Office for National Statistics

Article

UK Environmental Accounts: How much material is the UK consuming?

Estimates of material consumption in the UK from 2000 to 2013, taking the extraction of raw materials and physical imports and exports into account. It explores how much material is consumed per person and shows how material consumption relates to economic activity (known as ‘resource productivity’). Comparisons with European estimates are also presented.

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Correction

6 August 2018

A correction has been made to raw material equivalents and raw material consumption estimates that appear within Sections 1, 3, 4 and 7 of the article. This was due to a small error in the data input into the tool used to calculate these estimates. You can see the original content in the superseded version. We apologise for any inconvenience.

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1 . Main points

The amount of material consumed in the UK has fallen from a peak of 955.2 million tonnes in 2001 (16.2 tonnes per person) to 712.2 million tonnes (11.1 tonnes per person) in 2013. Material consumption was lowest in 2009 at 682.9 million tonnes (11.0 tonnes per person).

Although the weight of imported products has generally increased since 2000 (off-setting the decline in extraction of raw material in the UK), the quantity of raw material required to manufacture the imported products has remained stable, suggesting improved resource efficiency.

Over the 2000 to 2013 period, resource productivity (the relationship between economic activity and material consumption), in the UK has positively increased, rising 59.4% from £1.87 per kilogram in 2000 to £2.98 per kilogram in 2013, reflecting the shift away from manufacturing towards financial and other service industries.

2 . Introduction

This release presents estimates of material consumption in the UK from 2000 to 2013, taking the extraction of raw materials and physical imports and exports into account. It explores how much material is consumed per person and shows how material consumption relates to economic activity (known as "resource productivity"). Comparisons with European estimates are also presented.

3 . What do we mean by "material’?"

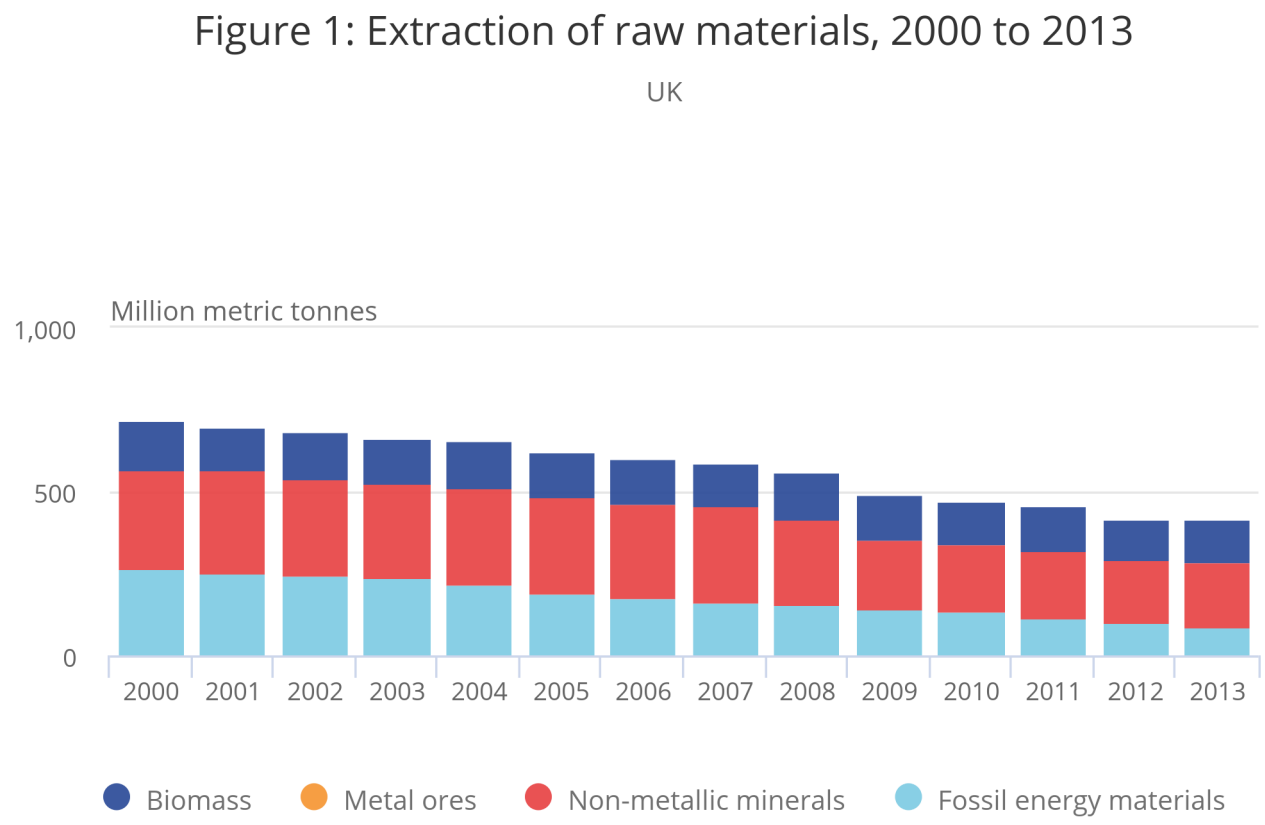
There are 4 broad categories of materials: biomass (crops, wood and fish), metal ores (iron and non-ferrous metals), non-metallic minerals (such as construction materials) and fossil energy materials (coal, oil and gas). These are presented here in terms of their physical weight, in million metric tonnes (unless otherwise specified).

