an EU-15 Member State, and nearly half was intended to be sent to countries in Asia and Africa which often do not have proper waste treatment facilities. The most frequent waste types shipped in violation with the rules were paper and cardboard, plastic, metal waste and WEEE (ESWI, 2009).

3.2 Environmental pressures and impacts from waste

Waste collection, treatment and disposal of waste cause environmental pressures such as greenhouse gases (GHG) and other air pollutant emissions and emissions to water and soil, and threatens biodiversity through littering (see Box 3.2). Environmental impacts of waste depend largely on the amount and characteristics of the waste as well as its management. For example, life-cycle analyses have shown that recycling has overall environmental benefits over landfilling for many waste types (WRAP, 2010). In addition to direct impacts from waste management, generation of waste is generally a sign of a waste of resources, with the associated environmental impacts of resource extraction and use (see Section 2.2).

The growing amount of waste generated therefore indicates growing impacts from waste, whereas the noted progress towards more recycling and recovery across Europe (see Section 3.1) indicates a decrease of environmental impacts. Some waste streams, such as hazardous wastes, WEEE and biodegradable waste, have potentially high environmental impacts compared to other types, especially if poorly managed. A study which monetised the environmental impacts of GHG emissions and some other emissions to air per waste stream and treatment option found the highest specific impact per kilogram of waste for landfilling and incineration of food waste, conventional storage of manure, landfill of construction waste and incineration of plastic waste (Schmidt, 2010). However, the inclusion of other pressures such as hazardous substances might change this picture. An overall quantified assessment of a broader number of environmental impacts across all waste streams in Europe does not exist. The following assessment, therefore, looks at the development using municipal waste, WEEE and landfilling as examples.

The shift from landfill to more recycling and recovery that has taken place in many countries for a number of waste streams in the last 10–15 years has clearly reduced the pressures of waste on the environment. According to national reporting to the United Nations Framework Convention on Climate Change (UNFCCC), GHG emissions from the waste sector — mainly landfills and waste incineration without energy recovery — in the EU-27 plus Norway and Switzerland fell by 37 % between 1995 and 2008, due mainly to reduced methane emissions from landfills (EEA, 2010c). If a wider perspective is taken,

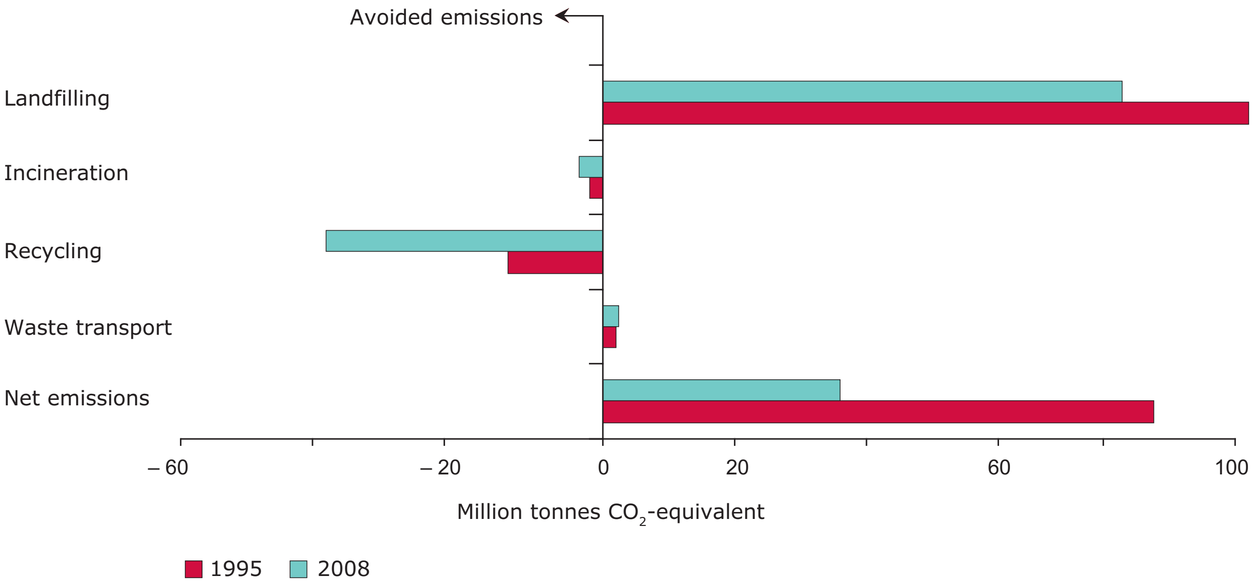
Box 3.2 Marine litter

Marine litter poses a threat to marine wildlife in all European seas (Ospar, 2007; OSPAR, 2009; HELCOM/UNEP/ RSP, 2007; BSC, 2007; UNEP/MAP, 2009). It consists of slowly degrading materials such as plastic fragments, plastic bags, plastic and glass bottles, metal and glass fragments and fishing gear. Marine litter, washed up on beaches, floating or polluting the sea floor, has a wide range of impacts on marine life ranging from entanglement and ingestion of litter to the dispersion of invasive species. Plastic changes into small, microscopic particles which are widely distributed in the world's oceans, causing further damage to ecosystems (Thompson et al., 2004; Mato et al., 2001; Takada, 2006; Vliestra and Parga, 2002; OSPAR 2009). Marine litter also significantly affects the economies and health of inhabitants of coastal communities. Serious public health issues are associated with hazardous materials, medical wastes, syringes, glass and other sharp and/or dangerous debris washed-up on beaches.

The situation hardly changed in the period of 2001–2006 as regards the average number of marine litter items found in the North-East Atlantic and the Baltic Sea. (Ospar, 2007, 2009; HELCOM/UNEP/RSP, 2007), and the same applies to the Mediterranean Sea between 2002 and 2006 (UNEP/MAP, 2009).

According to a general overview prepared by UNEP (2005), the main land-based sources of marine litter are storm water flows from urban areas and tourist activities, riverine loads of waste and in some areas also direct discharges of municipal or industrial sewage and from municipal landfills located in coastal areas. The main sea-based sources are commercial shipping, fishing vessels, pleasure craft, offshore oil and gas platforms and aquaculture.

Figure 3.8 Emissions from municipal waste management in the EU-27, excluding Cyprus, plus Norway and Switzerland, 1995 and 2008, CO_2-equivalents



Source: ETC/SCP, 2011.

which includes the GHG emissions avoided by replacing virgin materials with recycled materials and by using recovered waste instead of fossil fuels for energy supply, the environmental benefits of better waste management are even higher.

Considering municipal waste only, around 9 % of total waste, the net emissions from landfills, incineration, recycling and waste transport, including the emissions avoided in the production of virgin materials and energy supply sectors through recycling and energy recovery, are estimated to have been cut by 57 % between 1995 and 2008 (see Figure 3.8). A study conducted in Germany for 1990–2005 (IFEU, 2005) found similar results for other impact categories such as acidification, eutrophication, toxicity to humans and the use of fossil and mineral resources.

