



Rethinking the road to the
circular economy

Introduction

Reality bites – let's understand why, as fast as we can

There is a growing feeling of urgency about moving towards a more sustainable economy, as illustrated by the Sustainable Development Goals and Paris Agreement. The circular economy is proposed as a solution for today's environmental challenges, such as climate change.

In 2015 we published '[Rethinking finance in a circular economy](#)'. It gained a lot of traction in uncharted territory. We focused our analysis on opportunities. It helped us, and many partners, to understand the concept much better. Now, five years on, it's time to take the next step. But we face a situation where reality bites: if anything, **the world is becoming less, not more circular**.

This report helps us to **understand** what is happening. It takes a new look at the circular economy. Firstly, it proposes seeing the circular economy as a **means** to an end, a way of causing less environmental harm. Secondly, we must face the strength of **opposing forces**. Thirdly, business needs **policy makers** to step in. And finally, **the financial sector** will have to step up its ingenuity to help scale up the circular economy.

We hope this report helps to address the next steps on our road to a circular economy. It is not an easy road, but understanding the hurdles may help us to step up the pace. Doing so will prove vital, so let's get started as fast as we can.

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Table of contents

Executive summary	3
1. Why do we need to move to a circular economy?	4
1.1 Why do we need a circular economy?	5
1.2 Why is a circular economy not always the solution?	6
1.3 What is the current status of the circular economy?	7
2. What are the hurdles for circular economy growth?	9
2.1 What are the hurdles in the economy?	10
2.2 What are the hurdles in the financing market?	11
3. How can we get the circular economy going?	13
3.1 What policy actions can set into motion CE growth in the economy?	14
3.2 What actions can stimulate financing of the CE?	16
3.3 Case studies: how to deal with the hurdles in practice	18
Sources	20
Appendix I: what is the circular economy about?	22
Appendix II: what are the main circular business models?	23
Colophon	24

Without policy the circular economy will shrink further

We are headed the wrong way

Today's world is far from circular. Research by Circle Economy estimates the world was 9% circular in 2015. As economies grow, that share falls: ING research shows consumers are less inclined to reuse when income rises. Also, higher demand for convenience goods drives up per capita resource demand. The world is becoming less circular as a result.

Circularity as a means to less environmental harm

The circular economy (CE) is seen as a means to several ends. We argue it should be seen, first and foremost, as a **way of reducing the negative environmental impacts of resource extraction, processing and waste.**

Secondary benefits of the circular economy are lower **supply risks related to geo-political tensions and resource scarcity.** These risks are relevant only for a relatively small share of all resources.

Striving for a fully circular economy not optimal

Since we see circularity as a way of reducing environmental harm, we should compare it with other strategies. Sometimes **other strategies can be more effective.** For example, electric vehicles and renewable energy may be more effective in reducing greenhouse gas emissions than a longer life span for cars. It is therefore **neither realistic, nor optimal** to strive for an economy that is 100% circular. CE seems best suited to quickly reducing impacts via **high volume & frequency goods that consist of few, homogenous resources,** such as (food) packaging and textiles.

Market failures main obstacle for circular growth

On the supply side of the economy, market failures are the main reason the CE is not taking off. Firstly, there are three major market failures in the economy:

1. **Negative environmental effects** of market activities (external costs), such as climate change and air pollution, **are not reflected in prices;**
2. **Transaction and operational costs are higher** in a CE, partly explained by the higher labour intensity of reuse and recycling strategies;
3. **Too low volumes** (demand and/or supply) for secondary goods and materials prevent circular markets from coming about.

These market hurdles hamper growth of the CE, by negatively affecting the business case of circular solutions. And even in instances where a positive business case exists, there are three hurdles in the financing market:

4. **Innovation risks are higher:** the innovative nature of the circular economy makes investing in CE riskier than conventional businesses;
5. **Financial institutions overlook 'linear risks':** some risks that are higher in the 'linear' than circular economy are overlooked, such as stranded assets risks and risks of more stringent environmental laws. Overlooking these risks works against the CE;

6. **The Product as a Service business (PaaS) model,** one of the main circular business models, is **perceived to be riskier** than conventional businesses.

Policy needed for scale

Current progress on the CE is too slow given the environmental harm done. **Policies that level the playing field between the current and circular economies are needed** to scale up the circular economy. This study identifies suitable policy actions:

- Price in negative externalities via taxing, norms, bans and subsidies;
- Spur innovations, e.g. platform technology, that lower transaction and operational costs in the CE;
- Disseminate knowledge and implement 'nudges' to increase market interest in engaging in the CE;
- Increase the amount of risk capital for CE start-ups;
- Stimulate further integration of 'linear' risks in financial risk models.

Business and financial sector must tackle hurdles

At the same time, companies can **take up the challenge of bringing the CE forward.** Despite the hurdles, we already see businesses are able to come up with **innovative circular business opportunities.** Financial institutions have to improve their risk approach as well as come up with new financing solutions, such as **project-based financing.**



Chapter 1 | Why do we need to move to a circular economy?

- | | |
|---|---|
| 1.1 Why do we need a circular economy? | 5 |
| 1.2 Why is a circular economy not always the solution? | 6 |
| 1.3 What is the current status of the circular economy? | 7 |

1.1 Why do we need a circular economy?

Reduction of environmental impacts main reason for CE

Circular economy is a means to several ends

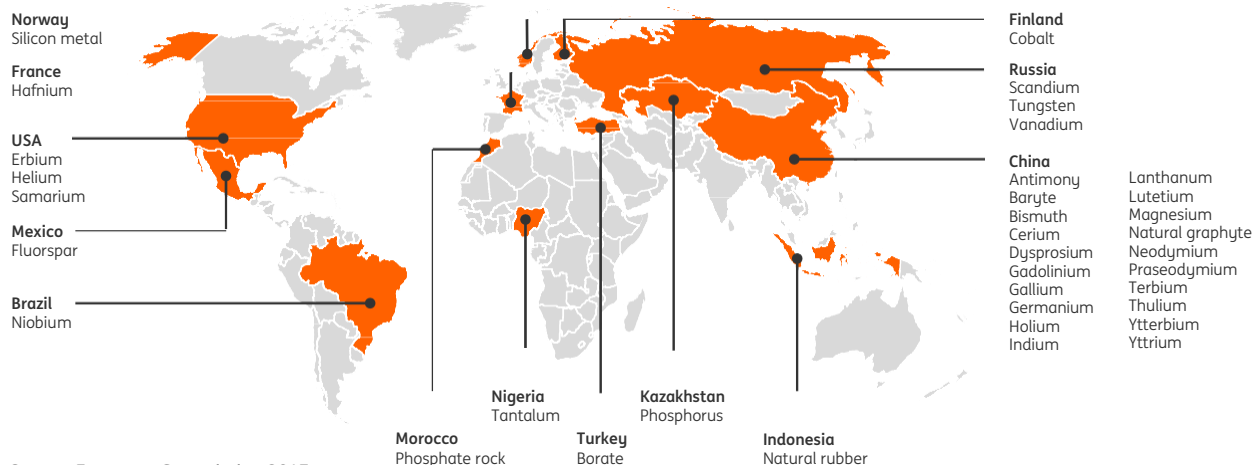
The current economy, which could be thought of as linear, presents us with a few important challenges. The circular economy (CE)¹ can help to tackle some of these.