How much material does the UK produce?

Figure 1 shows that the extraction of raw materials[1] in the UK has gradually declined, falling 41.7% from 717.9 million tonnes in 2000 to 418.7 million tonnes in 2013. The sharpest fall was observed in 2009 during the economic downturn, when the quantity extracted decreased by 12.2% compared with the previous year.

Figure 1: Extraction of raw materials, 2000 to 2013

UK



Source: Office for National Statistics; Department for Environment, Food and Rural Affairs; Food and Agriculture Organization of the United Nations; Eurostat; European Forest Institute; Kentish Cobnuts Association; British Geological Survey

Notes:

1. Metal ores are not visible on the figure as less than 10 thousand tonnes have been extracted each year since 2000.

The main types of materials extracted are non-metallic minerals such as sand and gravel (113.9 million tonnes in 2013), and limestone and gypsum (58.1 million tonnes in 2013), which are largely used for construction activities. Within the biomass category, a large quantity of fodder crops (56.5 million tonnes in 2013) are produced each year, which are used mainly for animal feed, although in recent years an increasing proportion has been used for producing biogas.

There has been a considerable decline in the extraction of fossil energy materials in the UK since 2000, although the quantity imported has increased. Fossil fuels are still the main source of energy consumed in the UK, accounting for 86.6% of total energy consumption in 2013. Other sources used for energy consumption in the UK include nuclear (7.2% in 2013) and renewable and waste sources (5.6% in 2013).

How much material does the UK import and export?

The UK imports and exports a large quantity of products in raw, semi-manufactured and finished forms ("all stages" of manufacture). These can be grouped into the main material categories outlined above.

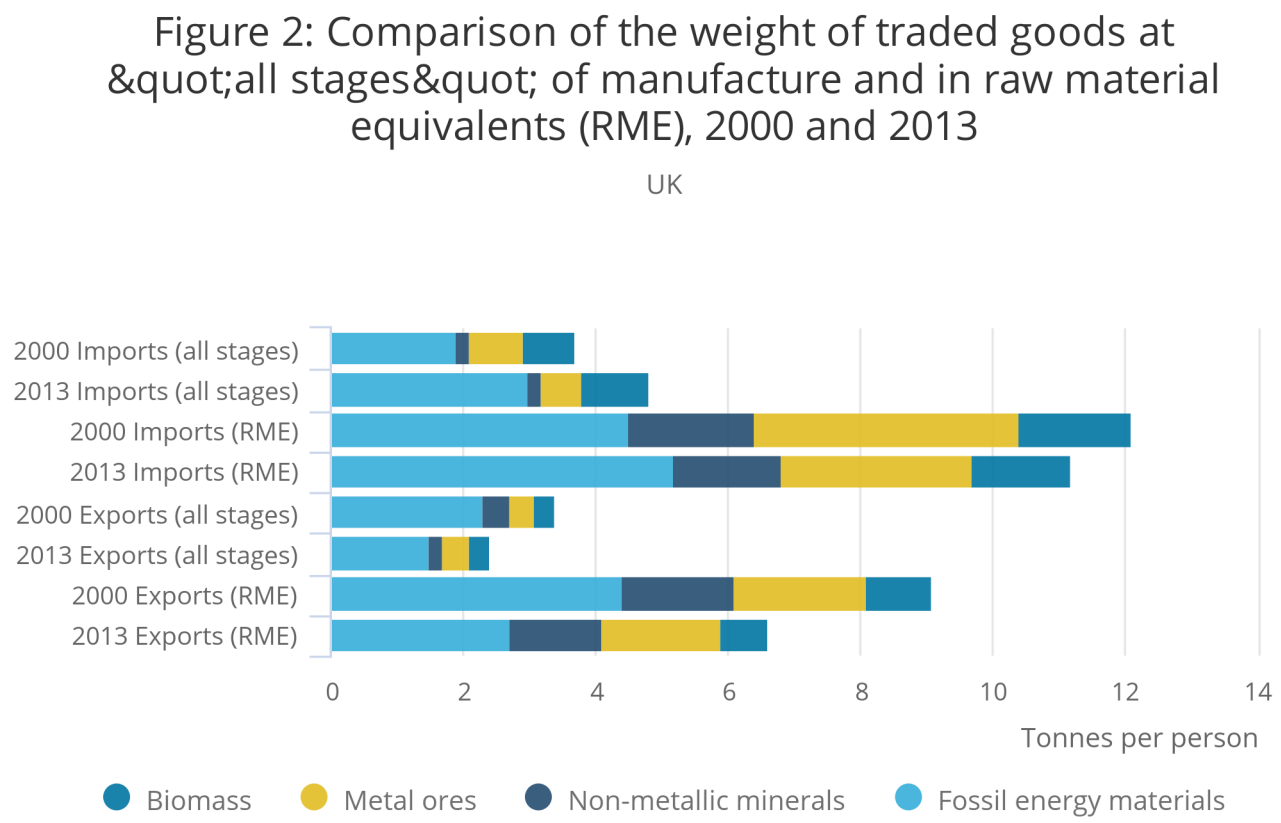
More materials are imported than exported and the gap between imports and exports has widened over the 2000 to 2013 period. As the quantity of materials extracted in the UK has also been declining, this suggests that we are becoming more reliant on the production of materials in other countries, which may be related to the reduced cost of sourcing some products from abroad.

