KfW Research
Focus on Economics

The circular economy – pivotal to sustainability and resource security

No. 258, 19 July 2019

Author: Anke Brüggemann, phone +49 (0)69 7431-1736, anke.brueggemann@kfw.de

The unabated growth of global resource consumption is the main cause of global climate change and biodiversity loss. At the same time, competition for scarce resources is intensifying. In the face of these challenges, the shift to a circular economy is expected to help make economic management sustainable and competitive. The aim is to design entire production systems in the form of closed-loop cycles that minimise waste and emissions as well as material and energy losses. This requires extensive measures all along the value chain.

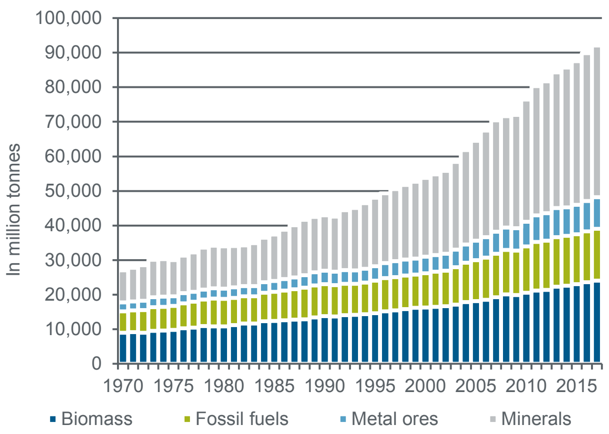
In December 2015 the EU Commission published its 'EU Action Plan for the Circular Economy', which aims to promote the transition of the EU to a more circular economy. Europe has only just embarked on a long-term process, as following figure illustrates: In 2016 an average of just 12% of the material used in the EU came from recycled products and reclaimed materials. With respect to the waste management side of the circular economy, Germany is one of the recycling pioneer states within the EU. But in regard to waste avoidance, product durability, recycling-friendly product design and material efficiency, Germany still has great development potential – as does all of Europe.

The transition to a circular economy will not happen by itself. Significant obstacles include increased costs of high-quality recycling compared with other disposal options such as waste incineration or downcycling[1], lower prices of primary materials, and hitherto insufficient demand for recycling products. Implementing a circular economy therefore requires a clear regulatory framework and economic incentives. The EU has provided important impetus with its action plan. But decoupling value creation from the use of newly extracted materials on a broad scale will require further steps. Chief among them are further measures that improve the quality of recycling products and more effectively address the issue of waste avoidance.

Global increase in resource consumption is driving climate change and biodiversity loss

The rise in resource consumption around the world continues unabated. Driven by population and economic growth as well as rising living standards, global material extraction has more than tripled since 1970. It increased from 27 billion tonnes in 1970 to 92 billion tonnes in 2017 (Figure 1). During the same period, the world's population doubled and global gross domestic product quadrupled. If the current trend continues, annual global raw material use is expected to double again to 190 billion tonnes by 2060.[2]

Figure 1: Global material extraction, 1970–2017



Source: IRP (2019).

The extraction and use of raw materials has considerable environmental impacts, ranging from greenhouse gas emissions and input of pollutants into air, water and soil to ecosystem damage. The International Resource Panel (IRP) of the United Nations estimates that half the global greenhouse gas emissions and more than 90% of biodiversity loss and water pollution are caused by the extraction and processing of biomass, fossil fuels, minerals and metal ores. That makes the unabated, rapid growth of global resource use the main cause of global climate change and biodiversity loss.[3]

Growing competition for natural resources

At the same time, the global growth in demand for raw materials and the scarcity of natural resources are leading to increasing price and supply volatility in the international commodities markets. As in the case of energy resources, extraction of important resources for material use is also concentrated on few countries – some of which are politically unstable – and mining companies. Besides, some countries have already started to build up reserves of strategically important resources, cut their raw material exports or take over firms to secure their access to resources in other regions.[4] Because of its high dependence on imports, Germany is particularly vulnerable to risks in commodity markets. In 2014, 58% of raw materials used in Germany for the production of goods were imported – much of it in the form of inputs in imported products. The import quota of metal ores was 100% because Germany practically has no ore deposits, or because mining them is not cost-effective.[5]

Against this background, the sparing and efficient use of resources and recycling already constitute important building blocks of Germany's economic and environmental policy for securing the country's supply of raw materials and competitiveness in the long term as well as mitigating the negative environmental impacts associated with the extraction and processing of primary materials.[6]