Environmental and health impacts also result from bad management of WEEE where hazardous substances are not captured, for example CFCs from fridges and freezers released instead of collected, and from a lack of or inefficient recovery of valuable materials. Whereas recycling in the EU has to comply with the treatment requirements of the WEEE Directive, the same standards are not applied in case of illegal export of WEEE to non-OECD countries, or if appliances are exported as second-hand goods. During an inspection project in 2008–2009, around one quarter of all violations of the Waste Shipment Regulation were connected with WEEE (ESWI, 2009). EU trade statistics give an indication of exports of used electric and electronic goods. For example, in 2005, more than 15 000 tonnes (522 000 units) of colour television sets and more than 5 000 tonnes of refrigerators, freezers or compressors were exported to African countries at relatively low unit prices (EEA, 2009a). Although these appliances are usually exported as used goods and some of them are repaired or reused, the low unit prices indicate that a large part is actually not usable or only used for extracting spare parts in the importing countries, and is in fact WEEE which is then used to extract valuable materials and finally disposed of. There is evidence that this dismantling and recovering valuable materials as well as the disposal in developing countries often takes place under devastating conditions for human health and the environment (Greenpeace, 2008; UNEP, 2009; Pwamang, 2009; Benebo, 2009).

But even when functioning second-hand electrical and electronic appliances are legally exported to non-OECD countries and used there for a while, the appliances may eventually threaten the health of people and the environment in these countries when they turn into waste. In addition, valuable resources including precious metals are lost to the European economy if the WEEE is treated with inefficient recovery methods.

Sub-standard landfills

Sub-standard landfills and dumpsites, but also closed but not remediated landfills, pose an environmental threat. More than 3 300 landfills in EU Member States were closed between 2004 and 2006 (calculated from data reported by EU Member States, Ecologic and IEEP, 2009). However, countries also reported a large number of landfills that did not comply with the requirements of the EU Landfill Directive and thus still have to be closed or upgraded. Many landfills were constructed without proper measures to reduce their potentially negative environmental impacts and have had to be closed or upgraded in order to comply with the minimum requirements of the EU Landfill Directive (see the SOER 2010 soil assessment (EEA, 2010n)). The European Commission has identified systemic failures in the implementation of the Landfill Directive, with 13 non-conformity cases and 11 bad application cases in 2009 as well as a large number of complaints related to illegal landfills and the failure of many Member States to improve the situation. Given these deficiencies in implementation, there is a high risk that 'a vast majority of Member States will not meet the deadline of 16 July 2009 by which all sub-standard landfills that existed before the introduction of the Directive need to comply with its requirements' (EC, 2009a) ([4]).

3.3 Outlooks

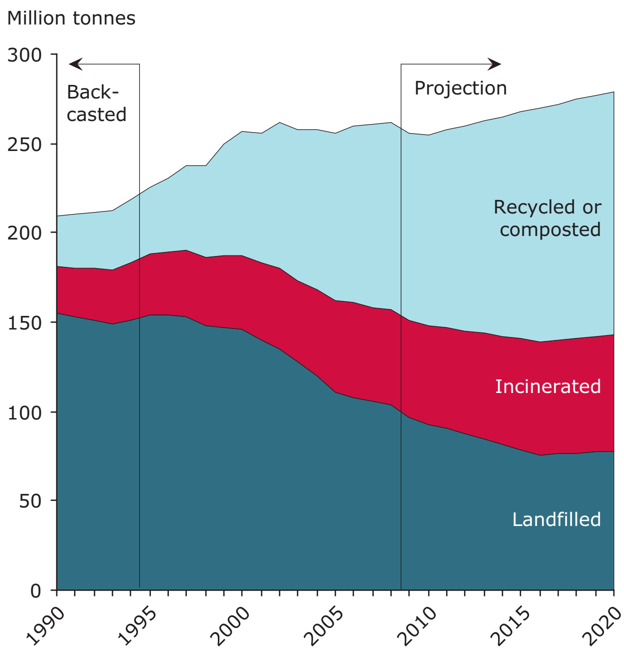
The development of waste generation in the EU depends largely on economic development, consumption, structural changes and resource efficiency, especially in the industrial production, construction and demolition and mining and quarrying sectors which together account for 70 % of all waste generated. On a global scale, waste generation can be expected to grow along with the expected growth in resource use (see Chapter 2). The share of recycling and energy recovery in waste management can be expected to increase due to several recently introduced new recycling and recovery targets in European legislation. It has been estimated that **total waste** generation in the EU-27 will increase by 60–84 % between 2003 and 2035, based on different macroeconomic scenarios — but these do not take into account the current economic downturn (Schmidt, 2010). In the same study, improvement potentials to reduce environmental impacts of waste were modeled. Within a recycling scenario, assuming the introduction of strong policies to extending recycling, the largest potentials were found for the recycling of plastic, iron, aluminium and glass waste. Within a treatment scenario, assuming optimisation of waste treatment, the largest potentials were identified for bio-gasification and the incineration of food waste, and bio-gasification of manure. For the identified waste prevention potentials see Box 4.2 in Chapter 4.

Generation of **WEEE** is estimated to increase by roughly 11 % between 2008 and 2014 across the EU-27, Norway and Switzerland, mainly due to rapid technological advancement accompanied by reduced prices (see also EEA, 2010d). This projection has been based, inter alia, on the correlation between economic growth and WEEE generation, the world economic outlook of the International Monetary Fund (IMF) taking into account the effects of the economic crisis, and IMF projections for population development (UNU et al., 2007; Huisman, 2010).

Municipal waste

Outlook models for municipal waste can be based on historical trends and correlations between municipal waste generation and influencing factors such as household consumption, number of people per household and population development (see also EEA, 2010d). According to a model developed by the EEA and its European Topic Centre on Sustainable Consumption and Production, municipal waste generation can be expected to grow to around 280 million tonnes in 2020 in the EU 27 (excluding Cyprus), plus Norway and Switzerland, 7 % above 2008 levels (ETC/SCP, 2011) (Figure 3.9). This scenario uses projections of economic

Figure 3.9 Trends and outlook for management of municipal waste in the EU-27 (excluding Cyprus) plus Norway and Switzerland, baseline scenario

