

Unleashing the Power of the Circular Economy

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Report by IMSA Amsterdam for Circle Economy
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Executive summary

This report for Circle Economy (CE) outlines the general direction and concrete steps that must be taken to accomplish a breakthrough to a circular economy - an industrial system that is regenerative by design. It also provides a knowledge base behind the concept, connecting it to sustainability.

There are several reasons for the recent interest in the circular economy. On the downside, our economic model is currently hitting a brick wall. Industrial development has brought enormous economic growth, but the linear economic model is unsustainable. Resource-scarcity risks are increasing, leading to more volatile prices and supply chains. Our society is headed for global overshoot and collapse. Steering away from this course requires breaking the current bond between prosperity and material consumption, or "decoupling".

The circular economy aims to address resource scarcity and environmental impacts. The current take-make-waste model is to be replaced by a circular one containing a so-called biocycle for biomass and a technocycle for inorganic materials, both involving cascades of reused, recycled or repaired materials and products.

On the upside, the circular model offers enormous opportunities including cost savings by waste reduction, better management of supply chains, companies becoming less sensitive to price volatility of resources, and building a longer and better relationship with their customers. It also boosts innovation, creates new jobs and is good for the environment.

The shift from our current economy to a circular one will take many years. There is no blueprint; we will have to invent it. Major investments are needed with as yet uncertain returns; the hundreds of billions of euros to be gained, as identified by recent reports, still have to be translated into concrete propositions. While some front-running companies are in the lead, cooperation between companies, governments, science and NGOs is crucial for success. This is why Circle Economy aims to accelerate the transition to the circular economy by acting as a go-between platform where the stakeholders can share knowledge and best practices in a safe environment.

To set the wheels of the circular economy in motion, a series of parallel steps are described to guide the way into this uncharted territory (see Table 1). The steps are based on our analysis of obstacles impeding the transition, ranging from financial, institutional, infrastructural and societal to technological barriers.

First, a number of bottom-up steps are needed to kick-start the first “niche” phase, by creating sufficient mass for change from successful circular business in a linear world. For instance by developing a long-term company vision identifying linear risks and circular opportunities.

Second, we need to initiate a number of top-down steps to transform the business environment in order to achieve the “mainstreaming” circular economy phase on the longer term. For instance by creating a tax shift from labour to material resources.

To set the wheels in motion, IMSA suggests organising fora on circularity, both on the circular economy in general and on specific value chains and themes. This enables the stakeholders to transform these steps into an agenda for coordinated actions. Even when not addressing each obstacle to the same extent, such combined action would accelerate the circular economy tremendously. Fortunately, consensus and support for the circular economy are growing while more research reports are due to guide us.

	Obstacles	Niche steps	Mainstreaming steps
Financial	<ul style="list-style-type: none"> 1. Major up-front investment costs 2. Environmental costs (externalities) are not taken into account 3. Shareholders with short-term agenda dominate corporate governance 4. Recycled materials are often still more expensive than virgin 5. Higher costs for management and planning 	<ul style="list-style-type: none"> 1. Set up a simple index for circular performance. Organisations (companies, harbours, governments, investors) can use this to give incentives to their value chain partners encouraging circularity 	<ul style="list-style-type: none"> 10. Replace traditional financial reporting by mandatory and accountable integrated reporting and develop the concept of True Value
Institutional	<ul style="list-style-type: none"> 6. Unlevel playing field created by current institutions 7. Financial governmental incentives support the linear economy 8. Circularity is not effectively integrated in innovation policies 9. Competition legislation inhibits collaboration between companies 10. Recycling policies are ineffective to obtain high quality recycling 11. Governance issues concerning responsibilities, liabilities and ownership 	<ul style="list-style-type: none"> 2. Encourage experimentation, innovation and redesign. In NL, use Green Deals to remove legislative obstacles and support access to finance and a resource passport 3. Gather and spread successful business examples 	<ul style="list-style-type: none"> 11. Create a tax shift from labour towards natural resources
Infrastructural	<ul style="list-style-type: none"> 12. Limited application of new business models 13. Lack of an information exchange system 14. Confidentiality and trust issues hamper exchange of information 15. Exchange of materials is limited by capacity of reverse logistics 	<ul style="list-style-type: none"> 4. Integrate circular economy principles in education and training programmes (leadership, in-company, MBA, economics, engineering, design and policy sciences) 5. Develop a long-term company vision identifying linear risks and circular economy opportunities 6. Search for material pooling opportunities 	<ul style="list-style-type: none"> 12. Implement a new economic indicator beyond GDP that steers towards circularity 13. Establish international independent systems to organise materials flows, including data gathering and exchange, labelling and certification, impact assessment, standardisation and material pooling
Societal	<ul style="list-style-type: none"> 16. Lack of awareness and sense of urgency, also in businesses 17. GDP does not show the real progress or decline of our society 18. Resistance from powerful stakeholders with large interests in status quo 	<ul style="list-style-type: none"> 7. Promote circular products using modern marketing techniques and social media 	<ul style="list-style-type: none"> 14. Adjust national and international government policies for corporate governance, accounting, competition, recycling, and health, safety and environment
Technological	<ul style="list-style-type: none"> 19. Limited attention for end-of-life phase in current product designs 20. Limited availability and quality of recycling material 21. New challenges to separate the bio- from the technocycle 22. Linear technologies are deeply rooted 	<ul style="list-style-type: none"> 8. Prepare roadmaps for established economic sectors 9. Initiate and stimulate stakeholder fora about the circular economy 	

Table 1 Overview of obstacles, niche steps and mainstreaming steps for the circular economy. For the analysis of obstacles see Appendix I; for the steps see sections 4.2. and 4.3.