1. CE market outcome for physically scarce materials

Firstly and contrary to common belief, many resources can **not** be denoted as scarce (PBL, 2017). Only a limited amount of all minerals, e.g. antimony, molybdenum and zinc, are scarce (Henckens et al., 2016). Here, markets will automatically support CE innovations that increase resource efficiency and/or substitute scarce materials, by increasing market prices

Europe depends on other countries for most critical raw materials (CRMs)

Countries accounting for largest share of EU supply of CRMs



Source: European Commission 2017

¹ Refer to Appendix I for a definition of the CE.

for scarcer goods. A more circular economy will therefore be the natural market outcome for physically scarce resources. Given that this holds for a minority of resources, physical scarcity can be seen as the least pressing problem that the CE needs to tackle.

2. CE can reduce a country's supply risks

Dependency on imported resources creates the risk of man-made scarcity in a world with geopolitical tensions. The threat of disrupted supply chains can add to, and result from, political tensions. Given that geopolitical developments are often unpredictable, this can lead to sudden price increases.

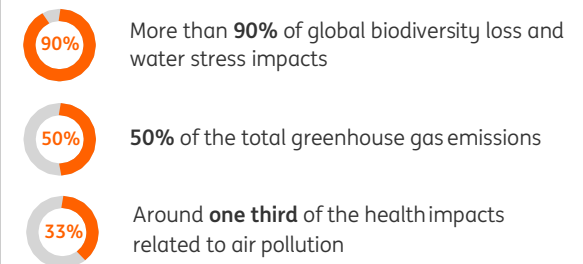
The US and most of Europe are traditionally net importers of primary resources (IRP, 2017). For Europe, China is the supplier of almost two thirds (62%) of all critical minerals. Shifting towards a CE lowers import dependency to the extent that it creates new substitutes for, or opportunities to recycle imported resources. CE in these cases can avoid sudden shocks.

3. Reducing environmental harm main reason for CE

So, scarce resources are only a **small** part of the economy. However, reducing resource use is **vital** for reducing negative environmental impacts. A major share of current negative impacts is related to resource extraction and processing (IRP, 2019). The most pressing environmental issues, loss in biodiversity, water scarcity, greenhouse gas emissions and air pollution are all strongly driven by resource use (see figure below).

Use of resources puts pressure on the environment

Resource extraction and processing account for...



Source: UN International Resource Panel 2019

1.2 Why is a more circular economy not always the solution?

Costs of higher circularity sometimes exceed the benefits

Circular economy is a means, not an objective

The CE is a means of reducing environmental harm. But circular strategies are not always the best solution (the most effective). There are indications of where circularity is, and is not, the most suitable strategy.

1. Other strategies are more effective

In some areas there are real opportunities for alternative strategies. For example in the agricultural sector, where the shift from animal to plant-based proteins is vital in reducing climate change impacts ([Waite et al., 2018](#)). Shifting from meat to plant-based proteins is initially more effective than applying circular practices in livestock production ([De Boer & Van Ittersum, 2018](#)).

In the energy sector, energy transition is key in reducing greenhouse gas (GHG) emissions ([Ellen Macarthur Foundation, 2019](#)). Electrification and renewable energy are relatively quick wins. Moreover, strategies that fit in the energy transition sometimes conflict with the principles of the CE (see figure). Given the fact that a major share of global climate impacts, biodiversity loss and water distress are caused in the energy and agricultural sectors, suggests that circular strategies should not always be the first choice ([European Commission, 2016](#); [Ellen Macarthur Foundation, 2019](#), [IRP, 2019](#)).

Costs of higher circularity exceed the benefits

Sometimes the business case for circular strategies is missing (financial costs exceed the benefits) and environmental gains are limited. For example the recycling of municipal plastic waste, where the optimal level of recycling usually lies below the maximum level. Beyond the optimum point, the extra financial costs (for collection, separation and recycling) exceed the extra financial benefits (the market value of the recyclables) and the environmental gains are small ([Centraal Planbureau, 2017](#); [PBL, 2017](#)). In this case, the extra effort should not take place, from a welfare point of view. Technological developments can shift the optimal recycling level up, by lowering the costs of recycling and/or increasing the quality of recycled materials.

2. Circular rebound may do more environmental harm

Circular rebound effects explain why circular activities can lead to higher resource use and more environmental damage, if these activities increase the level of production. There are two main routes:



First, if circular products do not act as a substitute for primary products, but create a new market. Think of the market for refurbished smartphones, which rarely compete with primary smartphones. Instead, second-hand phones are mainly sold to consumers with low incomes that would otherwise not have bought a smartphone ([Stegeman, 2019](#); [Zink & Geyer, 2017](#));

Second, if circular economy activities increase supply of secondary materials that substitute for primary materials. As supply increases, the prices of the primary materials may fall. This may in turn drive demand for both goods up ([Zink & Geyer, 2017](#)).

Prioritise homogenous, high volume & frequency goods

So, circularity is a way to lower environmental damage, but not always the best or only way. CE seems best suited to quickly reducing impacts for sectors with high volume and high frequency goods, that consist of few and homogenous resources, such as (food) packaging and textiles. Substantive long term gains will be made via circular solutions for complex, lower frequency goods such as electronics and construction.

Lowering GHG emissions not always served best with circular strategies

	Shift to renewable energy	Why this conflicts with the circular economy
 Electric Vehicles	Replace current fleet by electric vehicles as soon as possible to phase out fossil fuel consumption	In the circular economy we want to maintain the value of the current fleet as long as possible to reduce the need to win iron ore
 Solar panels	Solar panels play a pivotal role in reducing GHG emissions.	Used solar panels are currently difficult to reuse and therefore value chains are mostly linear.

1.3 What is the current status of the circular economy? (1/2)

We are becoming less circular

Towards 2050 the global population will increase by 2 billion (UN, 2019b), leading to even more environmental pressure. This in turn increases the urgency of becoming more circular. However, little progress has been made so far. We see:

1. A world that is still far from circular;
2. Two demand trends working in the opposite direction; and
3. Few regions with concrete circularity targets

1. The world is far from circular and it is getting worse

There is no single universally accepted and overarching measure of circularity. However, some of the most important indicators leave no doubt that the current world is far from being circular:

- Research by **Circle Economy (2019)** shows us the global economy is **9%** circular. The percentage indicates the share of recycled materials in all material inputs into the global economy. For the EU this share is somewhat higher, around **12%** (Eurostat, 2019a);

Expansive growth fast fashion conflicts with the CE



1 The calculated calendar date on which humanity's resource consumption exceeds the earth's capacity to regenerate those resources in a year. It fell on July 29 in 2019, compared to September 23 in 2000.