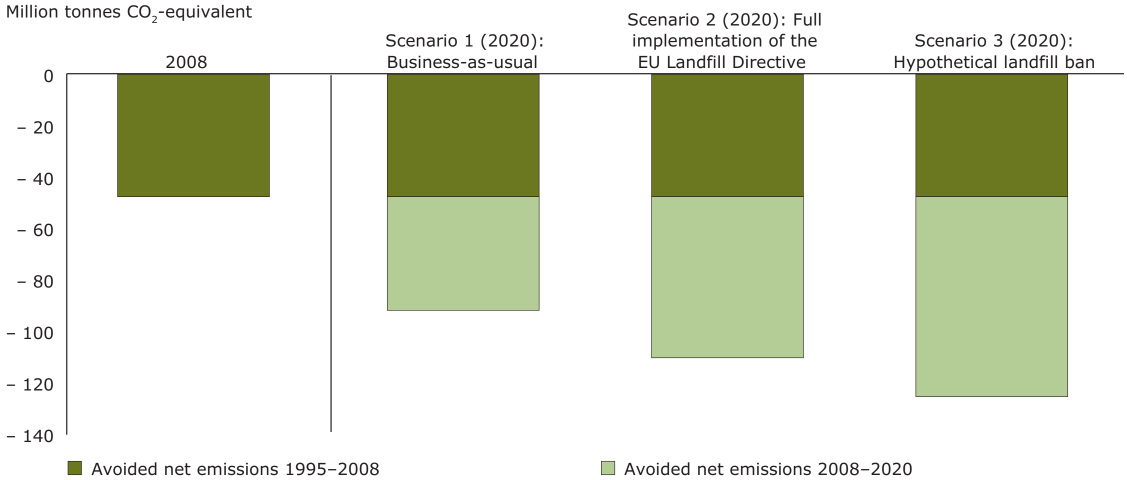


Notes: 1) In case of a difference between generated municipal waste and amounts reported as landfilled, incinerated, recycled/composted, the difference has been distributed proportionally to the three management options;
2) The projection of municipal waste generation assumes a fall in GDP in 2008–2010, and a gradual recovery to 2 % annual growth until 2020.

Source: ETC/SCP, 2011a.

([4]) Data on the implementation situation in 2009 was not available before the publication of this report.

Figure 3.10 **GHG emissions avoided due to better management of municipal waste in the EU-27, excluding Cyprus, plus Norway and Switzerland**



Source: EEA, 2011c.

development, taking into account the economic downturn of 2008/2009, as used by the European Commission for the modelling of GHG emissions scenarios (EC, 2010b), and the uncertainty in the economic projections also introduces uncertainties in the projection of municipal waste generation. This scenario does not take into account any specific policies on waste prevention. If the historic trends in the development of the shares of recycling and composting, incineration and landfill are used to project waste management until 2020, recycling of municipal waste would increase from 40 % in 2008 to 49 %, while landfill would stabilise at around 28 %. However, full implementation of current EU waste policies, especially the EU Landfill Directive, across the EU could reduce landfilled quantities further, but requires additional implementation activities in a number of Member States.

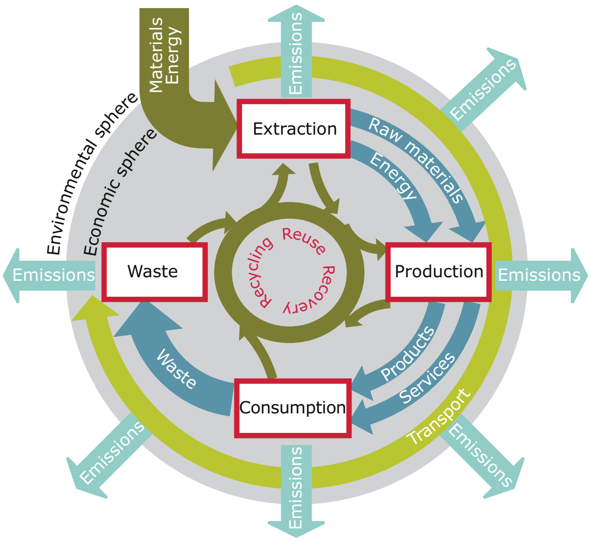
Improving the management of municipal waste would result in saving around 44 million tonnes of CO_2 equivalent in 2020 compared with 2008, if the indirect benefits of increased recycling and recovery are included (see Figure 3.10; EEA, 2011c). In a scenario where all countries would comply fully with the Landfill Directive's targets to divert biodegradable municipal waste from landfill, this potential saving would rise to 62 million tonnes. A hypothetical ban on landfilling biodegradable municipal waste would enhance this further to 77 million tonnes, showing the substantial co-benefits for climate change mitigation of a good implementation of the EU Landfill Directive. For comparison, this potential is of the same order of magnitude as the reduction expected in the EU-27 Member States through the implementation of the Directive on the Energy Performance of Buildings in 2020 compared to 1990 (EEA, 2009c).

4 Policies and responses

All stages of the life-cycle chain (see Figure 4.1) offer opportunities to improve resource efficiency, reduce waste generation, reduce emissions and close the material loops in the economy. They are also interrelated, changes in one stage of the life-cycle often have effects on other stages — for example, more recycling or better resource efficiency in production can reduce the demand for extraction of raw materials and decrease energy-related GHG emissions.

Globally, the sustainable use of resources gained prominence as part of the 2002 Johannesburg World Summit on Sustainable Development (WSSD). In 2007, in a joint initiative between the EU and the United Nations Environment Programme (UNEP), an International Panel for Sustainable Resource Management was set up to provide independent scientific assessments of the environmental impacts of the use of resources over their full life cycle, and advise governments and organisations on ways of reducing these.

Figure 4.1 Life-cycle chain: extraction – production – consumption – waste



Source: EEA-ETC/SCP.

4.1 Resource use and waste in recent key EU policy documents.

The sustainable use of natural resources and management of waste, with an emphasis on prevention and recycling, have moved up the EU environmental policy agenda in recent years and, under the heading of 'resource efficiency', has gained prominence on the economic policy agenda as well. Among operational objectives and targets in the area of conservation and management of natural resources, the revised 2006 EU Sustainable Development Strategy identified:

- '... Improving resource efficiency to reduce the overall use of non-renewable natural resources and the related environmental impacts of raw materials use, thereby using renewable natural resources at a rate that does not exceed their regeneration capacity.
- Gaining and maintaining a competitive advantage by improving resource efficiency, inter alia through the promotion of eco-efficient innovations.
- Improving management and avoiding over-exploitation of renewable natural resources such as fisheries, biodiversity, water, air, soil and atmosphere (...).
- Avoiding the generation of waste and enhancing efficient use of natural resources by applying the concept of life-cycle thinking and promoting reuse and recycling.'

The 6EAP represents the environmental dimension of the EU's Sustainable Development Strategy. Reviewed in 2007, it sets natural resources and waste as one of four environmental priorities. 6EAP aims to achieve '... better resource efficiency and improved resource and waste management, to help bring about more sustainable patterns of production and consumption, thereby decoupling the use of resources and the generation of waste from the rate of economic growth ... ' acknowledging that the EU's '... social and economic development must take place within the carrying capacity of ecosystems. The amount of waste continues to grow and the inability to break the link between economic growth and the environmental impacts of resource use, consumption and waste remains an essential concern'. The 6EAP aims '... to decouple economic growth from environmental degradation' with a view to:

- 'making the EU the most resource-efficient economy in the world;
- 'achieving a significant overall reduction in the volumes of waste generated (…);
- 'a significant reduction in the quantity of waste going to disposal and the volumes of hazardous waste produced(…); and
- 'encouraging re-use and for wastes that are still generated: the level of their hazardousness should be reduced and they should present as little risk as possible; preference should be given to recovery and especially to recycling (…)'.