Transition from a linear to a circular economy necessary

In order to be able to sustainably secure humankind's natural bases of life, the IRP calls for a shift in the use of resources. In its most recent report to the UN (March 2019) it calls upon policymakers to push for a transition from a linear to a circular economy through a combination of durable products, smart product design, standardisation, reuse and recycling. Modelling performed by the panel reveal that such resource-efficient economic policy tools would both allow global prosperity to continue growing and enable global climate action targets to be achieved.[7]

The IRP has thus taken up the concept of the circular economy, which has received growing attention from researchers and society in the past years. So far there is no uniform definition of the concept. Basically, however, it aims to decouple value creation from resource use as much as possible. In Germany the concept of the circular economy is often expressed using the term '*Kreislaufwirtschaft*', but this term is often still associated merely with recycling in Germany, so its meaning is too narrow. The concept of circular economy goes far beyond this. The aim is to design entire production systems in the form of closed-loop cycles in which waste, emissions, material and energy losses are minimised (see Figure 2). If implemented consistently, circular economy is a radical departure from the current linear 'make, consume, dispose' global economic model.

An ideal model of a circular economy requires modifications all along the value chain:[8]

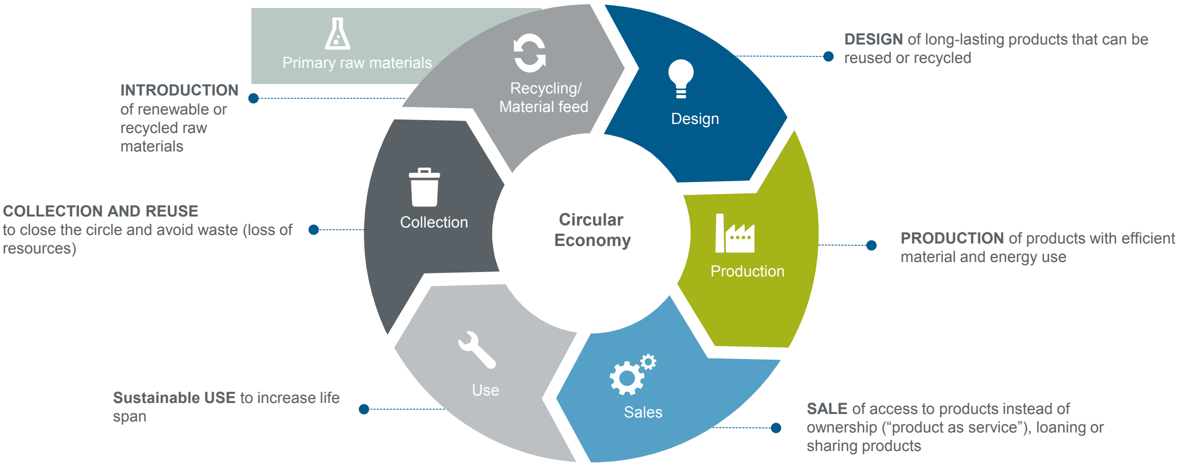
- **Design:** Products should be durable and suitable for reuse, sorting and recycling.
- **Production:** The production of the products should be material and energy efficient.
- **Distribution:** Business models should be adapted so as to maximise utilisation of products (e.g. through rental or sharing).
- **Use:** Product use is designed for durability (including repairability and reuse of end-of-life products).
- **Collection / recycling:** After use, products are taken to a differentiated value recovery system in which materials are specifically identified and sorted as a basis for high-quality recycling.
- **Recirculation:** The secondary raw materials obtained are reintroduced into the production process, minimising the use of primary materials.

The EU on the road to a circular economy

Under the 'EU Action Plan for the Circular Economy' of 2015, the European Union provides strong impetus for advancing the transition to a more circular economy in the EU. The programme of action aims to 'maintain the value of products, materials and resources in the economy for as long as possible, and to minimise the generation of waste.' The proposals address the entire product life-cycle from production and consumption to waste management and the market for secondary raw materials. In addition to reducing resource and energy consumption as well as greenhouse gas emissions, the EU wants the plan to protect businesses against scarcity of resources and boost the competitiveness of EU industry. Brussels also hopes it will generate new business opportunities and create more employment.[9]