Based on **Earth Overshoot Day**¹ (Global Footprint Network, 2019), it takes **1.75 earths** to support humanity's demands on ecosystems. One important underlying cause is that around **one third** of global annual food production is wasted or lost (European Parliament, 2017);

- Increasing product lifetimes are an indicator of circular economy growth. The number of garments purchased each year by the average consumer however increased by **60%** between 2000 and 2014, while clothing items are kept **about half as long** as in 2000 (McKinsey, 2016). Lifetimes of consumer electronics also seem to be becoming shorter, which has a negative effect on the circularity level (The Guardian, 2015);

2. Two demand trends are going in the wrong direction

Two global demand trends are working against growth of the circular economy:

a. Welfare gains will shift consumption towards less sustainable products. Economic growth will raise per capita welfare levels globally (PwC, 2017). This will in general lead to:

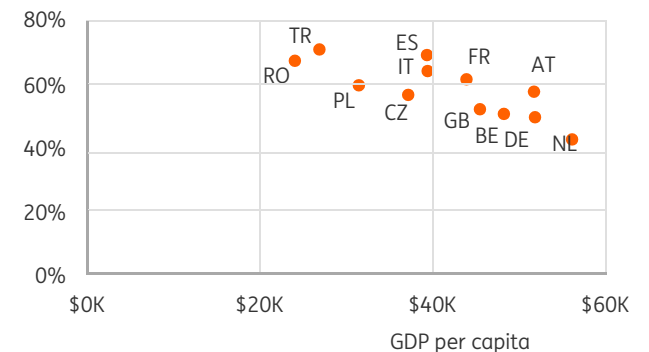
- An increase in per capita consumption;
- A shift towards less sustainable consumption patterns (e.g. higher meat consumption) (Our world in data, 2019). Research by the EEA finds a positive correlation between per capita welfare

and ecological footprints (European Environment Agency, 2015). Recent ING research in addition shows that countries with a higher GDP per capita tend to reuse less (see figure below);

- b. Growing demand for convenience**, as illustrated by the vast increase in demand for convenience food and e-commerce (McKinsey, 2019). This increases the use of packaging and associated packaging waste (ING Economics Department, 2019).

Less inclined to reuse products when income rises

Share of consumers with a positive attitude towards future reuse of products* versus 2018 GDP per capita



* Share of consumers expecting to increase reuse of products in next 3 years by having them repaired if they break (instead of throwing them away)

Source: ING International Survey 2019

1.3 What is the current status of the circular economy? (2/2)

Adoption of CE in policy-making still limited

Circular growth needs a helping hand

The two countertrends (p. 7) illustrate that actions are needed to push the transition to a circular economy, in so far that it contributes to reducing environmental harm. Without taking measures, annual resource use is forecast to double by 2050, while waste is expected to grow by 70% ([UN, 2017](#); [World Bank, 2018](#)).

CE acknowledged as means to reducing environmental harm

polymakers worldwide see the potential role the CE plays in tackling environmental issues. The UN for example acknowledges the role CE can play to reach some of the Sustainable Development Goals and the climate goals in the Paris Agreement ([UN, 2018](#); [UN, 2019a](#)). The Ellen MacArthur Foundation ([2019](#)) has also argued the CE plays an important role in tackling climate change. Multiple countries are exploring ways in which they can apply circular practices to reduce negative environmental impacts.

Adoption of CE in policy making is limited

Despite the growing interest, inclusion of the CE in policy-making is still limited. The contribution of circular strategies to policy goals needs to be better understood and measured. The right measurement tools enable policymakers to define milestones, measurable targets and identify the circular policies that are most effective in tackling environmental issues.

CE requires changes in all value chain phases

Moving to a CE requires changes in the way products are designed, produced and reused. Circularity targets in Europe, however, focus on recycling and waste (the last two product stages). The required changes in design and production are not translated into measurement targets.

Europe and China are leading the way policy-wise

Europe and China are the only regions so far that have adopted the circular economy in policy making. The EU announced in the Green Deal to design a new Action Plan for the Circular Economy in 2020 ([EC, 2019b](#)).

Quantitative circular targets focus on recycling and waste

EU quantitative circularity targets



Source: [European Commission 2019a](#)

Some European countries have complementary circular ambitions and targets. The Netherlands aims to be 100% circular in 2050. Given our previous discussion in paragraph 1.2, it is neither realistic, nor optimal that this can be achieved.

To sum up: we have discussed that moving to a CE is a means to reducing environmental harm. Trends on the demand side of the economy are however working in the opposite direction, pushing down the economy's circularity rate. The next big question is: can the supply side of the economy reverse this trend? We will discuss the main hurdles for CE growth on the supply side of the economy in Chapter 2.



Chapter 2 | What are the hurdles for circular economy growth?

2.1 What are the hurdles in the economy?

10

2.2 What are the hurdles in the financing market?

11

2.1 What are the hurdles in the economy?

Hurdles: externalities, high transaction costs and low volumes

Markets are in favor of linear production

If moving to a circular economy were easy, we would already be much more circular today. Looking at the supply side of the market, the circular economy is more complicated than the current 'linear' economy, in that:

- The CE takes both environmental and financial costs into account;
- Circular strategies require more intensive value chain co-operation; and
- Circular strategies require that secondary markets emerge.

These supply barriers are holding back growth of the circular economy. Until these hurdles are overcome, the circular economy will not take off.

Hurdle 1. Negative externalities not priced

Extraction and use of resources cause environmental costs (think of air pollution and biodiversity loss). These costs are referred to as 'externalities', because they often fall outside of the current market mechanism and remain unpriced. From an environmental point of view it is generally better to use secondary than primary resources, in line with the circular economy (PBL, 2017). However, as long as externalities are not fully taken into account, the financial costs of using primary resources will in many cases be less than the costs of secondary resources. This puts the CE at a competitive disadvantage to the current linear economy.

Hurdle 2. Higher costs in a CE

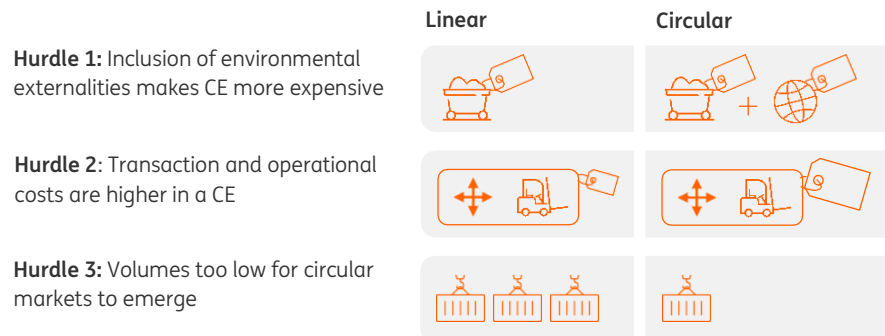
High transaction and operational costs pose a second barrier for the circular economy. Transaction costs include the costs of tracking down second-hand goods, finding suitable partners, organizing the reverse logistics and negotiating the terms of the collaboration. The shift to a CE also implies an expansion of reuse and recycling activities, which are more labour-intensive. This will drive up operational costs related to collecting, sorting out and processing of disposed goods. The international character of value chains makes it more difficult and more costly to find and gather products for reuse. The higher costs discourage new types of co-operation within or between value chains. If these costs are too high, circular markets will fail to emerge.