However, one of the main drawbacks of grouping imports and exports of products at different stages of manufacture into material categories is that this approach does not take the weight of raw materials extracted to produce the manufactured products into account. To overcome this, the Office for National Statistics (ONS) has used a new model developed by Eurostat to estimate the raw material equivalents (RME) of traded goods. For example, using this approach, one tonne of imported steel is transformed into the equivalent of crude iron ore which had to be extracted and processed in order to produce one tonne of steel. This helps to provide a more accurate picture of environmental impact and gives a better indicator of our "global material footprint" (see below).

Figure 2 shows that imports and exports in RME are substantially higher than the same flows measured at all stages of manufacture. In 2000, imports in RME were estimated at 12.1 tonnes per person, 3.2 times higher than imports of products at all stages of manufacture (3.7 tonnes per person). In the same year, exports in RME were estimated at 9.1 tonnes per person, 2.7 times higher than exports of products at all stages of manufacture (3.4 tonnes per person).

Figure 2: Comparison of the weight of traded goods at "all stages" of manufacture and in raw material equivalents (RME), 2000 and 2013

UK



Source: HM Revenue and Customs; Office for National Statistics

The weight of imports at all stages of manufacture was 4.9 tonnes per person in 2013, 1.3 times higher than in 2000. However, the weight of imports in RME was 6.8% lower in 2013 at 11.3 tonnes per person. The gap between exports at all stages of manufacture and in RME was also narrower in 2013 compared with 2000. The apparent decline in demand for raw material in the manufacturing of products suggests that resource efficiency is improving, perhaps reflecting progress in energy efficiency and production practices as well as in material recycling and re-use.

Notes for What do we mean by "material'?

1. A distinction can be made between material that is "used" and "unused". "Used" refers to an input for use in any economy (for example, where a material acquires the status of a product) and "unused" refers to materials that are extracted from the environment without the intention of using them. Only materials that are "used" are included here.

4 . How can we measure material consumption?

Domestic material consumption (DMC) is an indicator that tells us how much material the economy is consuming. It is calculated as:

DMC = Domestic extraction + imports – exports

Material consumption (DMC) in the UK was fairly stable between 2000 and 2007 but then declined sharply in 2008 and 2009 at the beginning of the economic downturn. Since 2010, it has been fairly steady again. In 2013, the UK consumed 570.0 million tonnes of material, consisting of 172.1 million tonnes (30.2%) of biomass, 12.8 million tonnes (2.2%) of metal ores, 198.1 million tonnes (34.8%) of non-metallic minerals and 187.0 million tonnes (32.8%) of fossil energy materials.

However, there are a number of limitations to the DMC indicator, most notably that it does not take the weight of raw materials (RME) used to produce imported and exported products into account. Using the RME of traded goods, an improved raw material consumption (RMC) indicator can be calculated:

RMC = Domestic extraction + imports (RME) – exports (RME)

Figure 3 shows the difference between DMC and RMC for 2000 to 2013. The trends are broadly similar, although the gap between DMC and RMC narrowed during the economic downturn. This is due in part to the decrease in UK imports of construction materials in 2008 and 2009.

RMC in the UK – which can be described as our global material footprint – fell 28.8% from a peak of 955.2 million tonnes in 2001 to its lowest point of 682.9 million tonnes in 2009. There were small increases in 2012, rising to 696.0 million tonnes and in 2013, rising to 712.2 million tonnes.