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Preface

About IMSA

IMSA Amsterdam¹ is an independent think tank and consultancy & research firm committed to the environment, sustainability and innovation. IMSA operates on the interface between industries, governments, NGOs, science and the critical outside world. In close cooperation with our clients we are looking for new roads to sustainable development.

Since 1985, IMSA has given strategic advice to companies that were hitting sustainability barriers related to material resource use. In addition, IMSA takes initiatives to bring stakeholders together on complex sustainability issues, such as plastic marine litter. In 2012, IMSA published for the Port of Rotterdam a discussion paper analysing the success factors for a circular economy in Rotterdam.^[1]

In 2012, IMSA Amsterdam became a partner of Circle Economy. This study forms a contribution to the Circle, in which we wish to further expand the knowledge base underlying the circular economy.

About Circle Economy

Circle Economy² (CE) is a non-profit organisation based in the Netherlands with the aim to accelerate the transition from a linear to a circular economy. Circle Economy believes that radical system change “inspired by nature” is vital and that companies and entrepreneurs play a pivotal role in the transition. It acts as an open and embracing network, with the backing from companies and individuals from all over the world. Circle Economy is focused on taking action, and helps organisations and individuals to realise their circular projects. It is based on a member/partnership model. Examples of current partners of CE are AkzoNobel, Desso, DSM, Philips, KICL, Van Gansewinkel as well as Turntoo, IMSA, Herman Wijffels and Louise Vet. Circle Economy can serve them by acting as a go-between platform where they can share knowledge and best practices in a safe environment.

Experts and stakeholders

We thank the experts and stakeholders listed in Appendix II for their helpful input in developing this report.

¹ www.imsa.nl

² www.circleconomy.com

Circular Economy



Introduction

This is a report for Circle Economy

This report was written at the request of Circle Economy (CE), a non-profit organisation based in the Netherlands with the aim to accelerate the transition to a circular economy (see Preface). It outlines the general direction and concrete steps that must be taken to accomplish a breakthrough to a circular economy - an industrial system that is regenerative by design.

In addition the report seeks to provide a solid knowledge base behind the concepts of the circular economy, to put the ideas in the broader context of sustainability, identify obstacles that impede the transition to a circular economy, and make a clear distinction between steps that can be taken to create sufficient mass for change (bottom-up) and the transformative steps that are needed to change the business environment (top-down).

Scope and structure of this report

This report gives a global overview of the practical steps towards a circular economy. The recommendations, though quite general, are written with the specific Dutch context in mind, but with the potential to extrapolate to Europe. A further breakdown of each step into specific actions is outside the scope of this report. For reasons explained in the box on page 12, the transformation towards a sustainable energy system and dematerialisation are not discussed either.

The report is structured as follows. In Chapter 2 the necessity for a circular economy is sketched. It shows that smart usage of natural resources is not only needed from an environmental point of view, but also a huge business opportunity and a prerequisite for dealing with critical resources. The fundamentals of the circular economy are outlined in Chapter 3. We loosely follow the approach of the Ellen MacArthur Foundation^[2], but also briefly discuss the history of the idea and alternative perspectives on the topic.

Chapter 4 forms the core of this report. Based on desk research, expert interviews and one expert meeting, 14 steps were identified that can promote a change towards a circular economy. Behind these steps lies a detailed analysis of current obstacles, which is made available in Appendix I. We discern two types of steps. The first type includes measures that can already be taken under existing rules and regulations. They are relatively straightforward and aim to increase the share of circular business (bottom-up). To make circular business models the norm for the entire economy a different type of measures is needed. These are aimed at transforming the business environment (top-down).

Our economic model is hitting a brick wall

Industrial development has brought enormous economic growth

During the last century, industrial and technological development in combination with global trade has resulted in an enormous economic growth, which has propelled human welfare. In developed countries living standards are high, and countries like China, Brazil, India, Indonesia are quickly catching up. This development path is rooted in exponentially increasing resource usage. During the twentieth century, worldwide material consumption increased eight-fold.^[3] By 2050, global resource use is expected to have tripled.^[4]

But the linear economic model is unsustainable

More and more signs show that this practice cannot be sustained.^[5, 6, 7] The dominant business model behind economic growth is a linear process, also characterized as "take, make and waste".^[8] This model is "disconnected" from the physical world, because the impacts on human, social and natural capital and the long-term availability of critical resources are not taken into account. The price for negative environmental impacts, called externalities, is either too low (as is the case for CO₂ in the EU ETS system) or non-existent (as for biodiversity loss).

As a result the human footprint exceeds the Earth's biocapacity by more than 50 per cent.^[9] Planetary boundaries have already been exceeded for climate change, biodiversity loss and the human interference with the nitrogen cycle. The boundaries for global fresh water use, change in land use, ocean acidification and interference with the phosphorous cycle are soon to be approached.^[10]

The world thus faces an unprecedented number of environmental challenges that are global in scope and interconnected by nature.^[11, 12] The growing population, globalised markets and growing material consumption will even further increase environmental and social pressure.^[13, 14]

Our society needs to steer away from global overshoot and collapse

Concerns about the effects of economic activities on society and environment have been vented for 50 years. In 1972, the report *Limits to Growth* was published by the Club of Rome and spread the alarming message that with business-as-usual, the human population is headed for global overshoot and collapse.^[15] In an update and review of this report the unsettling conclusion was reached that the changes in policies over the past 30 years had been insufficient to get on a more sustainable track.^[16, 143] The current financial crisis is a symptom of the economy itself suffering from a linear production model.^[5, 8, 12] Thus, out of necessity, mankind needs to break the current bond between prosperity and material consumption.^[17, 18]

In very general terms there are two paths to achieve this goal.