Hurdle 3. Volumes too low for circular markets

The circular economy requires markets for secondary resources and second hand goods. Many of these markets are nowadays absent due to insufficient demand or supply. This prevents circular markets from coming about. In some cases potential demand for circular goods is in place, but a lack of knowledge, willingness and/or value chain co-ordination hinder the manifestation of circular supply. In other cases a lack of consumer demand is the key issue. Previous research indicates these are the main barriers to CE growth (Kirchherr et al., 2017a).

Volume will be less of an issue for value chains that depend on physically scarce resources and/or that are prone to geo-political supply risks. Here, prices increases of primary resources will stimulate the emergence of circular supply chains and markets.

Three hurdles put the circular economy at a disadvantage



2.2 What are the hurdles in the financing market? (1/2)

Hurdles: innovation risks and 'blind spot' for 'linear' risks

In addition to the supply hurdles in the market economy, there are some hurdles that impede the financing of circular business models¹. As it turns out, there are three hurdles to obtaining finance for CE growth.

Hurdles in the economy hamper financing of the CE

The existence of externalities, high transaction costs and low volumes are also a hurdle to CE financing. Given that this puts the circular economy at a competitive disadvantage compared to linear economy, it is naturally less attractive to finance circular business models. However, there are additional hurdles for CE growth in the financing market.

Hurdle 4. Innovation risks hamper financing of the CE

The **innovative nature** of the circular economy makes investing in CE riskier. The absence of track records makes it harder to estimate future expected profits. These **innovation risks** put the CE at a disadvantage over conventional business models with proven track records.

Hurdle 5. 'Blind spot' for 'linear risks' works against CE

Financial institutions may **not fully take into account the extra risks of linear compared to circular loans and investments**, also referred to as **'linear risks'** ([European Bank for Reconstruction and Development, 2018](#)). If this is the case, this works against financing of the CE. Examples of 'linear' risks are stranded asset risks and risks related to more stringent environmental policies, which will generally be lower for circular businesses. However, financial institutions tend to be focused more on the short-term ([Van Tilburg et al., 2018](#)), while these risks matter for business performance in the longer run.

PaaS model solution to some of the CE hurdles

Businesses with a PaaS business model¹ sell the functionality of a product, rather than the product itself. The property rights thus remain with the supplier and customers use the product through a lease, subscription and/or pay-for-use arrangement. This has a positive effect on the PaaS business case, as it helps to overcome supply hurdles 2 and 3:

- Transaction costs of reuse strategies will be lower, as product ownership is centralised with the PaaS businesses. This reduces the costs of tracking down products at the end of their lifetime (hurdle 2);
- PaaS businesses naturally take on the role of coordinator. If coordination failure is the root cause circular markets do not exist, PaaS models can help to open up circular markets (hurdle 3).

However, the PaaS model has a specific hurdle that needs to be addressed, as it has five ways in which financial risks are higher than of traditional sales models. We will discuss these risks on the next page.

Reasons that make the circular economy riskier to finance

Hurdle 4: Innovative nature

Hurdle 5: 'Linear risks' are overlooked

Hurdle 6: Some CE business models are (PaaS) perceived riskier



¹ Refer to Appendix II for a description of the five main circular business models.

2.2 What are the hurdles in the financing market? (2/2)

Diverging risks of PaaS model pose a challenge

Hurdle 6. Diverging financial risks of PaaS model

Of the five circular business models the financial risks of PaaS models diverge most from linear business models. The perceived higher riskiness poses a barrier for the financing of this model, in addition to the limited experience with the financing of PaaS models. There are four areas where PaaS models have higher risks than traditional sales models:

a. Usage risks are higher

PaaS providers are exposed to higher usage risks, the risk that assets are used at a lower rate than expected, and compared to traditional sales models. PaaS businesses have longer pay back periods (ING, 2015), as expected cash flows are spread over a longer time period (where a sum of money is paid at once in exchange for asset ownership). Often, the length of contracts is shorter than the period needed to pay back the asset investment. The increased emphasis on future cash flows increases the level of uncertainty, as there is no guarantee a new contract will be signed after the current contract's termination date. This negatively affects the financial business case.

b. Risk that collateral value is limited

Liquidity risks of the PaaS model are higher and collateral security lower than in a traditional sales model (ING, 2015). The main assets of a PaaS business are usually the assets leased to customers. These can serve as collateral to lenders.

The collateral value is however limited as these assets are not directly accessible. Collateral value is further limited if assets:

- i. Have relatively low value and/or are dispersed (resulting in relatively high collection costs);
- ii. Fulfill a primary or societal need. Social pressure will in that case prevent financiers from seizing the assets in case of a default;
- iii. By law automatically belong to the owner of the larger good (referred to as legal accession). This is e.g. the case when lighting is integrated in the ceiling of an office. It is in that case part of the superstructure of the building and by law owned by the landlord. Legal arrangements exist that can solve this issue, but this needs to be organised.

c. Credit risks are higher

Credit risks (e.g. the chance of bankruptcy and non-payment) are higher for PaaS businesses. By increasing the affordability of products, they allow customers to

use a product by paying a small amount periodically instead of paying the total purchase value at once. This poses the risk that suppliers attract less creditworthy consumers (adverse selection).

d. Moral hazard risks are higher

PaaS businesses face higher moral hazard risks than traditional sales businesses. In the latter case, property rights are transferred to the buyer when a sale occurs. By doing so, producers shift product risks to the buyer and avoid moral hazard risk: the tendency of consumers to handle a product less carefully if they are not the owner.

Altogether, we have discussed six hurdles on the supply side of the market that prevent the CE from taking off. Given these supply hurdles and the demand trends working in the wrong direction (paragraph 1.3), we conclude that CE growth will not be induced by the market itself and that there is a need for policies. We will discuss what policies are required in Chapter 3.

Five differences that make the PaaS model riskier

- a. Higher usage risks
- b. Limited collateral value
- c. Higher credit risks
- d. Higher moral hazard risks





Chapter 3 | How can we get the circular economy going?