Figure 3: Domestic material consumption (DMC) and raw material consumption (RMC), 2000 to 2013

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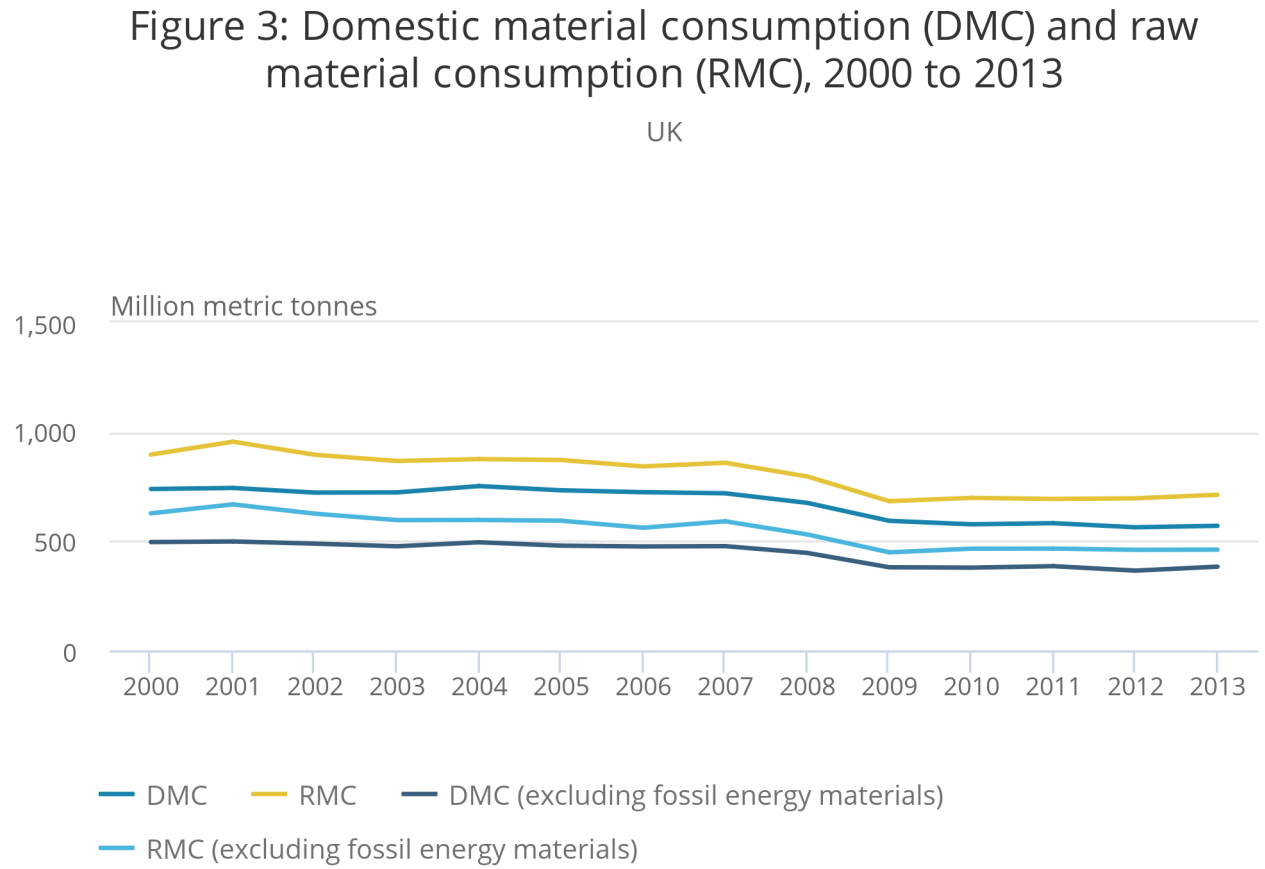

Source: Office for National Statistics

Fossil energy materials constitute a large proportion of DMC (32.8% in 2013) and RMC (35.3% in 2013). However, it is arguably more appropriate to monitor them in terms of energy consumption and climate change impacts rather than their physical weight. DMC and RMC excluding fossil energy materials are therefore also presented in Figure 3. Excluding fossil energy materials, the UK's global material footprint (RMC) fell by 31.0% from 668.2 million tonnes in 2001 to 461.0 million tonnes in 2013. During the same period, DMC decreased by 23.2% from 498.4 million tonnes in 2001 to 383.0 million tonnes in 2013. The narrowing of the gap between DMC and RMC excluding fossil energy materials is due in part to the decline in imports and rise in exports of metal ores in RME. The concentration of metals in extracted metal ores is often less than 1.0%, which means that the extraction of concentrates usually results in a much higher RME than the actual weight of traded goods. While the UK population has been increasing, the quantity of material consumed per person has been steadily decreasing. In RMC, consumption fell from 16.2 tonnes (11.3 tonnes excluding fossil energy materials) per person in 2001 to 11.1 tonnes (7.2 tonnes excluding fossil energy materials) per person in 2013.

How does material consumption relate to economic activity?

"Resource productivity" is a measure that quantifies the relationship between economic activity and consumption of natural resources. On a national level, it is calculated by dividing gross domestic product (GDP) [1] by material consumption (DMC). This shows the amount of economic value generated in relation to every kilogram of material consumed.