- 1 To make economic success independent from resource use (resource decoupling) and minimise the environmental impact of resource usage (impact decoupling). To operate within the planetary boundaries, an *absolute* decoupling needs to be realised.
- 2 To re-evaluate what is meant by economic success. In other words: a reorientation from production of goods as in GDP to other measures of well-being. For lack of an official definition, we call this: welfare decoupling. Both paths are illustrated in Figure 1.

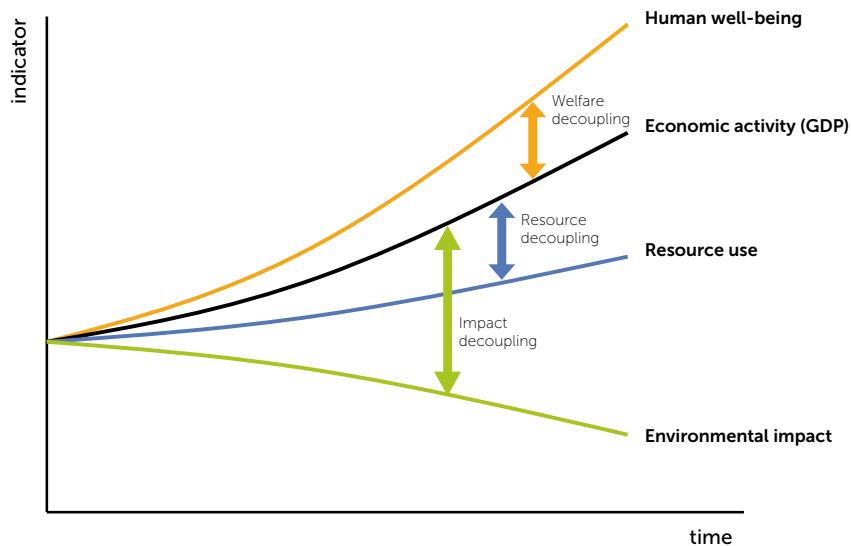


Figure 1. Stylized representation of decoupling (after UNEP, 2011^[7])

A schematic graph to illustrate different types of decoupling. In this example human well-being grows faster than economic activity measured as GDP with relatively less resource use. The environmental impact of economic activities is absolutely decoupled in this example: the total environmental burden is decreasing while economic growth or human well-being increases. N.B. The developments of the four indicators in this figure are not linked to any scenarios, but only mean to illustrate the different types of decoupling

Renewable energy and dematerialisation are not discussed in this report

This report focuses on closing the loops of material resources. Meanwhile, the most pressing environmental crises are related to the energy system with its global dependence on fossil fuels. In line with other writers, we postulate that a general prerequisite for a circular economy is that it derives its energy from renewable resources. For ideas on the steps towards such a system change in energy we refer to the large body of literature that is available on this topic.^[19, 20, 21] In addition, with respect to dematerialisation, the circular economy cannot fully avoid waste and pollution. First, because the rules of nature imply that products and materials cannot be recycled indefinitely without losses or degradation. Second, because people will always litter. Both factors constitute a fundamental limitation for the circular economy, implying it can never achieve 100% circularity. Consequently, dematerialisation is crucial besides renewable energy to reduce the environmental impact of our economy as depicted in Figure 1, even if we close the loops as far as we can.

Resource scarcity risks are increasing

Next to the environmental concerns, there is a growing consensus that many resources are or will become scarce³.^[8, 22, 23] Scarcity refers not only to the limited physical availability of materials, but also has a *geopolitical* (e.g. trade barriers can preclude materials for trade) and *economic* dimension (e.g. limitation in supply chain, distribution problems or market failure).^[24] In addition, scarcity is related to the available *quality* of the ecological (and social) conditions (e.g. air pollution and availability of fertile land).

More volatile prices and supply chains

The linear economic model has prevailed until now, because resources were cheap and abundant. In the last decade, however, prices for natural resources increased or became more volatile.^[8, 25] In 2008, the prices of many commodities peaked. Supply chains themselves are becoming more volatile too. The continuous search for efficiency (maximalisation of throughput) has resulted in extreme fragility.^[22] Companies need to become more resilient against the increased risks of volatile resource prices and supply chains.

Enormous opportunities

The financial crisis urges companies and economies to look for all possible measures to save and stabilise costs. One obvious candidate is the prevention of waste by applying the well-known triple-R: reduce, reuse and recycle. Indeed, several companies have reported impressive cost savings from waste prevention programmes.^[26, 27] The EMF adds redesign, repair, refurbishment, remanufacturing and cascading to the list of strategies.^[28] Moreover, Ellen MacArthur's announcement of the first EMF report at Davos 2012 mentioned a business opportunity for the circular economy of \$380 billion up to \$630 billion per year for Europe alone^[28], while the European Commission estimated annual net benefits of improving business efficiency in the range of €245 billion to €604 billion.^[139]

³ When discussing scarcity, often a distinction is made between renewable resources (e.g. food, water and wood) and non-renewable resources (e.g. oil, minerals and metals).^[24] Both types of resources are vulnerable to the different dimensions of scarcity as shown in a recent study by the The Hague Center for Strategic Studies on scarcity of food, water, oil, gas and minerals in the EU^[30].

Next to the financial opportunities, a circular economy has indirect benefits for business as well: supply chains are better managed, companies become less sensitive to price volatility of resources, and they build a longer and better relationship with their customers. Moreover, it boosts innovation and is good for the environment. In addition, transforming our economy as described in section 4.3 has the potential to create new jobs.^[8, 22]

In recent decades, incremental steps such as increasing efficiency were taken to improve processes and products. The increased environmental and social problems illustrate that these have not been effective enough.^[16, 29] Governments, scientists and businesses all around the world start to acknowledge that a more transformative approach is needed on how we establish our economy. One of these approaches is the circular economy.