- | | |
|---|----|
| 3.1 What policy actions can set into motion CE growth in the economy? | 14 |
| 3.2 What actions can stimulate financing of the CE? | 16 |
| 3.3 Case studies: how to deal with the hurdles in practice? | 18 |

3.1 What policy actions can set into motion CE growth in the economy? (1/1)

Actions: environmental taxes and stimulation of CE innovations

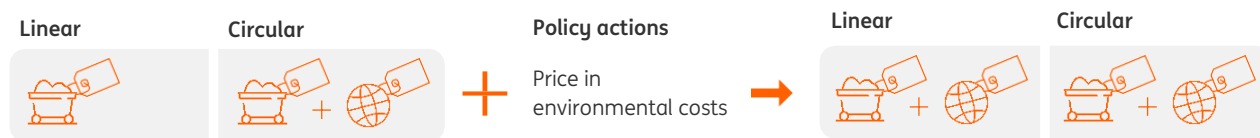
Policies are needed to resolve the supply hurdles in the market for CE growth (paragraph 2.1). This will improve the competitiveness of circular businesses and unlock new circular business opportunities, which will stimulate market players to become more circular. Policies should be aimed at:

1. Pricing in negative externalities;
2. Lowering transaction and operational costs;
3. Opening up markets for secondary goods.

Action 1: price in environmental externalities

Internalisation of environmental costs in market prices helps to level the playing field between the linear and circular economy. This provides an incentive for 'green' consumption and innovation by increasing the relative price of polluting over that of 'green' products. Given that circular production is generally more environmental friendly than linear production, pricing of externalities works in the circular economy's favor.

Policies can create an equal level playing field between the linear and circular economy



¹ This happened with the ban of Chlorofluorocarbons (CFCs) to protect the ozone layer. This triggered the development and use of hydrochlorofluorocarbons (HCFCs), which turned out to be potent greenhouse gases

Taxing most effective

Policy tools to deal with externalities include taxes, subsidies, norms and bans. Some rules of thumb help to see how to reduce pollution at the lowest possible cost. In general it is more effective to ([OECD, 2008](#); [PBL, 2017](#)):

- Tax polluting activities, so producers will seek a lower-cost solution avoiding pollution. Bans or standards only provide an incentive to reduce pollution up to the point where producers are in compliance and not beyond this point.
- Implement norms or bans where consumers are insufficiently sensitive to prices. When implementing a ban, make sure that banned products are not replaced by more harmful products¹;
- Tax polluting activities instead of subsidizing 'green' alternatives. A subsidy may increase total demand, thereby limiting its positive impact;
- Charge polluters for the damage they cause, instead of levying a tax on the end consumer;

Putting theory into practice is complex

Three aspects make pricing of externalities complex:

- Translating environmental externalities into market prices is difficult:** available estimates are highly uncertain ([CE Delft, 2017](#));
- Balance between effectiveness and costs:** often the first-best option is very costly or difficult to implement ([PBL, 2017](#)). Charging the polluter directly for its damage can be more costly than levying a tax earlier or later in the value chain. Moreover, pollutants are in general less easy to observe and measure, than production inputs or end products. However, taxing pollutants is more effective.
- Co-operation more effective, but complex:** Internationally co-ordinated environmental policies are more effective, but also more time consuming and complex to implement. The fact that many value chains are international makes local pricing policies less effective, as externalities related to domestic consumption cause damage abroad.

Another drawback of tackling the issue at a local level is that businesses may move abroad to countries with more lenient environmental laws.

3.1 What policy actions can set into motion CE growth in the economy? (1/2)

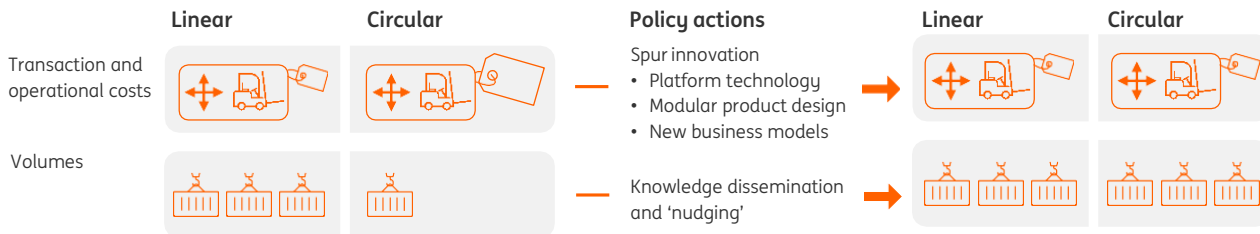
Actions: knowledge dissemination and 'nudging'

Action 2. Spur innovations that lower costs of the CE

By stimulating innovations that lower the transaction and operational costs of the circular economy, policymakers can facilitate CE growth. For example:

- **Platform technology** helps to **lower information costs** by matching supply and demand for residual waste streams and secondary products;
- **Modular product design** can help to improve the reusability of products and/or **lower the operational costs** of reuse;
- **New business models** help to improve the infrastructure for circular strategies. An example is [Madaster](#), a library and generator for material passports, which helps to lower the **costs of tracing** the provenance of materials in real estate.

Policy actions bring linear and circular more in balance



Mission driven innovation

Mariana Mazzucato stresses the structural role of governments in fostering innovation ([Mazzucato, 2018](#); [EC, 2018](#)). She argues that policymakers can stimulate innovations that lower the costs of the CE by defining concrete and engaging circular missions. These missions need to be supported with measurable targets. Furthermore, financial and non-financial instruments are needed to foster bottom-up innovation: think of conditional subsidies and loans, Public-Private-Partnerships and CE procurement standards ([Van Tilburg et al., 2018](#)).

Stimulate cross-value chain collaboration

Collaboration between suppliers within and between value chains is key in a circular economy. Appendix 2 discusses the increased interactions in circular value chains by discussing the five main circular business models. Policymakers should therefore encourage value chain players to collaborate with each other, by defining missions from a problem-focused instead of a sectoral

lens: it is for example better to aim for 100% carbon neutral cities, than a 100% fleet by 2030. Meeting the first requires collaboration between multiple sectors, while the second solely focuses on the automotive sector.

Action 3. Knowledge dissemination and 'nudging'

Dissemination of CE knowledge among consumers and producers and 'nudging' can increase the effectiveness of environmental taxes and innovation policies ([Centraal planbureau, 2018b](#)). Kirchherr et al. ([2017a](#)) find that lacking consumer interest and awareness and a hesitant company culture hold back growth of the circular economy. The CE concept has not become mainstream yet and is still mainly the domain of sustainability professionals.

A campaign on the need to throw glass in recycling containers in the Netherlands is a successful example of knowledge dissemination. It has enabled the recycling of glass by changing consumer behaviour ([Centraal planbureau, 2018a](#)). Nudges are interventions that steer people in particular directions but fully preserve freedom of choice. Take for example the placement of coloured foot steps in the direction of stairs, to encourage people to take the stairs. Both knowledge dissemination and 'nudging' can help to realise the scaling up in demand needed to open up circular markets, and can trigger businesses to explore available circular business opportunities.

3.2 What actions can stimulate financing of the CE? (1/2)

Inclusion of 'linear risks' levels the playing field

Even with the discussed policy actions on the previous page, circular businesses are still disadvantaged in the financing market, due to the three hurdles in this market:

- Innovation risks of CE businesses are higher than of proven business models;
- Financiers tend to overlook the exposure of conventional businesses to 'linear' risks;
- Deviating risk profile of PaaS business model.

policy-makers can stimulate financing of the CE in different ways (actions 4 and 5). Financiers can further develop financing solutions for PaaS models to reap the benefits of this business model.