Resource productivity is an aggregate indicator of an economy's material efficiency. It shows whether material consumption and economic growth are closely associated or whether they are becoming "decoupled". "Decoupling" in this context means breaking the link between an environmental and economic variable. This can be either absolute or relative. Absolute decoupling in this context occurs when material consumption is stable or decreases while GDP increases. Relative decoupling occurs when the rate of change in material consumption is less than the rate of change in GDP.

Figure 4 shows that DMC has generally decreased and that GDP has generally increased. Between 2000 and 2013, on average, DMC fell by 1.9% each year while GDP grew by 1.7%. This represents absolute decoupling.

Figure 4: Resource productivity(1), 2000 to 2013

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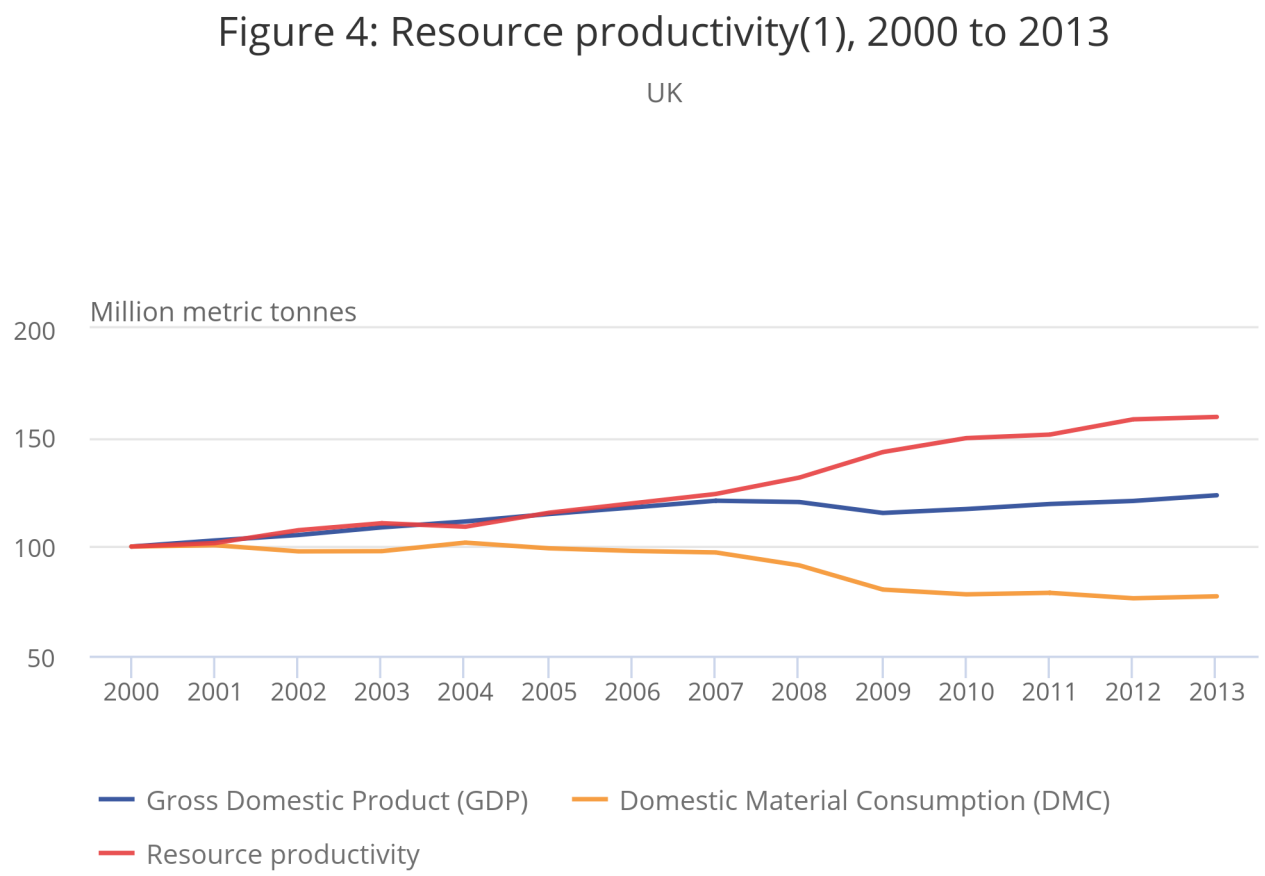

Source: Office for National Statistics

Notes:

1. Resource productivity was calculated using GDP in chain linked volumes (series ABMI).

During the 2000 to 2013 period, there was a 59.4% increase in resource productivity, rising from £1.87 per kilogram in 2000 to £2.98 per kilogram in 2013. Annual growth was greatest in 2009, when resource productivity increased by 8.9% compared with the previous year. One of the main reasons for growth in resource productivity in the UK is the shift away from manufacturing towards high value added and less resource-intensive sectors such as financial, digital and other service industries.

Notes for How can we measure material consumption?

1. In chain linked volumes (series ABMI).

5 . How do we compare with Europe?

At present, DMC is the most widely-used indicator to make European comparisons of material consumption. This is because estimates of RMC are still developmental and only a small number of countries have produced estimates to date.