The circular economy as a new model

The circular economy aims to address resource scarcity and environmental impacts

In a circular economy, the industrial system is restorative or regenerative by design. Within the circular economy new business models are developed that reduce the need for virgin raw materials. This is accomplished by rethinking how production chains can become closed loops. The circular economy aims to become a new paradigm that essentially changes the functions of resources in the economy: waste material of one (industrial) process will be input for another, and products will be repaired, reused and recycled.^[17]

In the circular economy, as propagated by the Ellen MacArthur Foundation, waste is minimised. This starts on the design table: in a circular economy a product will be constructed in such a way that, at the end of the product's life, the materials, depending on the kind of material, would biodegrade in a safe way or could be easily separated for reuse.^[17, 22] The resources in end-of-life products are valorised for similar or new applications. Key aspect is that material resources circle in short cycles (e.g. with little transportation, as local as possible), in which the material is kept as pure as possible (in order to ease the reuse) and the quality remains as high as possible over the longest possible time. Current supply chains have become vulnerable to disruption. In a circular economy resilience is built in through diversity: a production system with many connections, including tailored and decentralised solutions.^[31]

The circular economy recognises a biocycle and a technocycle with distinctly different design criteria. In the biocycle, biomass returns into the biosphere after product use - either directly or in a cascade of consecutive use. It forms nutrients in the end-of-life phase, e.g. for the soil, without adding to environmental pressures.

The technocycle contains inorganic products and materials such as metals and plastics. These materials should stay in closed loops to ensure circular use of non-renewable resources and to prevent potential pollution. This requires a resource passport⁴, management and exchange of resource-related information, end-of-life systems for flows of resources and products, networks of material exchange and networks of collection.^[32] In terms of business models, the circular economy replaces the concept of a consumer with that of a user. Unlike today, products are leased, rented or shared wherever possible.^[8, 22] In Figure 2 a schematic overview of the circular economy is given.

4 A resource passport aims to disclose product information on the scarcity, toxicity and recyclability of the materials in the product in order to close the resource loops.^[24]

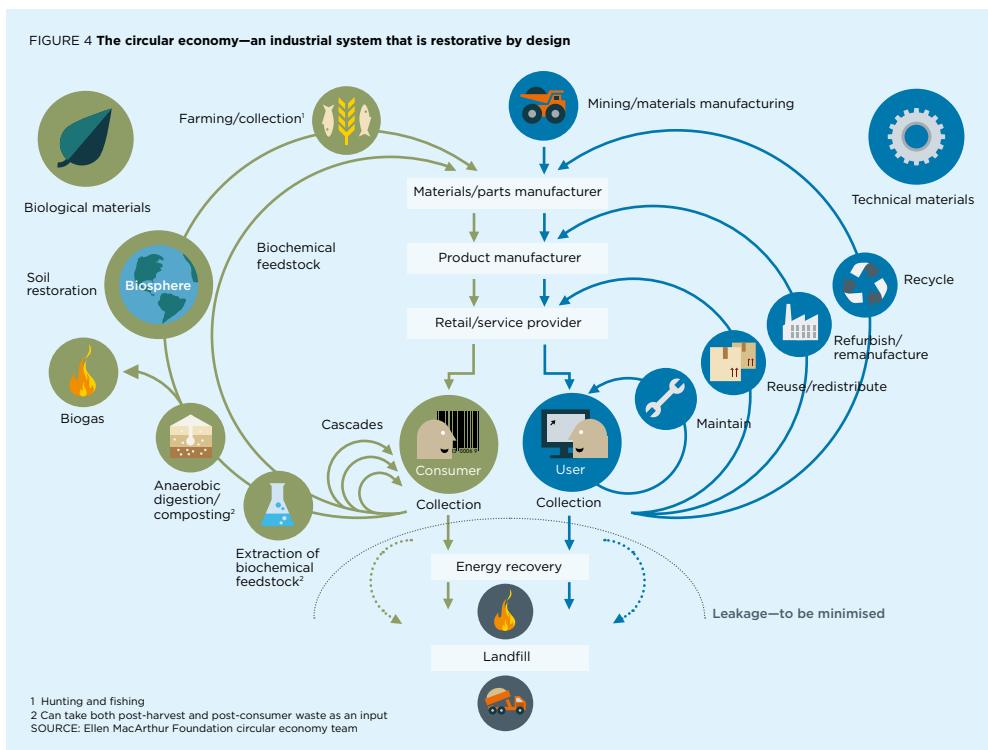


Figure 2. The circular economy consists of the biocycle, the technocycle and cascades

Source: EMF (2012)^[8]

This report
focuses on the
Ellen MacArthur
Foundation's
perspective on the
circular economy

The transition towards a circular economy will be a non-linear process, in which the development of consumption patterns, the scale of influence and technological developments cannot be overseen.^[33] This is also why there is no clear-cut definition of the circular economy. In the EMF approach, material use is decoupled from prosperity, and economic growth from an industrial perspective, with a shift from owner to user but less attention for societal implications.

However, there are a number of other views possible. For instance, some understand that the circular economy is something like a recycling society with similar rules as our own, while others consider the circular economy as a fundamental shift away from material production and consumption and towards decoupling.^[34] Industrial companies tend to focus on the engineering, design and investment challenges of the circular economy.^[20] For many countries, including China, Japan and the USA, the most import driver is resource security. The pragmatic, traditional approach includes stockpiling and diversification of supplies, while using trade policies to consolidate competitiveness.

Some question the underlying philosophy of the societal structure and emphasise the necessary shifts in social and economic values of our society.^[35] Others regard local solutions or collaborative consumption as important aspects.^[36, 37] Finally, there are schools of thought that search for fundamentally different ways of exchanging goods and services, in which a monetary flow may not even be involved.^[31, 36]

This report focuses on the EMF perspective on the circular economy because it is based on system thinking⁵, just like IMSA's methods and Circle Economy's approach, and because it has attracted strong interest from industry as well as other parties.