Action 4. More risk capital for CE start-ups

Governments can **increase the amount of risk capital for CE start-ups** to stimulate financing of the CE. Research by Oliver Wyman (2017) indicates that limited availability of risk capital is a barrier for CE growth in the Netherlands. policy-makers can influence the amount of CE risk capital in two ways (Van Tilburg et al., 2018).

- Indirectly, by providing guarantees for private loans or investments in the CE; or
- Directly, by providing loans to the CE, or investing in CE start-ups. Reviewing the conditions attached to existing public innovation funds can help, if these are focused on technological ('hard') innovations. CE innovations tend to be 'softer' (e.g. business model or organisational innovations).

Action 5. stimulate further integration of environmental and linear aspects in risk models

Research shows that **'linear' risks** and environmental aspects are not fully incorporated in decision-making by financial institutions (Centre for Sustainable Finance, 2016; EBRD, 2018; DNB, 2019). Existing **instruments to measure** these risks **need further improvement** in order to take them into account. This will increase the interest of financial institutions in financing CE ventures:

- **Portfolio adjustments:** a major shift from 'linear' to circular financing will help to reduce environmental harm. This will in turn mitigate the adverse effects of environmental harm on financial business performance;
- **Individual investment decisions:** circular businesses are less exposed than conventional businesses to e.g. reputational risks and the trend towards more stringent environmental laws.

Encourage data investments for 'linear risk' modelling

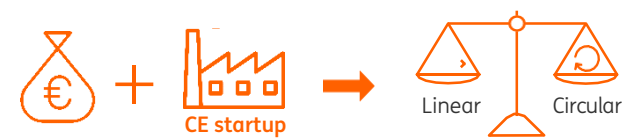
The researchers from CCSF show that a lack of data discourages financiers to develop tools that include environmental aspects in risk models. Policy-makers can stimulate market players to invest in the availability and quality of the required data, by e.g. expanding disclosure requirements on environmental aspects. An example is the recently implemented sustainability disclosure requirements by the European Commission (2019).

Shift focus to long term performance

Another way in which policy-makers can stimulate integration of 'linear risks' is with governance adjustments that shift the focus of financial institutions to the longer-term. Research shows us that the tendency of the financial market to focus on the short-term is partly driven by the practices and regulations that govern them (Caldecott & McDaniels, 2014).

Take for example the adjustment of the solvability rules for insurers (Solvency II) that enable investments with longer-term horizons (Van Tilburg et al., 2018). Sending credible signals on future tightening of environmental regulations is another way to stimulate a longer-term focus, by making lenders take into account the higher legal risks of linear businesses. This will improve the competitiveness of environmentally friendly over conventional businesses and will thus work in favour of the CE.

More risk capital for CE start-ups helps to level the playing field



3.2 What actions can stimulate financing of the CE? (2/2)

Financiers need to develop tailored solutions for PaaS model

Financiers need to develop new financial solutions

Of the five circular business models, it is the PaaS model that has diverging financial risks compared to traditional sales models. It requires that financiers develop new financial solutions that help to deal with the extra risks discussed in paragraph 2.2. The limited experience with the usage risks of PaaS businesses poses an important barrier for the financing of these businesses. It is up to the financial sector to explore ways of managing these risks.

Exploring ways to deal with usage risks

Financiers are currently looking into ways **to deal with the extra usage risks** of PaaS models. Possible solutions for financing PaaS businesses are different for business-to-business (B2B), versus business-to-consumers (B2C) oriented businesses:

- **B2B:** usage risks can be managed with legal contracts that provide security on future expected cash flows. These contracts enable the use of project-based financing models, where finance is provided to a project, instead of a company. The financing business case is then based on future expected cash flows, rather than on past track records. The security about future cash flows that can be obtained from contracts is higher for longer-term contracts. Given the long-term nature of many of these contracts, project based financing provides a solution for B2B PaaS models;

- **B2C:** these PaaS businesses often rely on short-term contracts, limiting the security they provide on future cash flows. An alternative scenario to fall back on is therefore needed in the case expected PaaS revenue falls short. Guarantees may provide a solution here, e.g. if the asset manufacturer agrees to buy back assets that cannot be marketed by a PaaS provider.

A thorough assessment of the creditworthiness of the customers underlying the contracts is a prerequisite for contract-based financing.

Identifying the most viable cases

Financiers need a method to pre-assess the business opportunity of different PaaS propositions based on relevant characteristics and past experience. This will help to allocate means more effectively, as the financing of PaaS businesses requires a tailored approach and is therefore more labor-intensive and costly (e.g. it takes time to set up the legal contracts needed for project financing). Relevant characteristics are e.g. collateral value, costs of relocation of assets and estimated market size.

Embedding the circular economy

Embedding knowledge of the circular economy in financial sector is essential to trigger financing of the circular economy. Employee training and empowerment are needed to enable them to identify, assess and finance circular businesses.

Financial sector as catalyst for circular growth

Beyond these actions, the financial sector can act as a catalyst for CE growth by helping to establish the collaboration needed for a flourishing circular economy. Due to its extensive network within and between value chains, the financial sector can facilitate the shift towards circular value chains.

Businesses and financial sector need to tackle hurdles

We discussed the role of policies in levelling the playing field between the circular and linear economy¹. But the CE can only get off the ground if businesses and the financial sector also take up the challenge of becoming more circular. By joining forces we can tackle the hurdles for circular growth (Chapter 2). The case studies discussed on p. 18 and 19 show us how businesses have already come up with innovative ways to deal with the CE hurdles. Business ingenuity is crucial for accelerating growth of the circular economy.

¹ The actions discussed cover five important policy areas, but are not exhaustive.

3.3 Case studies: how to deal with the hurdles in practice (1/2)?

Business ingenuity can unlock circular business opportunity

Although policies are needed to lower the CE hurdles and accelerate CE growth, there are ways in which businesses can deal with them in the meantime. The case studies in this section illustrate how the circular economy is making progress, with business ingenuity and creativity. **Technological inventiveness** is the starting point for most of the business cases. One key is companies finding **'win-win'** solutions, such as finding a way of making consumers' lives easier or offering them additional protection against risks. This way, customers have a personal benefit in purchasing circular solutions. **Scaling up to achieve** efficiencies and finding ways to **finance the related risks** are other keys to success.



Success: commercial & circular interest are aligned

Swapfiets offers cycling as a service in many European cities. The bicycle fleet has grown rapidly towards 175,000 users. Swapfiets offers its clients 'a bike that always works'. With this service, **customers are free of the burdens** of owning a bike such as repairing flat tires, regular maintenance and **being insured against theft** (with a deductible excess). The main purpose of the PaaS model is to offer cycling as a service, not to increase circularity. However, **commercial and circular interests are aligned**. In order to offer 'a bike that always works', Swapfiets uses more expensive parts to ensure the high quality and lifespan of the bike. E.g. more durable alloy rims and lighting that works on magnetism instead of batteries.