With the European Commission's resource efficiency flagship initiative (EC, 2011c) and the European Commission's Communication on a Roadmap to a resource efficient Europe (EC, 2011a), the focus is expanding to cover a wider range of resources. These resources include raw materials such as fuels, minerals and metals as well as food, soil, water, air, biomass, biodiversity and ecosystems. In other words, this is a broad definition of resources that includes renewable and non-renewable resources as well as ecosystems structures, functions and services. Together they form the natural capital underpinning the functioning of European and global economies and our quality of life.

In this context, the term 'resource efficiency' denotes a political goal of: 'allowing the economy to create more with less, delivering greater value with less input, using resources in a sustainable way and minimising their impacts on the environment' (EC, 2011a).

In economic terms resource efficiency is about creating more outputs with fewer inputs. In ecological terms it could be understood as using resources in a sustainable way that maintains ecosystem structures and functions. In social terms, it could be translated into minimising the impacts of resource use on people's health, enabling equitable access to resources and sharing the benefits of their use for wealth, welfare and quality of life.

Such broader definitions move far beyond the limited economic definition of resource efficiency. They challenge existing terminology and analytical tools when considering objectives, targets and indicators that address the different domains, the dynamics between them and the spill-overs, synergies and trade-offs in play when designing coherent policies.

In the area of waste, the Roadmap aims to turn waste into a resource including the following ambitious objectives:

- '…Waste generated per capita is in absolute decline.
- Recycling and re-use of waste are economically attractive options for public and private actors due to widespread separate collection and the development of functional markets for secondary raw materials.
- More materials, including materials having a significant impact on the environment and critical raw materials, are recycled.
- Waste legislation is fully implemented.
- Illegal shipments of waste have been eradicated.
- Energy recovery is limited to non recyclable materials, landfilling is virtually eliminated and high quality recycling is ensured.'

Are we decoupling environmental impacts from economic growth?

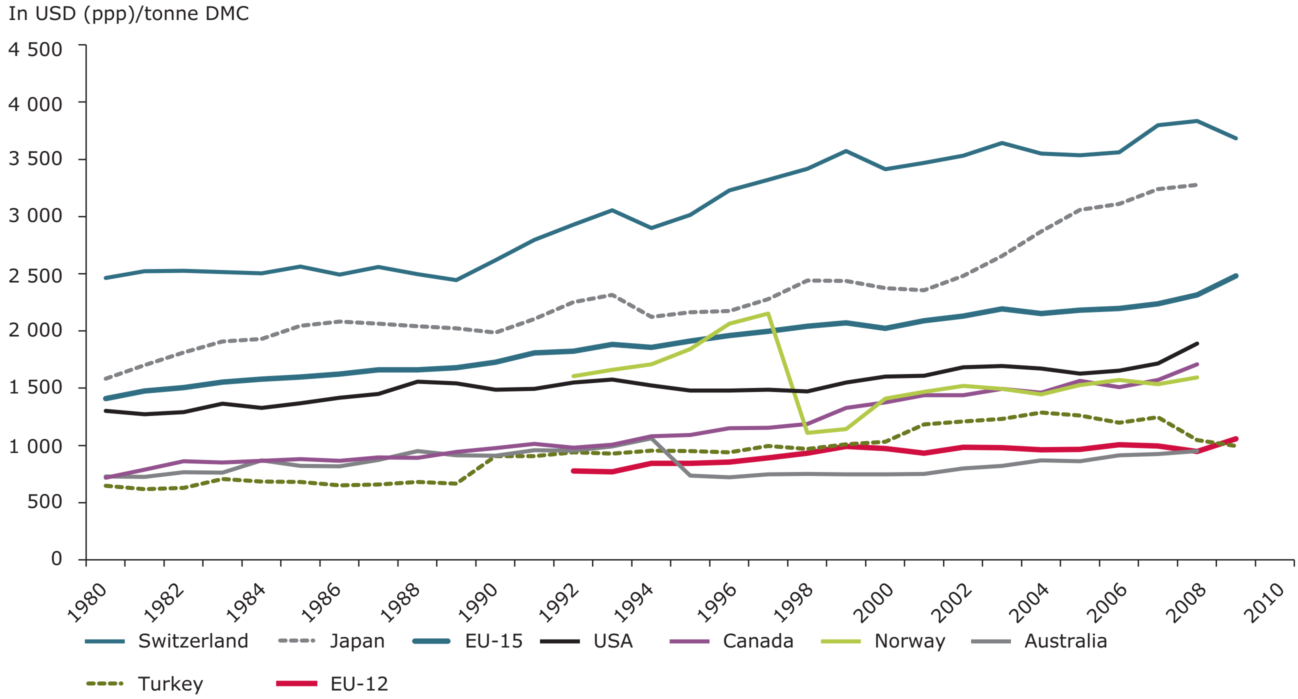
There is no clear-cut answer to this policy goal. First of all, a decoupling is in fact two decouplings — between resource use and economic growth and between resource use and environmental impacts (see Box 2.2). Concerning the former, there have been steady improvements in resource productivity over recent decades, and the EU economy has grown faster than the use of resources (see Figure 2.3). A relative decoupling between economic growth and resource use has thus been achieved for the EU as a whole. However, there have been strongly diverging trends in individual countries. In some, such as Germany, Hungary, Italy, the Netherlands or the United Kingdom, a fairly strong decoupling has occurred reflecting a clear long-term trend of decreasing consumption of material resources. In contrast, in countries including Austria, Cyprus, Estonia and Romania, the opposite has been the case — their use of resources has risen and material productivity declined.