The circular economy builds on similar concepts such as Cradle to Cradle

The rationale behind the circular economy is not new. The concept was already described by Kenneth Boulding in 1966 as "a long-term aim compatible with economic growth, sustainability and zero waste".^[39] Previously, several proposals were put forward to dematerialise economies by a factor 4, 5 or even 10.^[40, 41, 42] The recent circular economy builds on and extends other approaches such as Industrial Ecology^[43], Biomimicry^[44], Blue Economy^[45], Natural Step^[46] and Cradle to Cradle^[47]. The processes in the biocycle of the circular economy are also discussed within the framework of a Biobased Economy^[48]. Many of these approaches refer to nature as a source of inspiration for innovation and as a metaphor for a regenerative economic model.

Cradle to Cradle considers, like the circular economy, "all material involved in industrial and commercial processes to be nutrients, of which there are two main categories: technical and biological" and aims to "design for effectiveness in terms of products with positive impact, which fundamentally differentiates it from the traditional design focus on reducing negative impacts"^[49]. As one can see, there are many related and overlapping ideas between these approaches.

There is widespread enthusiasm for the ideas of the circular economy. There appear to be several reasons for this. First, the concept is positively framed, i.e. in terms of economic opportunity rather than environmental necessity. Second, it offers ingredients for economic reform in a time of financial crises. Last, the circular economy promises to be an open and transparent concept for companies.^[50] Thus, the circular economy could bring the ideas of Cradle-to-Cradle further for a larger number of businesses.

⁵ System thinking is "the ability to understand how parts influence one another within a whole, and the relationship of the whole to the parts", not only in place, but also in time.^[38]

Steps towards a circular economy



Steps towards a circular economy

4.1 A transition without a blueprint

Cooperation between business, governments, science and NGOs is essential for success

So how do we get there? Obviously, not overnight. The shift will take many years. Existing system structures (values, institutions, regulations etc.) will fade away and new structures will appear.^[51] According to EMF the transition "is likely to be a messy process that defies prediction, and both the journey and the destination will no doubt look and feel different from what we might imagine today".^[52]

In most Western countries, governments have reduced their interference with the market while public awareness of the importance of the circular economy is limited. As a result, the initiative for change lies with companies with a long-term strategic vision.^[53] Examples are the members of Circle Economy as well as business organisations such as the World Business Council for Sustainable Development (WBCSD). Front-running companies are key actors in changing economic practices by means of innovation and change.^[55] However, the businesses driving the transition will have to ask their partners, science institutes, NGOs and governments to assist them in taking the measures needed for success. This is why Circle Economy aims to accelerate the transition to a circular economy by acting as a go-between platform where the stakeholders can share knowledge and best practices in a safe environment. Circle Economy is active in the following leverage points for change: science, research & education; business transformation and innovation; capital and financing; communication; and advocacy. In the area of advocacy, business confederation *De Groene Zaak* cooperates with CE to promote the concept of a circular economy in the Netherlands.^[54]

From niche to mainstream

EMF distinguishes between a pioneering phase and a mainstreaming phase. The identification of different phases is essential because they require different focuses and actions.^[56] In the pioneering phase, the circular economy will be a niche in a linear world. Many circular propositions are not yet competitive. This is the phase we are currently in and which will last for years to come. Steps to take are relatively straightforward and aim at increasing the share of circular business under existing rules and regulations. In the mainstreaming phase, the circular economy will become "normal" practice. Steps to accelerate this phase can start now but include measures to radically change the business environment.



4.2

Setting the wheels in motion

Step 1 Set up a simple index for circular performance

**Companies,
harbours,
governments and
investors can use
a simple index to
give incentives
to their value
chain partners
encouraging
circularity**

Allegedly Einstein said: "not everything that can be counted counts, and not everything that counts can be counted". At the moment there is a discrepancy between what counts in the economy – monetary value – and what should count in creating well-being, i.e. true value. Despite an enormous increase in reporting initiatives, the corporate negative impact on ecosystems continues to increase.^[57] Compared to financial accounting, social and environmental reporting carries less weight in decision-making and moreover suffers from several methodological shortcomings (linked to obstacles 2, 4, 17, 19 in Appendix I).

For the circular economy to become a success, a simple measure of achievement will be needed, as a first step towards fully integrated reporting (see step 10). This allows organisations (companies, harbours, governments, investors) to give incentives to their (chain) partners to become more circular, e.g. in procurement processes. In addition, governments can support front-running companies with tax^[58] or subsidies measures based on the index. It will also provide first insights in true value creation throughout the value chain.

**The CO₂
Performance
Ladder and
Environmental
Ship Index are
effective examples**

Examples for greenhouse gas emissions and air pollution might serve as a template for such an index. The *CO₂ Performance Ladder* developed by the Dutch railway company Prorail stimulates sustainable procurement based on carbon emission and material use.^[59] Another effective example is the *Environmental Ship Index (ESI)*, developed by the Port of Rotterdam.^[60] With a minimum of effort ships are awarded points for an emission performance

2

In the Netherlands, Green Deals can be used to remove legislative obstacles, to relieve upfront investment and develop a resource passport

that is above the current emission standards of the International Maritime Organization. An increasing number of ports use the ESI to award a reduction in port fees to the cleanest ships. The ESI is open, transparent, adaptive, voluntary, and registration is free of charge. Consequently, over 1700 ships have currently registered, which is impressive within the timeframe of two years.

An index for circular performance should be simple to use, based on a synergy of practical and scientific knowledge, transparent in set-up about weighing and limitations, and data used should be open for verification.^[61] The index should be set up in such a way that a maximum number of companies can join.

Companies do not have to wait for such an overall index to be fully developed and implemented. They can already start to realise their own instruments to give incentives such as discounts to their partners, based on the specific attributes of their value chain.