Hurdle: moral hazard risk poses a challenge

Bikes are expected to last six years. The first Swapfiets bikes have been on the road for two years now. So currently the reverse logistics flow of bikes is limited and confined to repairs during the lifespan of the bike. A plan for what to do with used bikes after six years will be developed when they have reached the end of their economic lifespan. Besides charity purposes, **it is unknown yet if the business case to give the bikes a second life is commercially viable** ([hurdle 2](#)). Furthermore, the company wants to **reduce 'application fraud'** as some customers stop paying soon after receiving the bike ([hurdle 6d](#)).

FAIRPHONE

Success: incentives & efficiency wins to close the loop

The fairphone is a smartphone fully designed by circular principles. The phone is **modular by design**, so that batteries, screens, cameras and so on can easily be replaced or upgraded. It offers customers the option of having the phone repaired (and even doing this themselves), rather than having to replace it. Fairphone intentionally introduces new models infrequently so that customers use their modules and phone longer. **Fairphone closes the loop with financial incentives to return old smartphones** (both fairphones and other brands), and **optimising recycling streams per module**.

Hurdle: circular phone much more expensive

The fairphone is designed to be used for five years, twice as long as the average smartphone. However, performance and design are middle of the road at the time of purchase. That could restrict repairability in 3-5 years as the model might be viewed technologically outdated by users (even when updates are taken into account).

The circular premium of around €200 is likely to be too high to make it a product for the mass market, so demand is likely to be limited ([hurdle 3](#)). The price difference is caused by the fact that costs for modular design and production are higher ([hurdle 2](#)) and the fact that negative externalities of cellphones produced in the linear economy are not priced in ([hurdle 1](#)).



Success: modular design, 3D printing and recycled inputs

Signify, formerly known as Philips Lighting, produces high quality, energy efficient and circular lighting solutions. Production has become more sustainable through eliminating waste and the use of 100% renewable energy by 2020. Products are circular due to **circular design thinking**, new **3D printing techniques** for which the materials can be reused and **increased use of recycled plastics**. The lights' material footprint has been reduced by 47% as a result. Signify sees that clients increasingly demand circular services, such as serviceable lights and replaceable components.

Hurdle: low demand for circular lighting

Demand for fully circular lighting is still low ([hurdle 3](#)). A systemic change towards a circular economy requires many changes in multiple dimensions like product design, reversed logistics, collaboration, business models, cultures, etc. They also need to converge at the same time.

Launching customers such as governments can accelerate demand for fully circular service models (Light as a Service) via government initiatives like the EU package for circular economy, Green Public Procurement and Green Deals.

3.3 Case studies: how to deal with the hurdles in practice (2/2)?

Business ingenuity can unlock circular business opportunity



Success: circularity increased with operational improvements & innovations

Dretea is a manufacturer of office furniture (chairs, tables and cabinets) with a strong focus on circularity. In the past years circularity was improved by **reducing waste, using better resources such as recycled monoplastics and the quantification of the ecological footprints of products**. Currently circularity is improved through **circular contracts**, including PaaS. Dretea also puts a lot of **R&D effort into bioplastics** that could be substituted for plastics from fossil fuels.

Hurdle: circular procurement is more costly & time consuming

The product life of office furniture has been extended by circular design and production. However, electronics have increasingly become a feature of office furniture. Think of electronically adjustable tables and digital lockers. As a result, **software updates and replacement of electronic parts need to be an integral part of the circular proposition**.

Circular procurement is gaining popularity but is still complex in practice.

- Customers need to have realistic ambitions. In businesses with **low profit margins** like **office furniture** it is **costly to trace the origin of every single material** in the product as is often demanded in tenders ([hurdle 2](#)).
- Furthermore, **customers have diverse goals**. Some focus on CO2 reduction, others on resource efficiency or both and the focus can change during the procurement process.
- For businesses, circular procurement can be improved by a more holistic view on circularity (not only the office furniture, but also carpets and lighting, not only in the headquarters but in every building of the company, etc). In practice, **businesses may start with fully circular tenders that lose their impact as they become fragmented** ([hurdle 2](#)).

Nowadays, fashion plays a role in the office furniture market. Tables that facilitate both sitting and standing have gained popularity quickly. As a result, **prices for second hand tables that only facilitate sitting have collapsed**. Low prices limit the possibilities to cover collection, refurbishment and distribution costs in order to give them a second life ([hurdles 3 and 6c](#)).



avantium

Success: growing demand & focused on innovation

Avantium develops innovative chemistry technologies across industry value chains in order to produce chemicals and materials based on renewable feedstock instead of fossil resources. It is best known for the **development and production of bioplastic PEF** that can replace fossil fuel-based PET plastic that is used in plastic bottles for water and carbonated soft drinks. Avantium is not a standard circular company; it however produces 'bio-based' resources that are essential for circular supply chains and circular companies. Avantium has developed **several technologies for bioplastics** and is now increasing production capacity by building production facilities. **Global demand for bioplastics is high** and global production is currently at maximum capacity.

Hurdle: scale needed to lower operational costs

In the past, improving plastic supply chains was all about substituting fossil fuel-based plastics with bio-based plastics and improving the quality of the bioplastics. Nowadays, this needs to be complemented by end-of-life policies to fight the plastic soup problem, both in water and on land, as a bio-based plastic soup is also harmful to the environment.

Global production capacity must be increased so that economies of scale can make bioplastics cost competitive ([hurdle 2](#)). The well known 0.5 litre bottle provides a case in point. Mass production of a plastic PET bottle costs around 6 eurocents per bottle. **With current low production volumes a bioplastic bottle costs almost three times as much**. This will go down when produced at mass scale. The pricing of negative externalities of PET and glass bottles or aluminum cans also improves the business case of biobased bottles ([hurdle 1](#)).

Financing green chemistry is difficult as it requires a long-term horizon, is capital intensive and is a high risk business ([hurdles 4 and 5](#)). Avantium has successfully passed through the 'valley of death' where many new ventures fail to attract sufficient finance or become a listed company. Becoming a profitable business in the coming years will further improve the company's ability to attract finance.

Finally, **better information is needed for consumers** as many cannot see the wood for the trees in the complex world of sustainability, circularity and plastics. Many believe that bioplastic means that it is biodegradable, while the term instead focusses on the resources from which the plastic is produced. While PEF degrades much faster than fossil-based plastics, it will take years. This incorrect view prevents consumers from disposing of them correctly, with many entering the environment instead of being recycled.

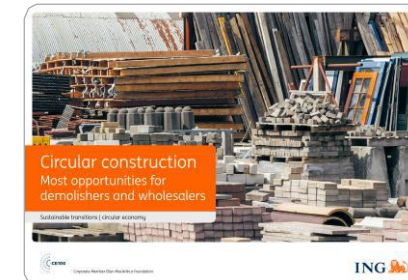
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Also of interest

Circular construction

Most opportunities for demolishers and wholesalers



Rethinking finance in a circular economy

Financial implications of circular business models



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Appendix I: what is the circular economy about?