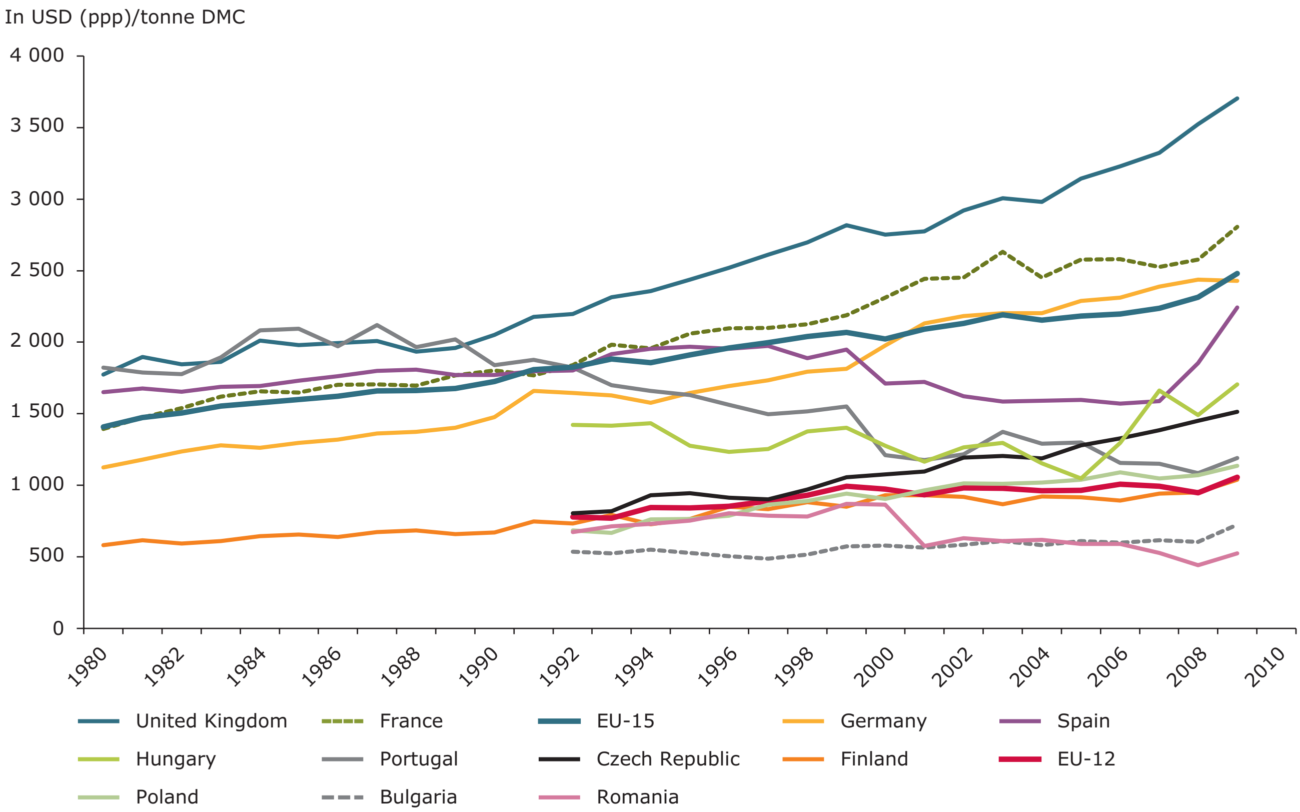
With respect to the latter decoupling, between resource use and environmental impacts, there are as yet no operational methods for quantifying the environmental impacts of resource use. It is therefore not possible to conclude whether environmental impacts and environmental degradation related to the growing use of resources are increasing or declining. Conventional wisdom assumes that the more resources are used, the higher the impacts, although the validity of this statement has been hotly debated in some quarters.

Is the EU becoming the most resource-efficient economy in the world?

Although there have been some long-term improvements in how efficiently the EU uses natural resources (see Chapter 2), there are no signs that it has become 'the most resource efficient economy in the world'. Figure 4.2 first contrasts trends in material productivity for the EU-15 and EU-12 with several other industrialised countries, and then compares 11 selected EU Member States — the remaining 16 EU Member States not shown on the graph fall somewhere between the trend lines for the United Kingdom and Romania.

Figure 4.2 Long-term trends in material productivity 1980(1992)-2009





Source: Top figure: GDP data from The Conference Board — Total Economy Database,- 2012, www.conference-board.org/data/economydatabase/; DMC data for 1980–1999 (EU-15): IFF database; DMC data for 1992–1999 (EU-12 and Norway): WI database; DMC data for 2000–2009 (EU-15, EU-12 and Norway): Eurostat; DMC data for other countries: OECD. Bottom figure: GDP data from The Conference Board – Total Economy Database, 2012, www.conference-board.org/data/economydatabase/; DMC data for 1980–1999 (EU-15 and EU-15 countries): IFF database; DMC data for 1992–1999 (EU-12, EU-12 countries and Norway): WI database; DMC data for 2000–2009 (EU Member States and Norway): Eurostat.

Box 4.1 Waste prevention potentials

Massmann, et al. (2009) have assessed waste prevention potentials in Europe. Their scenario assumes an ambitious policy framework favouring waste prevention at the EU and national levels, including, for example, a shift from income taxes to consumption taxes or the extension of producer responsibility. Assuming additional measures directed at specific waste streams, the highest waste-prevention potentials were estimated for:

- manure and food waste by reducing meat consumption;
- food and vegetable waste by better planning and logistics in the food industry;
- beverage packages by better packaging design;
- construction and demolition waste by better planning of construction activities, extended use of off-site construction methods and an extension of the lifetime of buildings;
- paper waste by reducing unwanted advertising;
- waste from chemical products and refined chemical products by reduced fuel consumption of cars;
- waste from metal products by more efficient use and eco-design; and
- waste from vehicles, equipment, machines and instruments by technological innovation.

During the period 1980–2009, material productivity in the EU was consistently lower than in Switzerland and Japan. There was also a notable disparity between the EU-15 and the EU-12, with the material productivity in the latter group lagging behind Australia, Canada and USA. Furthermore, there was a very wide spread within the EU itself, with one order of magnitude difference in material productivity between the United Kingdom, which was even ahead of Bulgaria, Japan, Romania and Switzerland.

Waste prevention: rhetoric or reality?

The trends for waste generation show that the objectives of the 6th EAP to substantially reduce the generation of waste, including hazardous waste, have not yet been achieved. Depending on the waste stream analysed, waste generation is stabilising or increasing, albeit not as much as GDP. It remains to be seen if the recent decline in waste generation for some waste streams will continue. But this overall picture does not reveal any specific developments, for example whether products are being produced with less waste per unit. This type of indicator would require detailed and high quality data that is not currently available. In addition, the amount of waste generated is only a very rough indicator of its environmental impact.

Recently, waste prevention has received more emphasis at the EU, national and regional levels: the revised Waste Framework Directive requires the European Commission to come up with proposals for measures to support waste prevention in 2011. Member States have to establish waste prevention programmes by December 2013, and the Commission has to submit waste prevention and decoupling objectives for 2020 by 2014.

Current initiatives at the national and regional levels can be summarised as follows (based on ETC/SCP, 2010):

- many waste prevention initiatives are regional or local and address businesses and/or households, including behaviour;
- waste prevention is often embedded in broader initiatives to reduce environmental pressures, for example the initiatives that aim, simultaneously,

Box 4.2 Product design that could change the production–consumption–waste chain

Product design plays a crucial role in the amount and type of waste generated. Products can be designed so that they can be repaired, re-filled or re-used. The type and combination of materials and hazardous substances used is crucial for the recyclability of a product.

Currently the incentives for product designers and manufacturers to design products that are long lasting, repairable, refillable, and easily recyclable are weak. These need to be enhanced and new business models developed that make these types of products, services and product-service-systems attractive and economically viable. The EU Eco-design (2009/125/EC) sets a framework for specifying eco-design principles and requirements for energy-related products, including design principles related to resource use and waste. Yet the focus in implementation so far is clearly on energy aspects. The EU Ecolabel is another instrument to guide design towards more resource-efficiency but it has had only limited influence on the overall market.

There are many concepts for better design, including the cradle-to-cradle concept which requires the use either of non-toxic, non-harmful synthetic materials that have no negative effects on the natural environment and can be used in continuous cycles as the same product without losing their integrity or quality, or of organic materials that, once used, can be disposed of without negative environmental impacts (Braungart and McDonough, 2002).

to reduce water and energy consumption, improve material efficiency and prevent waste;
- many initiatives focus on food and biodegradable waste, paper waste and WEEE;
- many initiatives are related to small and medium-sized enterprises; and
- many internet-based tools are being developed.