A number of measures have already been adopted on the basis of the action plan. The most prominent EU resolutions definitely include new recycling targets for municipal waste and banning the sale of certain single-use plastic products. The rules provide for the EU member states to each recycle at least 55% of municipal waste (including household waste

Figure 2: Value creation cycle in the circular economy



Source: KfW-Research, based on acatech (2018).

and commercial waste similar to household waste) from the year 2025, at least 60% from 2030 and at least 65% from 2035. The average European recycling rate for these types of waste is currently 47%.[10] Furthermore, from 2035 not more than 10% of all municipal waste will be allowed to be taken to landfill within the EU.[11] In order to protect the oceans and the environment, a Europe-wide ban on the sale of plates, cutlery, stirrers and balloon holders made of plastic, styrofoam cups and cotton buds containing plastic will apply from 2021. All of these items are among the single-use products most commonly found on Europe's beaches. In addition, by 2030 all new single-use plastic beverage bottles must be made from at least 30% recycled plastics.

Example of municipal waste shows that waste generation levels and current waste management practices differ substantially from one EU country to another. Denmark produces the highest annual quantities of municipal waste per capita (777 kg), followed by Malta (647 kg), Cyprus (640 kg) and Germany (626 kg). The lowest quantities are found in Romania (261 kilograms), Poland (307 kg), the Czech Republic (333 kg) and Slovakia (348 kg). Wealthier countries tend to produce more waste per capita. In Cyprus and Malta, tourism is partly responsible for the higher quantities. Hardly any municipal waste goes to landfill in Belgium, the Netherlands, Sweden, Denmark, Germany, Austria and Finland because waste incineration and recycling play a major role in these countries. In Greece, Malta, Croatia, Cyprus and Romania, on the other hand, more than three fourths of municipal waste still ends up in landfill. Germany and Austria have Europe's highest recycling rates, at 66% and 59% (Figure 3).[12] These figures underscore the fact that EU member states face different challenges in meeting the recycling and landfill targets for municipal waste set by the EU.

The Action Plan for the Circular Economy is just the start of a long-term process for the EU. The following figure illustrates that Europe still has a long way to go in transitioning to a circular economy: In 2016 an average of just 12% of the material resources used in the EU came from recycled products and reclaimed materials.[13] Further steps are needed to be able to achieve largely closed-loop material cycles. Chief among them are further measures that improve the quality of recycling products and more effectively tackle the issue of waste avoidance. Even though the EU affords highest priority to waste avoidance, the relevant regulations are clearly less binding than those pertaining to classic recycling. Moreover, the packages of measures adopted by the EU so far focus very strongly on the portion of municipal waste that makes up around 10% of the total waste quantity generated in the EU. A stronger focus should be placed on other types of waste such as high-volume construction and demolition waste as well as manufacturing waste.

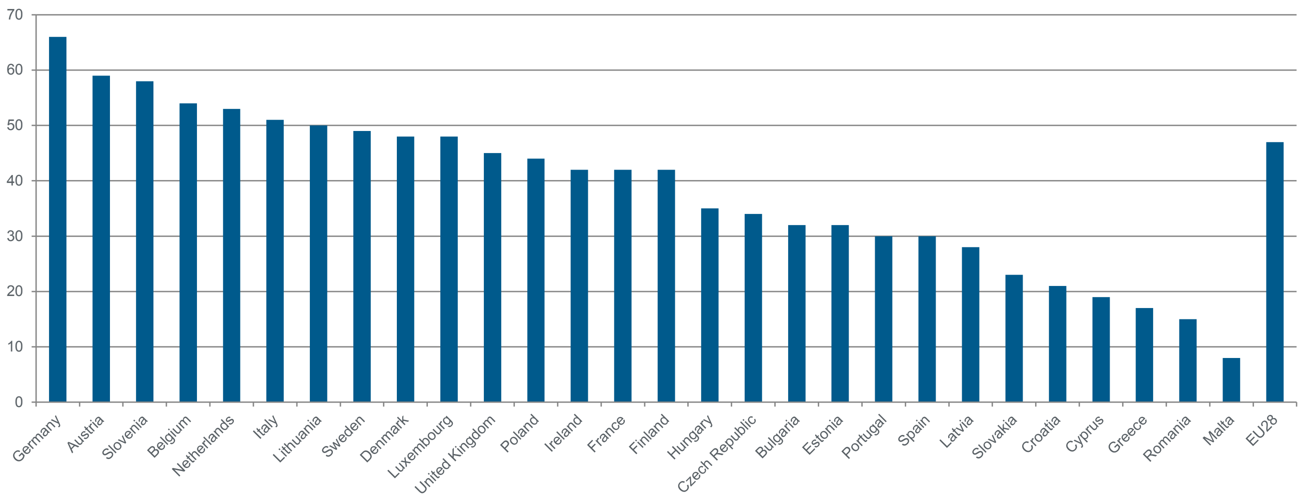
Where does Germany stand?