CE aims for growth, without natural capital loss

What is the circular economy?

Lots of interpretations of the circular economy (CE) exist. It is therefore good to make explicit what we mean by it. Consensus tells us that we should look at both its purpose and its principles¹.

Purpose: economic growth, without natural capital loss

The purpose of a circular economy is to create welfare by realising growth within the earth's regenerative capacity. In other words: economic activities must not result in permanent natural capital loss.

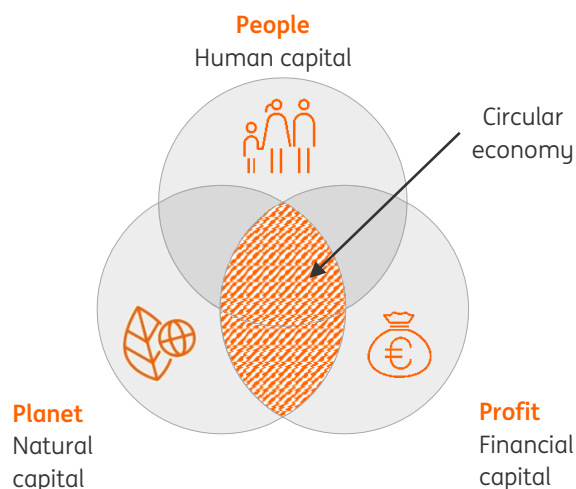
Viewed from the commonly used "triple bottom line" (people, planet, profit framework) the circular economy thus mainly focuses on creating environmental (planet) and financial value (profit).

Three basic principles

A circular economy is based on three principles, being that it aims to:

- **Reduce resource use:** by increasing resource efficiency², consuming less, sharing goods and substitution of scarce resources;
- **Retain value:** the value of goods and materials in use should be kept as high as possible, for as long as possible;
- **Minimise waste:** useful resources or energy of disposed products or by-products should be recovered to reduce waste and resource extraction.

Circular economy mainly focuses on 'planet' and 'profit'



Not just about closing the loops

With the definition in mind we can tackle a common misunderstanding about the CE: unlike of what the name suggest, the CE is not always about 'making circles'.

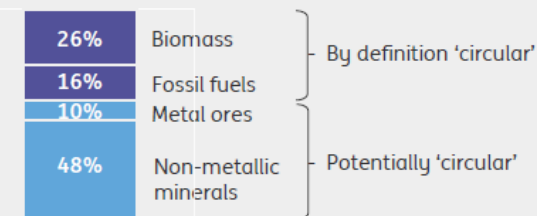
Of the four material types used for production (biomass, fossil fuels, metals and non-metallic minerals), only the material cycles of metals and non-metallic minerals can be closed. Biomass and fossil fuels on the other hand are by definition not 'circular', in the sense that they can only be consumed once: once you eat an apple or use a gallon of gasoline the value drops to zero.

That does not mean that activities related to biomass and fossil fuels do not fit in the concept of a circular economy. However, circularity for these materials is about:

1. Ensuring that the level of consumption does not exceed the earth's regenerative capacity (biomass);
2. Substitution with renewables (fossil fuels);
3. Higher resource efficiency and less waste.

42% material use by definition not 'circular'

Share of global material extraction in 2017



Source: [UN International Resource Panel 2017](#)

¹ There is no uniformly accepted definition of the circular economy ([Kirchherr et al., 2017b](#))

² Resource efficiency: resource use per product

Appendix II: what are the main circular business models?

Five underlying circular business models

Five main circular business models

Circular business models were mentioned a couple of times to discuss the hurdles for CE growth (Chapter 2). Here we describe the main circular business models. We **adopt** the five business models defined by Accenture (2014)¹, which are commonly used as the main business models underpinning the CE.

Why do we need new business models in the CE?

The shifted focus from transactions and cost efficiency as main profit drivers in the linear economy, to higher resource efficiency, less resource use and value retention in the CE explains why businesses need to earn profits in a different way.

1. Circular supplies

Business models based on supplying fully renewable, recyclable or bio-based resources as alternative to single-lifetime inputs.

2. Resource recovery

Business models that recover useful resources or energy out of disposed products or by-products and thus transform waste into value.

3. Product life extension

Business models that extend working lifecycles of goods and materials by reselling, repairing, refurbishing, remanufacturing and repurposing of products.

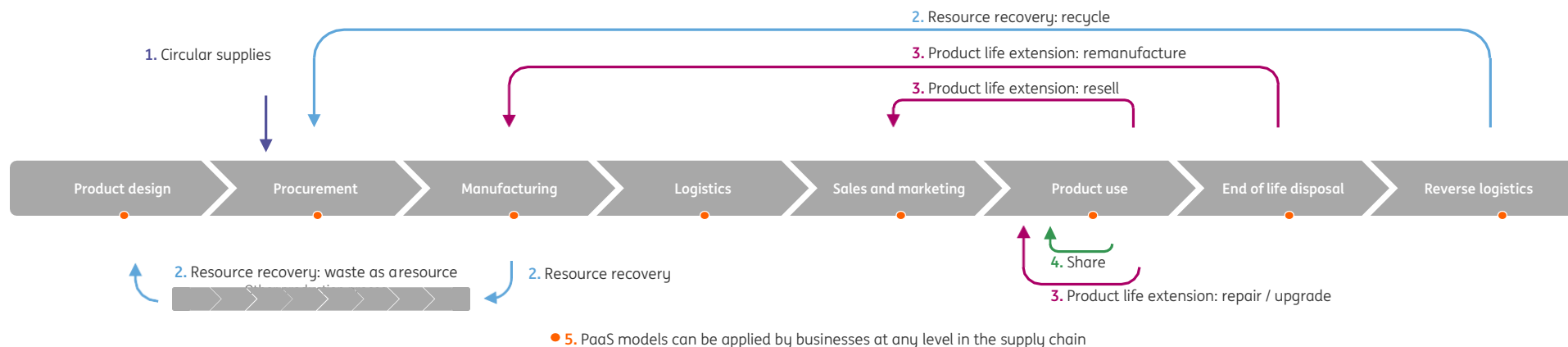
4. Sharing platforms

Business models that promote a platform for collaboration among product users (individuals and/or organisations). The platforms enable increased utilisation rates by facilitating shared use, access or ownership of products.

5. Product as a service (PaaS)

Business models that offer product access, instead of ownership, to customers. Businesses retain ownership of products, while products are used by one or many customers through a lease or pay-per-use arrangement.

Circular business models translate the CE concept into business opportunities



Source: [Accenture, 2014](#); [Kirchherr et al., 2017b](#)

¹Based on an analysis of more than 120 case studies of companies that are generating resource productivity improvements in innovative ways.

Would you like to know more?

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