Waste prevention also includes reducing the hazardousness of waste. But the amount of hazardous waste is still increasing, although changes in classification might have influenced this. Directive 2002/95/EC on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS Directive) specifically aims at reducing the hazardousness of products and wastes. WEEE is thus expected to become less hazardous in future (ARCADIS ECOLAS and RPA, 2008). But the approach of banning dangerous substances in certain products does not give incentives for further reducing the hazardousness of products and wastes beyond the banned substances.

Generally, waste prevention requires changes in production, better design of products, and changing consumption patterns (see EEA, 2010d). Policies for waste prevention, therefore have to be integrated into many other policy areas (see Box 4.2).

Is Europe becoming a recycling society?

Both the European Thematic Strategy on the Prevention and Recycling of Waste and the revised Waste Framework Directive formulate the aim of the EU becoming a recycling society. This is reinforced by the 2011 Roadmap to a resource-efficient Europe, calling for virtual elimination of landfilling and limiting energy recovery to non-recyclable waste. Together with Member State initiatives, EU policies have acted as strong drivers of more recycling, as described in the previous sections. Between 1993 and 2008, targets for the separate collection, recycling and recovery of several waste streams have been introduced through EU Directives (see Table 4.1). According to the Roadmap, these targets will be reviewed in 2014.

Table 4.1 Overview of specific targets for waste management in EU Directives

	Directive	Year	Recovery targets	Recycling targets	Collection targets
Packaging waste	1994/62/EC	2008	60 %	55 %	
Tyres	1999/31/EC	2006	Zero landfill of tyres		
Landfill of biodegradable municipal waste	1999/31/EC	2006	Reduction to 75 % of the amount generated in 1995		
		2009	Reduction to 50 % of the amount generated in 1995		
		2016	Reduction to 35 % of the amount generated in 1995		
End-of-Life Vehicles (ELV)	2000/53/EC	2006	85 % incl. reuse	80 % incl. reuse	100 %
		2015	95 % incl. reuse	85 % incl. reuse	100 %
Waste Electrical and Electronic Equipment (WEEE)	2002/96/EC	2006	70–80 % (differs according to WEEE categories)	50–80 % incl. reuse (differs according to WEEE categories)	Min. 4 kg per inhabitant per year
Batteries and accumulators	2006/66/EC	2012			25 %
		2016			45 %
Batteries and accumulators		2011		50–75 % efficiency (differs according to battery type)	
Paper, metal, plastic, glass waste	2008/98/EC	2015			Separate collection of at least paper, metal, plastic, glass
Waste from households and possibly from other origins	2008/98/EC	2020		50 % of materials such as at least paper, metal, plastic and glass (incl. reuse)	
Construction and demolition waste (excl. soil and stones)	2008/98/EC	2020	70 % (incl. reuse)		

Notes: All targets apply per country. Some EU Member States have derogation periods for a number of the targets. The targets have been simplified for the purpose of giving an overview. Exact dates, waste types addressed, etc. are given in the respective directives.

Source: EU directives as specified in the table.

For some materials, especially from industrial sources, recycling is driven by market forces. Until now, the EU has used mainly regulatory instruments to promote recycling and recovery, and economic instruments such as taxes on landfill or waste incineration, product charges or trade of recycling quota are used in a number of countries at the national or regional levels to support the diversion of wastes from disposal to recycling and recovery.

The EU waste directives set quantified recycling targets for approximately 47 % of the around 3 billion tonnes of waste generated annually in the EU Member States plus Norway, and at the moment about 50 % of the targeted wastes are recycled (see Table 4.2). The large differences in recycling levels between countries, as shown in the previous sections, indicate that there is considerable room for improvement beyond these targets if Europe wants to become a recycling society.

Recycling already covers a reasonably large share of EU consumption of certain materials, especially paper and cardboard, and iron and steel. The share of recycled materials in consumed materials could increase substantially if recycling infrastructure and collection rates improve (Figure 4.3; EEA, 2011d).

Generally, recycling works best if a market for the recycled materials exists or can be created. Recycling had been favoured by rising prices for many secondary and primary materials in recent years (see Figures 1.3 and 1.4). Recycling markets suffered during the economic crisis but seem now to be recovering.

In addition, the EU Landfill Directive, with its targets to divert biodegradable municipal waste from landfill, has been effective in increasing the use of alternative waste management options, as shown in an in-depth EEA analysis of five countries and one region (EEA, 2009b): in accordance with the provisions of the Landfill Directive, the cost of landfill in the countries/regions examined has increased considerably; four out of six countries/regions also use landfill taxes to discourage landfill; and rising gate fees generally support the diversion of waste from landfill. The Landfill Directive's approach for reducing biodegradable municipal waste going to landfill, with its combination of long-term and intermediate targets, seems to be working. However, full implementation of the diversion targets remains a challenge for many countries.

Currently, all recycling targets are related only to the amounts of recycled waste. But in reality, recycling often means down-cycling, that is the recycled materials have a lower quality than the virgin materials and thus can not fully replace them. Future policies need to improve not only the quantity of waste recycled but also the quality in order to further reduce the environmental impacts of

Table 4.2 Recycled amounts in the EU-27 Member States plus Norway in 2006/2007 related to EU directives, which include binding recycling/recovery targets

	Generation	Recycling + reuse currently achieved ([e])	Estimated reuse+recycling rate ([f])
	Million tonnes	Million tonnes	
Packaging waste (2007)	82.5	48.3	59 %
End-of-life vehicles (2007) ([a])	6.1	5.0	82 %
Waste electric and electronic equipment (2006) ([b])	6.7	1.5	23 %
Municipal waste (2007)	262.3	101.5	39 %
Construction and demolition waste including soil (2006) ([c])	971	518	53 %
Total waste targeted with EU recycling targets (2006)	1 329	675	51 %
Estimated total waste in the EU, without waste from waste treatment operations ([d])	2 803	1 062	38 %

Notes: ([a]) Arising and treated at authorised treatment facilities. Slovenia is included with 2006 data. 4.51 million tonnes are recycled and 0.51 million tonnes are reused.

([b]) WEEE generation figure covers amount put on the market, as generated amount is not known. Twenty-two countries have reported and 18 countries have reported recycling and reuse of WEEE.

([c]) The recycling amounts include material recovery and backfilling operations. Soil is also included but excluded in the new recycling target for construction and demolition waste of 70 % by 2020. Data about recycling of construction and demolition waste have been found for 18 countries.