With respect to the waste management side of the circular economy, Germany is one of the EU member states that has attached high importance to recycling for a long time. In the year 2016, 70% of all waste generated in Germany was sent for recycling.[14] Not only does this save primary materials but relevant quantities of energy and associated greenhouse gas emissions. In 2013 alone, 493 million tonnes of primary materials and 1,400 petajoules of primary energy were avoided in Germany and abroad thanks to the activities of Germany's secondary raw materials industry.[15]

In order to achieve the goal of a circular economy that encompasses the entire value creation chain of a national economy, however, there is further need for action in Germany as well. Most recently, only around 14% of non-energy resources used in industry have been obtained from waste in Germany.[16] And issues such as reuse, repair, product durability, recycling-friendly product design and material efficiency in particular illustrate that Germany still has great development potential – as does all of Europe.

Figure 3: EU recycling quotas for municipal waste

Share of recycled or composted municipal waste in per cent



Source: European Parliament (2018), data from 2016.

The main challenges for Germany in transitioning to a circular economy are:

- **Waste avoidance / resource efficiency:** Total waste generation in Germany dropped by around 12% between 2000 and 2016. Since 2012, however, waste quantities have increased again (+8%).[17] At 626 kg per capita per year, Germany's municipal waste generation is significantly higher than the EU average of 482 kg.[18] Further measures to avoid waste and improve material efficiency are therefore required.

- **Recycling quotas:** Additional recycling potential can be increased in Germany as well. Two examples: First, as a result of a new EU-wide calculation method, the EU recycling quota of 65% for municipal waste that has to be achieved by 2035 is challenging for Germany as well and requires additional efforts. The new calculation method means that the recycling rate of 66% so far reported by Germany will drop because in future it will no longer allow the rate to be based on the input quantity brought to recycling facilities, but solely on the material effectively recycled (output quantity). Second, the new German Packaging Act requires, among other things, the recycling rate for plastic sales packaging to be increased from currently 36% to 63% by the year 2022.[19] What remains problematic is that some of the plastic waste generated in Germany is exported for recycling to countries with low environmental standards for the recycling process and the disposal of sorting residues – particularly to Southeast Asia. To protect the environment and the world's oceans, an EU-wide export ban on poorly recyclable plastic waste is to enter into force from 2021.

- **Quality of recycling products:** In order to be able to make cycles as closed as possible and increase the acceptance of the use of secondary materials on the buyer side, a greater focus will have to be placed on improving the quality of recyclates (prevention of downcycling). Besides separation of the relevant waste fractions, this will require innovative processing and recycling technologies as well as quality standards for secondary materials where appropriate. Finally, businesses will need stronger incentives to develop more recycling-friendly products and manufacture them using more secondary raw materials (recyclates).

- **Strategically important resources:** Technological metals such as indium, rare earths, gallium or neodymium have great importance for the digitalisation of industry and a number of environmental technologies such as electric mobility and renewables. At the same time, the supply of these resources is fraught with great risks, either because the existing deposits are concentrated in certain countries or enterprises, or because their static ranges are very low. Although the recycling of technological metals can be an important approach to resource security in Germany, its potential is so far hardly developed. The recycling of end-of-life electrical appliances and vehicles, for example, remains largely focused on the reclamation of mass metals such as iron, copper and aluminium. Technological metals are also difficult to recycle because of the very small quantities used in end products. Greater incentives for recycling (e.g. through recycling quotas for critical resources) and for the development of innovative recycling methods are necessary to be able to tap into this resource potential more broadly. A particular challenge here is that considerable quantities of end-of-life appliances and products containing technological metals in Germany currently do not flow back into the regulated material cycle. This is due to the legal and illegal export of end-of-life products to developing and emerging countries. Moreover, many small electrical appliances still end up in the household waste bin in Germany despite an extensive collection infrastructure.[20]