In terms of DMC, the 28 member states of the European Union (EU-28) consumed 6,700.2 million tonnes of material in 2013. Germany consumed the most (1,294.5 million tonnes), followed by France (780.2 million tonnes) and Poland (657.0 million tonnes). The UK consumed the fourth highest amount at 570.0 million tonnes.

Figure 5 shows the quantity of material consumed per person in each of the EU-28 countries in 2013. The EU-28 consumed 13.2 tonnes per person on average while the UK consumed only 8.9 tonnes per person, 0.5 tonnes more than the quantity consumed per person in Spain (8.4 tonnes), which was the lowest consumption rate across the EU-28. In contrast, Finland consumed the most material per person at 34.5 tonnes, followed by Estonia at 30.9 tonnes per person and Ireland at 26.2 tonnes per person.

Figure 5: Domestic material consumption (DMC) per person, 2013

EU-28 countries

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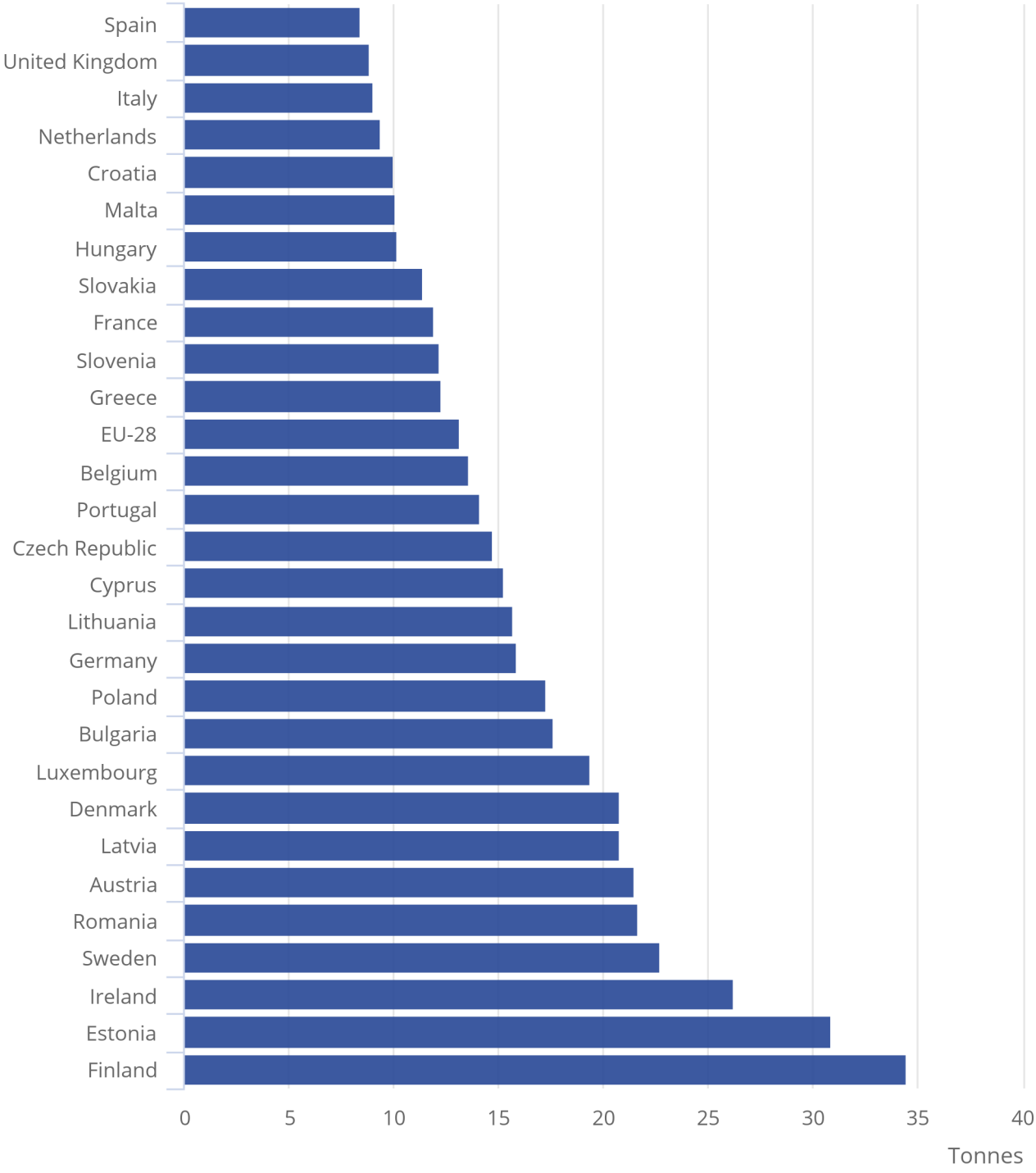

Source: Eurostat, Office for National Statistics (UK figure only)

Notes:

1. Provisional and/or estimated data for most countries.

Material consumption patterns vary between countries for a variety of reasons, including availability and extraction of domestic resources, imports and exports markets, the size of agriculture, manufacturing and construction industries, differences in living standards and economic development, and population density.