As a starting point for measuring circularity, impact decoupling could be quantified in terms of kilograms and euros, e.g. by quantifying recycling streams more thoroughly. Environmental impacts such as CO₂ emissions can be added as soon as they can be measured with such accuracy that the uncertainties added over the value chain stay well below one hundred per cent.

Step 2 Encourage experimentation, innovation and redesign

In the pioneering phase, policy-making should focus on enabling actors to experiment and stimulate circular economy innovations and redesign of existing products (obstacle 19 in Appendix I) and value chains. For instance, to further develop practical implementation of new business models, reverse logistic systems and a resource passport, room for experimentation needs to be created. In the Netherlands, Green Deals are an existing tool to enhance experimenting activities that foster a sustainable economy. Green Deals help citizens, companies and societal organisations to realise sustainable initiatives. Governments can support with access to finance (see obstacles 1, 7 in Appendix I), mediation between stakeholders towards mutual visions, sustainable procurement (e.g. based on the index mentioned in step 1) and by relieving inhibiting laws and regulation (obstacles 6 – 10).^[62] Using Green Deals for circular experimentation and innovation can help relieve the major upfront investments in new business models and technologies (obstacles 20 - 22), develop new financial models, and provide clarity and guidance on goals, responsibility and liabilities of the stakeholders involved.

**Top sector policy
should support
circular economy
innovation**

In addition, innovation policy needs adjustment in order to stimulate circular research, development and innovation. In the Netherlands, R&D is supported by the “Top sector” policy. Some argue that this policy is ineffective since it does not structurally address the need for a sustainable economy.^[63] It may foster the position of incumbent companies with high interests in the status quo, while leaving little room for the exploration of new business opportunities. Clear commitment towards the circular economy in this policy would be needed. The attention to innovation will be a continued feature in all phases.^[64]



**Lease a jeans –
Mud Jeans**

Step 3 Gather and spread successful business examples

The technical viability of business models based on circularity has already been confirmed for many products and services.^[8] However, although widely studied, as far as we know, new business models – in which consumers become users – are limitedly implemented (obstacle 12 in Appendix I).^[65] Experimentation, as mentioned in step 2, helps to address the limited practical knowledge. It is important to show examples that prove the commercial viability of circular business models, both for entrepreneurs, investors and incumbent firms. They show that existing obstacles can be overcome to generate return on investment. In addition, communicating the creative solutions, valuable insights, success factors and lessons learned of circular business models from pioneering companies can inspire other business to take up circular business as well. Therefore, gathering and spreading successful examples of circular business cases can help accelerate the circular economy. Existing networks such as Circle Economy, The Circular Economy 100 initiated by EMF,^[66] and MVO Nederland^[67] can be helpful in exchanging these examples among interested businesses.

Although too young to speak of a commercial success, one appealing recent example is “Lease a jeans” from the Dutch company Mud Jeans. Rather than buying jeans, you can lease a jeans made from responsibly produced organic recycled cotton. Repair service is free and returned jeans are re-leased as vintage or recycled into new ones.^[68]



Step 4 Integrate the circular economy principles in education and training programmes

The principles of a circular economy, including system thinking and inspiration by nature, should become an integral part of education programmes, especially in the MBAs, economics, engineering courses, design academies and policy sciences, but also in leadership programmes for business leaders.^[8, 137] This is crucial to address the lack of awareness and sense of urgency concerning the circular economy (see obstacle 16 in Appendix I). Front-running companies can start in-company training programmes for all

The circular economy principles, including system thinking, should be integrated in in-company training, MBA, economics, engineering, design academies and policy sciences

personnel, following the example of flooring company Interface. Using training and other measures, they have involved and empowered their entire workforce in the creative innovation process of becoming a circular enterprise.^[69] The EMF is giving special attention to education.^[8] Subsequently, learning is not a responsibility of a single person or discipline. Designers and developers need to cooperate to co-create and produce "utility" in which the possible services and performance, safety, collection, recycling, consequences of littering and end-of-life possibilities are taken into account, like cascading, refurbishing, reuse or biodegradation.^[8, 70, 71] Including consumers and scientists in the design phase helps increase the success of the product.^[72, 73]



Develop a vision based on a life-cycle approach

Step 5 Develop a long-term company vision identifying linear risks and circular economy opportunities

Instead of focusing on core activities only (see obstacles 3, 16, 17 in Appendix I), companies should develop a long-term vision identifying risks of linear activities and opportunities of circular ones, e.g. in their waste streams.^[74] This starts with assessing current practices, e.g. knowing which materials are processed in the products^[75] and understanding what risks and opportunities are related to these. "Will the material become scarce?" or "is toxicity an issue?" are key questions for assessing risks. Perhaps there are opportunities in the use of materials that are abundant or wasted in other value chains?

During the pioneering phase, controlling unintended side-effects of measures aiming at circularity requires extra attention.^[56] A life-cycle approach is an invaluable tool to create awareness of trade-offs in environmental performance.