Conclusion

What can be surmised from the above observation is that the transition to a circular economy will not occur on its own. Significant obstacles on the path to a circular economy include increased costs of high-quality recycling compared with other disposal options such as waste incineration or downcycling, lower prices of primary materials (which do not map the cost of environmental damage), and hitherto insufficient demand for recycled products. The implementation of a circular economy therefore requires policymakers to set a clear regulatory framework and economic incentives. The EU has provided important impetus with its action plan. But decoupling value creation from the use of newly extracted materials on a broad scale will require further steps. These include, in particular, more binding directives on improving the quality of recycled products and waste avoidance. What is also important for successful implementation is that all stakeholders of the value creation cycle take responsibility and cooperate with each other – from the product designer and manufacturer through retailers and consumers to recycling companies. ■

[1] Downcycling refers to waste recycling in which the recycled material is of lesser quality or less workable than the original material. This is often due to the accumulation of foreign elements in the secondary materials which prevents them from being used in high-quality applications.

[2] Cf. IRP – International Resource Panel (2019): Global Resources Outlook 2019. Natural resources for the future we want. United Nations Environment Programme, Nairobi, Kenya.

[3] Cf. ibid.

[4] Cf. BMU – Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (2016): Ressourceneffizienzprogramm II. Programm zur nachhaltigen Nutzung und zum Schutz der natürlichen Ressourcen (*Resource Efficiency Programme II. Programme for the sustainable use and protection of natural resources* – our title translation, in German), Berlin.

[5] Cf. German Federal Environment Agency (2018): Die Nutzung natürlicher Ressourcen. Bericht für Deutschland 2018 (*The use of Natural Resources. Report for Germany 2018* – our title translation, in German), Dessau-Roßlau.

[6] Cf. BMU (2016): loc. cit.; BMWi – Federal Minister for Economics and Technology (2010): Rohstoffstrategie der Bundesregierung. Sicherung einer nachhaltigen Rohstoffversorgung Deutschlands mit nicht-energetischen mineralischen Rohstoffen (*Raw Materials Strategy of the Federal Government. Securing a Sustainable Raw Materials Supply of non-energy mineral resources for Germany* – our title translation, in German), Berlin.

[7] Cf. IRP (2019): loc. cit.

[8] Cf. acatech (2018): Circular Economy. Impulspapier für den 1. Innovationsdialog in der 19. Wahlperiode am 3. Dezember 2018 (*Impulse paper for the 1st innovation dialogue in the 19th legislative period on 3 December 2018* – our title translation, in German), Munich.

[9] Cf. European Commission (2015): Closing the loop – An EU action plan for the Circular Economy. COM (2015) 614 final.

[10] Cf. Eurostat (2019): Circular economy in the EU. Press release of 4 March 2019, 39/2019.

[11] Transitional arrangements will apply for member states that are far from reaching the targets.

[12] Cf. European Parliament (2018): Waste management in the EU: infographic with facts and figures, in: News European Parliament, 9 April 2018 (data from 2016).

[13] Cf. Eurostat (2019), loc. cit.

[14] Cf. Federal Statistical Office (2018): Waste Balance 2016.

[15] Cf. German Federal Environment Agency (2019): Stoffstromorientierte Ermittlung des Beitrags der Sekundärrohstoffwirtschaft zur Schonung von Primärrohstoffen und Steigerung der Ressourcenproduktivität (*Substance flow-oriented determination of the contribution of the recycling industry to conserving primary materials and increasing resource productivity* – our title translation, in German) (Texte 34/2019), Dessau-Roßlau.

[16] Cf. BMU – Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2018): Abfallwirtschaft in Deutschland 2018. Fakten, Daten, Grafiken (*Waste management in Germany in 2018. Facts, figures, graphs* – our title translation, in German), Berlin.

[17] Cf. German Federal Environment Agency (2018): Waste generation, https://www.umweltbundesamt.de/daten/ressourcen-abfall/abfallaufkommen

[18] Cf. European Parliament (2018): loc cit; data from 2016

[19] Cf. German Federal Environment Agency (2018): Schwerpunkt Recycling (*Focus on recycling* – our title translation, in German), in: Das Magazin des Umweltbundesamtes 1/2018.

[20] Cf. Institute for Futures Studies and Technology Assessment (2018): Recycling von Technologiemetallen (Recycling of technological metals). Case study, Berlin.