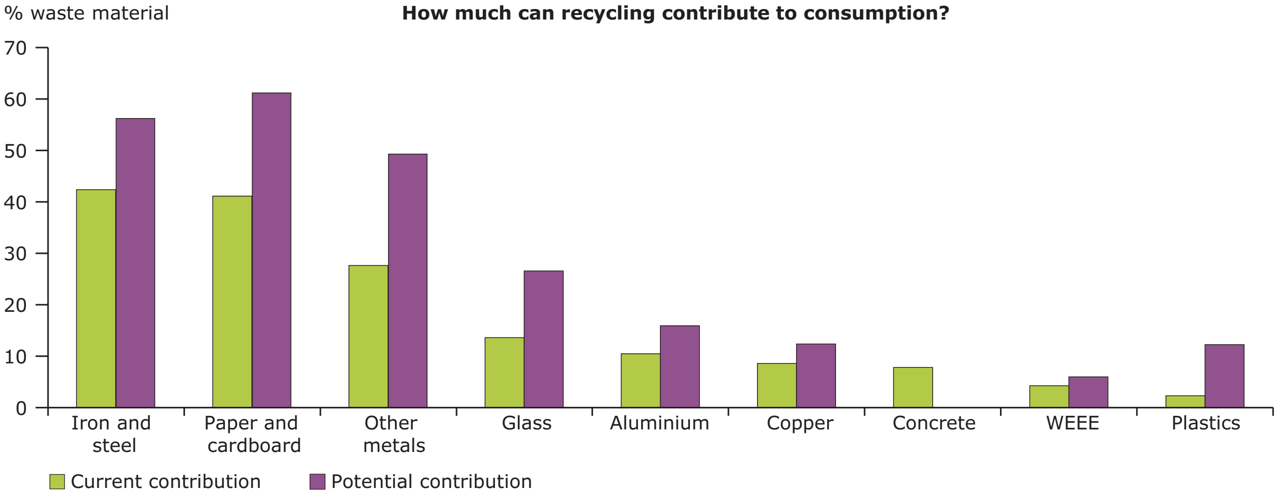
([d]) In order to avoid double counting, the amount is calculated by using the total generated waste amount according to Eurostat less the waste generated by waste management facilities. Recycling is calculated as the difference between waste recovered and waste incinerated with energy recovery.

([e]) Reused waste included only for ELV and WEEE.

([f]) The achieved recycling rates for WEEE, MSW and construction and demolition waste cannot be directly compared to the recycling targets in Table 4.1 as they are partly calculated differently than required by the respective directives.

Source: Calculated by ETC/SCP, based on data from Eurostat Data Centre on waste, March 2010 and ETC/SCP, 2009a.

Figure 4.3 Recycling's current and potential contribution (*) to meeting EU demand for various materials, 2006



Notes: The calculation of EU consumption is described in detail in ETC/SCP, 2011. The reference year for concrete is 2004. (*) The current and potential contribution figures are both based on the infrastructure available in 2006. Future changes in collection rates, improved recycling structures and market conditions could significantly influence the potential contribution figures.

Source: Eurostat data centre on waste, 2011; Eurostat, 2010, Prognos, 2009.

waste. Development of quality standards for recycled materials where these are not yet available, eco-design of products that improves recyclability, and detoxification of products can all play roles in moving closer to this aim. The European Commission's *International Reference Life-Cycle Data System Handbook* and the European Reference Life-Cycle Database (JRC, 2010) are tools that could help monitor progress in this respect.

Recently, leakage of valuable resources through exports of end-of life or second-hand products has been noted as an important enviro-economic problem, especially for cars and electric and electronic appliances (see Box 4.3 and Section 3.1), and this problem is now increasingly also recognised as a threat to the supply of Europe with critical metals. Critical metals are characterised by supply risks combined with high economic importance (Ad-hoc Working Group on defining critical raw materials, 2010).

Experience with the implementation of the WEEE Directive — especially low collection rates compared with the number of products sold and the leaking of WEEE to low-standard treatment within Europe or through exports — have been addressed in the recast of the Directive. The new Directive, voted by the European Parliament in January 2012 and expected to be considered by the European Council later in 2012, foresees a collection target, to be met by 2016, of 45 % of those e-goods placed on the market in the three preceding years. This target will rise to 65 % by 2019, or 85 % of WEEE generated. Ten countries will get derogations, meaning a lower target and more time to comply. In order to combat illegal exports of WEEE

Box 4.3 Diffuse loss of the platinum group of metals due to export of used cars

Export of second-hand goods and subsequent unsuitable waste treatment in the receiving countries can result not only in environmental and health impacts in the importing countries, but also in a considerable loss of resources. Hagelüken et al. (2005) have estimated that about 6.25 tonnes of the platinum group metals are exported annually from Germany in the catalytic converters of used cars. This amount is equal to about 30 % of all the platinum group metals used for production in the country. Although most exports are to EU Member States, some 100 000 used cars are exported annually through Hamburg to destinations outside the EU, mainly to destinations in Africa and the Middle East. Whereas the EU Directive on end-of-life vehicles requires the dismantling of vehicles scrapped in the EU and the recycling of catalytic converters which contain considerable amounts of the platinum group metals, it is likely that these are lost when the cars are exported to countries that lack the necessary regulations and recycling capacities (Buchert et al., 2007). Production of the platinum group metals results in high pressures on the environment — often outside the EU — which could be reduced considerably if these metals were recycled.

disguised as used goods, the burden of proof will be reversed. Exporters will have to document that exported e-goods are shipped for repair or reuse (European Parliament, 2012). However, initiatives to develop environmentally sound WEEE treatment in developing countries are also necessary. Giving full responsibility for this to the producers of electric and electronic goods that does not end at the borders of the EU might help to prevent sub-standard treatment and enhance recycling of precious materials contained in WEEE. However, this would need coordinated action at the international level.

4.2 Policy coherence

Policies on resource use and waste are closely linked in terms of their effects on the environment and the economy. More broadly, they are key in greening the economy and implementing resource efficiency. The use of resources and generation of waste, as well as the trade in primary and secondary (waste-derived) materials share a number of common driving factors and possible responses (see Table 4.3).

In 2008, responding to concerns about resource scarcity and long-term access to resources, the European Commission presented 'The raw materials initiative — meeting our critical needs for growth and jobs in Europe'. The Commission points out that '... while the rising costs of energy and the high dependence of the EU on energy imports is already high on the political agenda, comparable challenges regarding certain non-energy raw materials have not yet received full attention'.

Recognising that 'the critical dependence of the EU on certain raw materials underlines that a shift towards a more resource efficient economy and sustainable development is becoming even more pressing', the initiative suggested reducing the EU's consumption of primary raw materials by increasing resource efficiency, improving eco-efficiency, the wider use of recycled materials, the prevention of leakage of valuable resources through exports of end-of-life products and increased use of renewable materials.