Material pooling may lead to additional revenue and less waste

Step 6 Search for material pooling opportunities

Businesses can explore opportunities to see how they can collaborate with others in material pooling. This is an activity in which company A exchanges left-over materials with company B that can use it. Material pooling may lead to additional revenue and less waste. This step is linked to a lack of infrastructure (see obstacles 13-15 in Appendix I), but is most of all an opportunity. For neighbouring companies that are not directly competing, collaboration is likely to be more successful.^[76] On the longer term, more complex forms of intelligent material pooling can become profitable.^[77]



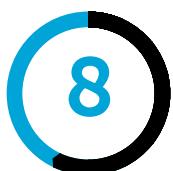
7

Apply professional marketing

Step 7 Promote circular products using modern marketing techniques and social media

There is no demand for circular products and services as such (see obstacle 12 in Appendix I). Within the context of new business models, it is important to consider that circular products or services fulfil needs and demands of consumers at least at a comparable level to the former alternatives.^[18, 78] For a circular economy, people also need to be willing to become more “users” than consumers. Good news is that borrowing and sharing products, selling and buying second hand goods, are rising in popularity.^[79]

Professional marketing is required to reach substantial markets and make a difference in terms of material and financial flows. In general, circular economy products and services should not be marketed as sustainable or green alternatives but on other advantages. The use of established modern marketing techniques for communication^[18, 80] is vital to connect with the motivations of most citizens: societal success, being “cool”, impressive material possessions, a lease car etc.^[81]



Stranded assets of existing business need to be included

Step 8 Prepare roadmaps for established economic sectors

Existing businesses that are strongly rooted in the linear economy stand to lose out on a transformation towards a circular economy (see obstacle 18 in Appendix I). For these parties to avoid or deal with stranded assets, it is essential to have a predictable and clear transition path or roadmap so they can adjust their business models. Such transition paths must be tailored to the specifics of an economic sector. The WBCSD has initiated a process to this end.^[18]

In addition, incumbent businesses need to be informed and assisted by front-running branch organisations such as the Dutch Confederation of Industries VNO-NCW. Those interested can be served in *communities of practice* by government-related organisations such as MVO Nederland and Agentschap NL. In addition, the organisations above and governments should help developing countries to leapfrog.^[17]



Dialogue is crucial for cooperation and success

Step 9 Initiate and stimulate stakeholder fora about the circular economy

Since the circular economy is not a blueprint but a process towards a sustainable economy, collaboration between companies and societal actors is key to success.^[31, 36, 75] This requires dialogue between stakeholders, for several reasons. For instance: to solve governance issues regarding responsibilities, liabilities and ownership; set mutual visions and enhance long-term collaboration towards common goals^[31]; join forces to remove obstacles; co-create; and share opportunities. This requires a good mutual understanding of value chain participants.^[82] In addition, dialogue helps

creating a sense of urgency (see obstacle 16 in Appendix I) and allows for discussions on values where needed. Additional success factors are trust, transparency, open governance, strong leadership and shared learning.^[31, 83]

In the Netherlands, Green Deals (see step 2) can be used to stimulate cooperation on circularity between chain partners and other stakeholders. If necessary, the government should offer financial support during the start-up phase of a forum. This is vital for establishing a trajectory aiming at closing the loop while optimising cost efficiency over the entire circle. To achieve this, powerful players like brand owners and retail need to accept their extended producer responsibility. Questions on how a circular economy should be organised need to be discussed: who will have what responsibilities and liabilities within the value chain; how and by whom will the chain be managed?

While governments, businesses, scientists and NGOs need to collaborate in order to deal with the challenges during the niche phase, stakeholder cooperation is even more crucial for transforming the economy as a whole, as described in section 4.3.

Besides initiating value chain redesign, Circle Economy can foster collaboration and partnerships by providing a safe environment for dialogues on circularity between stakeholders, both at the general level and for specific value chains and themes, to underpin and support concrete circular projects.

4.3

Transforming the economy

**More is needed
to re-shape
the business
environment**

The previous steps can be taken within the current context of a linear economy. However, to acquire a true transformation of the economy, more activities are needed that re-shape the fundamentals of the business environment. This section discusses steps that foster such transformation. While initiating them in parallel with the niche steps, they will require more effort and the results will not be immediate. Experimentation, collaboration and study will be needed to foster the basis to justify these revolutionary proposals. To be effective, such steps need to be reinforced by governments with strong political support for removing all financial, institutional, societal and other obstacles, preferably in an international context.



**Scrutinise
social and
environmental
results with the
same stringency
as financial
results**

Step 10 Replace traditional financial reporting by mandatory and accountable integrated reporting and develop the concept of True Value

An integrated report is essentially a sustainability or corporate social responsibility (CSR) report integrated with the annual financial report. While both the financial reporting and sustainability reporting are subject to rules and regulation with regard to the information presented, those

for sustainability reporting are less stringent.^[145] Moreover, at least in the Netherlands, auditing of the CSR report by an independent party such as an accountant is not mandatory.^[146] In practice, it means that CSR reports differ considerably in what they present and how the information is presented. Critics therefore argue that CSR is used mainly as a marketing tool.

To promote a circular economy it is essential that information on resource use, with its social and environmental impacts, gets treated with the same amount of scrutiny as financial information. This requires an integrated reporting of financial, social and environmental performance that is subject to auditing^[145] (see obstacles 2 and 3 in Appendix I). Mandatory and accountable integral reporting can make companies and their stakeholders aware of the growing linear risks they face, such as water, food and natural resource insecurity and changing consumer preferences, and that do not feature clearly in the company's financial report.^[141] This will help them steer into the direction of circularity and sustainability. Individual companies can already use integrated reporting as an aid for long-term strategy. They can also base their vision on people and planet values beside profit, and voluntarily implement the precautionary approach to, for instance, phase out the use of possibly harmful materials in their products. Businesses and governments together need to start a process that results in a mandatory form of integrated reporting that is subject to auditing.

Develop the True Value concept

There is, however, one step further to take. Ideally, the integrated performance should be expressed by the same measure – the simplest one being money. PUMA, a sportswear company, has pioneered this approach by voluntarily publishing an environmental profit and loss account.^[84] It shows that the company's negative impact should theoretically be valued at €145 million. The World Business Council for Sustainable Development is working on the development of this so-called True Value concept.^[18] If successfully introduced, it can create transparency in true value creation throughout the value chain. Individual companies, following the example set by PUMA, can start by calculating and publishing their own environmental profit and loss account. Integrating the environmental profit and loss account in integrated reporting would be the next step that will transform economies. When applied at a large scale it will fundamentally alter the business environment, since it makes transparent the profit and loss of business to society and environment.