In terms of resource productivity, Figure 6 shows that values across the EU-28 countries in 2013 ranged from 0.64 (Estonia) to 3.76 (Netherlands) purchasing power standards (PPS) [1] per kilogram. The EU-28 average was 2.02 PPS per kilogram. In general, member states with relatively high GDP per person tend to have resource productivity levels above the EU-28 average. In 2013, the UK had the third highest resource productivity at 3.13 PPS per kilogram.

Figure 6: Resource productivity, 2013

EU-28 countries

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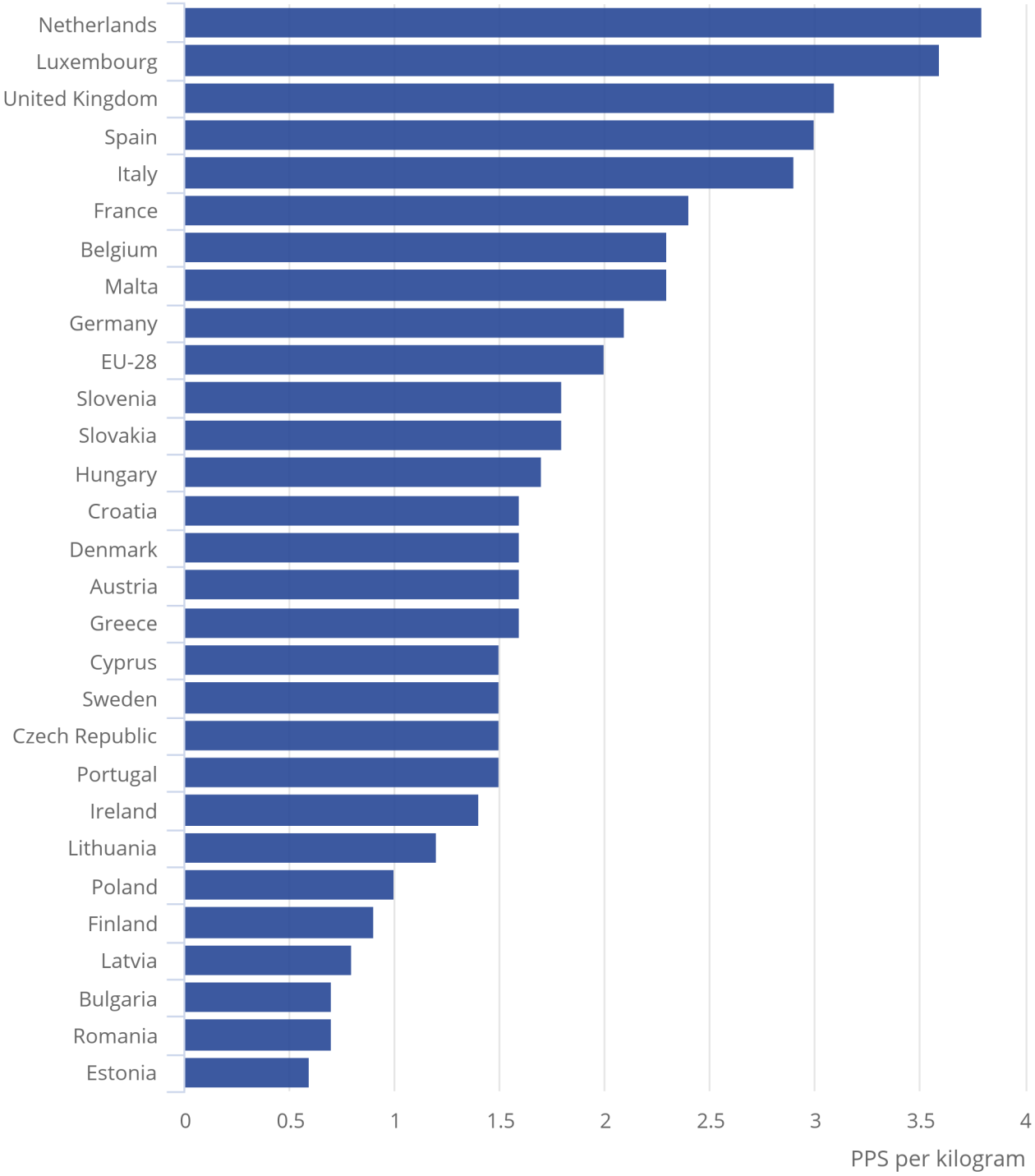
EU-28 countries



Source: Eurostat

Notes:

1. PPS is the technical term used by Eurostat for the common currency in which national account aggregates are expressed when adjusted for price level differences using purchasing power parity (PPP). Thus, PPPs can be interpreted as the exchange rate of the PPS against the Euro.