In March 2010, the EU adopted EUROPE 2020, a European strategy to achieve sustainable and inclusive growth, which identifies a resource efficient Europe as one of seven flagship initiatives. This initiative aims to create a framework for policies to support the shift towards a

Table 4.3 Common drivers/factors and shared response options for resource use and waste

Trends	Common drivers/factors	Shared response options
• Growing use of material resources • High absolute amounts used • Increasing quantities of waste generated • Loss of valuable resources through waste	Economic growth model based on intensive use of resources. Growth of population and changing demographics. Increase in disposable incomes and household expenditure. Prices for materials and products not fully including external effects. Consumption patterns based on high material use. Difficulty in changing existing production systems and infrastructure due to long pay back periods. Rebound effects where gains from efficiency improvements are offset by increasing consumption.	Integrated policies to enhance resource efficiency and to reduce waste generation. Targets for resource efficiency and waste management. Sustainable materials management across the entire life-cycle (including closing material loops). Development of less material-intensive business models and removing market failures hampering re-use, recycling and recovery. Policies fostering innovation aiming at resource efficiency, re-use and recycling. Eco-design — design of resource-efficient products that enable repair, re-use and recycling. Addressing consumption patterns and the rebound effects.
• Large scale import of material resources and products • Global competition for access to strategic materials • Growing trade in waste • Illegal export and import activities	Growing global demand for materials (both primary and waste-derived). Limited availability of certain strategic resources in the EU Specialisation of some economies in resource exports. Global differences in environmental standards and labour costs drive imports of products into the EU and exports of second-hand goods beyond the EU. Imports of materials and goods into the EU create low-cost transport capacities back to the exporting countries which is used for waste exports. High profits from illegal trade, for example, illegally logged timber, illegal export of WEEE.	Greening the economy and shifting to knowledge-based economic development model Internalisation of external costs of material extraction and processing, transport, as well as waste disposal. Incentives to increase re-use, recycling and recovery in Europe International cooperation and technology transfer in the area of resource efficiency, re-use and recycling. International cooperation on combating illegal trade practices. Better control and enforcement systems.

Box 4.4 Environmental and economic policies hand-in-hand

In an encouraging example of policies working synergistically, the 2008 EU Action Plan on Sustainable Consumption and Production and the 2008 Raw Material Initiative both address challenges related to resource use. The former, together with the 2005 Thematic Strategy on the Sustainable Use of Natural Resources, seeks to address environmental impacts while the latter focuses on ensuring security of supply to maintain the competitiveness of European industries. Both these initiatives stress the need to improve the resource efficiency of the European economy and to increase recycling. This recognises that increasing resource efficiency of the EU economy will not only be positive for the environment, but will help maintain the competitive edge of European industries at a time of competition for access and increasing resource prices. Most recently, EUROPE 2020, a European strategy for smart, sustainable and inclusive growth, identified sustainable growth promoting a more resource efficient, greener and more competitive economy as one of the key priorities for the next decade.

resource-efficient and low-carbon economy which will help to:

- boost economic performance while reducing resource use;
- identify and create new opportunities for economic growth and greater innovation and boost the EU's competitiveness;
- ensure security of supply of essential resources;
- fight against climate change and limit the environmental impacts of resource use.

The September 2011 European Commission's Communication 'Roadmap to a resource efficient Europe' provides more operational directions by setting out this vision "… by 2050 the EU's economy has grown in a way that respects resource constraints and planetary boundaries, thus contributing to global economic transformation. Our economy is competitive, inclusive and provides a high standard of living with much lower environmental impacts. All resources are sustainably managed, from raw materials to energy, water, air, land and soil. Climate change milestones have been reached, while biodiversity and the ecosystem services it underpins have been protected, valued and substantially restored." In addition, the Roadmap provides ambitious targets that support the aim to turn waste into resources.

Closer integration between waste management and improving resource efficiency is clearly one of the more obvious starting points, and one with a well-established precedence. Recycling is one of six lead markets addressed by the EU's Lead Markets Initiative, which was created to support innovation in the EU and bring new products and services to the market. The initiative sets out a number of actions to boost recycling, including ensuring the quality of recycling products and reducing the environmental impacts of recycling processes. And a specific need has been identified: to stimulate demand for recycled materials (EC, 2009b).

There are a number of policies which will actually contribute to growing amounts of waste, for example, the shift from landfilling to waste incineration will lead to more (hazardous) flue gas cleaning residues, and the implementation of the Urban Waste Water Treatment Directive which will lead to more sewage sludge.

Current socio-economic policies which tax labour highly but impose no similar taxes on materials use, combined with a lack of incentives for design that enables repair and upgrading, increasing labour costs, miniaturisation, mass production and the shortening of economic product life, generally discourage the repair of products in favour of replacing them with new ones, leading to growing amounts of waste. For example, whereas prices for the repair of furniture and furnishings and household appliances rose on average by 2.7 - 2.8 % per year between 2000 and 2007, prices for most consumer durables did not keep up with inflation resulting in a reduction in the price index for household appliances of 1.1 % per year (Eurostat, 2009c: 233).

Overall assessment of policy responses

On the whole, even though new policies have begun to address the challenges related to the growing, efficient use of resources, the response to date has not been robust. The actions that have been taken do not yet effectively address the underlying causes of the continuously growing amounts of materials used, but tend to focus instead on reducing the environmental impacts. As yet, there are no specific targets or operational indicators for the environmental impacts of resource use which could drive policy implementation. Given this lack of targets and indicators, distance-to-target assessment and progress monitoring are not possible. There are hopes that the EU flagship initiative on resource efficiency will provide the necessary impetus in this regard and drive policy action.

Setting up and implementing policies for more sustainable use of resources is proving to be a complicated task. Experience at the country level shows that institutional and regulatory frameworks tend to be dispersed, with overlapping and unclear responsibilities (EEA, 2011b).

Last but not least, the reliance on technological improvements to reduce resource use needs to be critically assessed. Experience shows that because of the rebound effect — incremental gains in technical efficiency being offset by more widespread consumption — it is unlikely that resource use can be reduced by technological improvements alone. Improving resource efficiency through technological change would have to be accompanied by making consumption patterns in Europe more sustainable, and various opportunities to do this have already been identified (see EEA, 2010d).

While policies on material resources are still at an early stage of development, the already comprehensive set of EU waste policies has been further developed in recent years. Important milestones are the Thematic Strategy on the Prevention and Recycling of Waste and the revised Waste Framework Directive. The Mining Waste Directive (Directive 2006/21/EC), the Batteries Directive (Directive 2006/66/EC), the European Commission's Communication on future steps in bio-waste management in the European Union (COM(2010)235 final) and the European Commission's Proposal for a Regulation on ship recycling (COM(2012)118 final) were issued to close loopholes in the Waste Policy Framework concerning these specific wastes. A number of directives tackling specific waste streams are well in the phase of practical implementation in the Member States — the WEEE Directive, End-of-life Vehicles Directive, the Batteries Directive and the Landfill Directive in the case of biodegradable municipal wastes.

However, waste policies are not well implemented in all EU Member States — 19 % of all new environmental infringement cases in 2006 and 2007 were registered in the area of waste policies (Zamparutti et al., 2009) — and better implementation of current waste policies is needed to fully capture the benefits that could result from them.

In today's global economy, Europe is, to an unprecedented degree, exposed to the risks of global market — including supply disruptions, price rises, and intense international competition for access to strategic resources. Recent strategic policy initiatives, sparked by the worldwide economic crisis and an increased recognition of systemic risks of continued dependence on imports of non-renewables, have focused on greening the economy, securing more sustainable growth through improving resource efficiency, and ensuring long-term security of supply of strategic materials. Resource efficiency, sustainable use of resources and management of waste demonstrate the need for — and the benefit of — coherent and long-term integration across various environmental, development, trade and sectoral policies. The journey there has only just begun.

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