2. Provisional and/or estimated data for most countries.

Differences in resource productivity across the EU are due to numerous factors, including national economic structure and sector composition (for instance, variation in industries and extent to which they are reliant on raw materials), degree of outsourcing of production and the existence of environmental policies encouraging recycling and re-use of materials[2].

There are known limitations of the resource productivity indicator and the figures must be interpreted with caution. In particular, GDP/DMC takes a national production perspective, which means that it is insensitive to changes in raw material uses that occur outside of national borders. Further, DMC does not take scarcity, economic value and environmental impact of the use of raw materials into account.

Notes for How do we compare with Europe?

1 PPS is the technical term used by Eurostat for the common currency in which national account aggregates are expressed when adjusted for price level differences using purchasing power parity (PPP). Thus, PPPs can be interpreted as the exchange rate of the PPS against the euro. 2. SERI (2012) Green Economies Around the World? Implications for resource use for development and the environment, p.50

6 . Why is material consumption important?

We are dependent on materials for the production and consumption of goods and services that fulfil human needs and improve our quality of life. As national and global populations continue to grow and aspirations of developing and emerging economies rise, there is increasing pressure on our resources and environment. Material resources are finite and there is a risk of material scarcity in the future if current production and consumption patterns continue. Becoming more efficient in the use of our materials is therefore fundamental to creating a sustainable economy and growth.

At a global level, raw material consumption and resource efficiency are relevant to 2 of the United Nations Sustainable Development Goals (SDGs):

- Target 8.4: Improve progressively, through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead

- Target 12.2: By 2030, achieve the sustainable management and efficient use of natural resources

SDG indicators specific to the UK are currently under development.

A resource-efficient Europe is one of the flagship initiatives of the Europe 2020 Strategy, which has a sustainable growth priority to tackle the issue of sustainable production and consumption. As part of the initiative, there is a Resource Efficiency Scoreboard, of which resource productivity is the lead indicator. The desired outcome is an increase in material productivity and a decoupling of material use from economic growth across Europe, achieved through sustainable use of natural resources.

The European Environment Agency has published an overview of policies, instruments, and targets relating to resource efficiency in 31 countries. Individual country profiles, which will include specific details of the UK's policy position on resource efficiency (a devolved matter across England, Scotland, Wales and Northern Ireland), are due to be published in spring 2016.

Towards a circular economy

Understanding the types, quantities and flows of materials in and out of the UK economy provides a useful starting point for assessing progress towards a circular economy. The concept and measurement of a circular economy is particularly complex and it requires engagement and co-operation of various actors (such as governments, product developers and manufacturers, scientists, digital experts, retailers, and consumers) ranging from individual to global levels.

In Europe, the European Commission (EC) has developed an ambitious set of proposals for "closing the loop" and a Circular Economy Package has been adopted. The EC state: "In a circular economy the value of products and materials is maintained for as long as possible; waste and resource use are minimised, and resources are kept within the economy when a product has reached the end of its life, to be used again and again to create further value. This model can create secure jobs in Europe, promote innovations that give a competitive advantage and provide a level of protection for humans and the environment that Europe is proud of. It can also provide consumers with more durable and innovative products that provide monetary savings and an increased quality of life."

Essentially, in a circular economy, we move from a "take-make-dispose" approach towards "recycle-repair-reuse". This is a shared global ambition. However, creating a shift in current patterns of raw material use towards more circular and sustainable production and consumption will be an ongoing challenge.

7. Background notes

1. The data included in this release are based on the economy-wide material flow accounts (EW-MFA) that are compiled by the Office for National Statistics and submitted to Eurostat annually in accordance with Regulation (EU) No 691/2011 on European environmental economic accounts (amended by Regulation (EU) No 538/2014).

2. The raw material equivalents (RME) and raw material consumption (RMC) estimates presented in this release and accompanying reference table have been calculated using a new Country RME tool published by Eurostat in October 2015. This was developed following extensive input and testing from specialist contactors and member states. The UK figures for 2000 to 2013 are all based on the coefficient approach.

3. RME and RMC estimates are Experimental Statistics as they have been calculated using a model that is still under development at European level. The results should therefore be used and interpreted with caution. If you have any comments or would like to provide feedback on any aspect of this release, please contact environment.accounts@ons.gsi.gov.uk

4. Precious metals have been excluded from RME imports and exports data for all years.

5. EW-MFA, RME and RMC data up to 2014 will be published in UK environmental accounts, 2016, due to be released on 5 July 2016.

6. Experimental RME and RMC figures for the UK were produced previously by the Department for Environment, Food and Rural Affairs in 2011 and in 2013.

7. The contributions of Suzanne Bradley, Natalie Harris and Stephen Wilson (HM Revenue and Customs), Tom Bide (British Geological Survey), and Renato Marra Campanale and Maaike Bouwmeester (Eurostat) for providing data and expertise are gratefully acknowledged.