Step 11 Create a tax shift from labour towards resources

The shift from linear to circular business models requires that the true costs of resource use, pollution and waste are not only reported, but actually included in the price of resources (see obstacles 2, 4, 6-8 in Appendix I). Raw materials are now cheaper than recycled materials, because negative effects of take-make-waste are left out of the equation. Such externalities therefore need to

be included in the price of resources. The price level should be predictable, adaptive, but above all high enough to stimulate change from linear to circular.

A shift of taxation towards resources

In practice, governments can accomplish this “true pricing” if they gradually shift taxation from labour to resources. The European Commission has recently propagated the need for shift towards tax on materials in a manifesto.^[85] The current high taxes on labour make businesses minimise their number of employees. Resources, however, remain untaxed or are at least taxed at a lower rate; they are used unrestrained. This system causes unemployment and scarcity of resources. A tax shift bringing tax on resources up and tax on labour down creates an incentive to use materials sensibly. It also makes services more affordable and boosts manpower, craftsmanship and creativity. It enables a circular economy and sustainable prosperity.^[86] It should be noted that national tax policies are strongly related with European policy. International cooperation is necessary for levelling market playing fields, ease competitiveness and reduce costs for business.^[87]



Step 12 Implement a new economic indicator beyond GDP that steers towards circularity

The GDP fails to measure sustainability and human well-being

In addition to step 10 in which measures on the performance at company level are described, measures of success on the macro level should be developed. It is important to be able to measure environmental and social aspects, because we behave according to what we measure and in order to set targets and create policies or incentives.^[88, 89]

The Gross Domestic Product (GDP), our most important macroeconomic indicator, fails to say anything about sustainability and human well-being (see Figure 1 in Chapter 2). An increase in GDP can easily coincide with a growing environmental impact and a reduction of human well-being (see obstacle 17 in Appendix I).^[90, 91] GDP information should be complemented with other measures showing resource impacts, pollution and social impacts.^[89] As long as governments keep basing their economic policies on the GDP, they are bound to counteract circular efforts by companies. On the other hand, when governments start basing their policies on a new economic indicator that includes circularity, they will actively steer the economy in that direction. As a result, they will start supporting and accelerating company policies following from integrated reporting. The United Nations and World Bank actively support the development of a sustainable development index beyond GDP.^[136]

Existing indicators could be used as a start

Indicators that could complement GDP and include measures of circularity already exist, but are limitedly implemented. The Decoupling Index proposed by UNEP gives a first insight in how the economy performs by taking material use into account. It shows the ratio of the change in the rate of consumption of a resource, or production of a pollutant emission, to the change in the rate

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International independent systems are needed for data gathering and exchange, labelling and certification, impact assessment, standardisation and material pooling

of economic growth (GDP) in time.^[92] As a start the Decoupling Index could be used. However, at the same time, efforts need to be made to also include and measure societal aspects, more environmental aspects and proximity.

^[93] Another example is the Genuine Progress Indicator. This is one of the first alternatives to GDP that was approved by science and used regularly by government and non-governmental organisations worldwide. The GPI is a variant of the Index of Sustainable Economic Welfare (ISEW), first proposed in 1989.^[94]

Step 13 Establish international independent systems to organise materials flows

Europe is strongly dependent on the import of material resources, and therefore particularly vulnerable for resource scarcity. The European Commission has only recently started to develop policies to deal with this vulnerability.^[95, 96] Apart from Germany, no European country has yet made any significant steps to set up the institutions that form the basis for a prolonged focus on resource efficiency.^[70] To govern issues concerning material resources related to data gathering and exchange, certification, impact assessment, standardisation and material pooling, international independent systems are required (see obstacles 6-11 in Appendix I).

First, a solid knowledge base on the issues needs to be developed. Compared to energy, there is strikingly little coordinated information gathering on material resource flows. With better understanding of the issues at hand, a roadmap for resource and impact decoupling can be developed.

An information exchange system should be developed in which confidentiality issues are taken into account.^[24] Next to this, specific collaborations could be set up to improve security of supply through materials pooling on a wider scale (as an expansion of step 6). To foster the ease of material exchange and reuse, standardisation needs to be organized. Certification is important in order to communicate and create accountability and credibility. Finally, there should be independent auditing. In return for higher costs for management and planning (obstacle 5 in Appendix I), such systems enable better management of supply chains.

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Step 14 **Adjust national and international government policies**

Adjust national and international government policies for corporate governance, accounting, competition, recycling, health, safety and environment

Finally, current legislation and institutional arrangement are based on linear thinking, which creates an unlevel playing field for circular economy.^[36, 97] To ensure that all incentives and regulations regarding resources and waste are in line with the principles of the circular economy, a critical review of current waste policies is needed (see obstacles 6-11 in Appendix I). Several national and EU policies (besides tax incentives) have been identified to create an unlevel playing field for a circular economy (see Appendix I.II). The following policies should be considered for a critical review:

- Existing laws and regulations for corporate governance deserve a reassessment with regard to their potential to reduce the influence of shareholders with a short-term agenda. For instance, stricter enforcement of certain elements in current Dutch law might have effects in this direction.^[98] Where necessary, new laws and regulations on the national, EU and international levels need to be developed and implemented. This will be a long, difficult but crucial process. Without it, all previous steps will be less effective.
- Accounting policy should solve the discrepancy between material and financial flows.
- At EU level the option to redevelop competition law should be discussed in order to enable closer cooperation between companies while protecting consumer interests. Improving this legislation will enable the transparency needed for companies to work as partners towards circularity: a fair and proportionate assessment of all links in the chain.^[99]
- Regulations on health, safety and environment, such as REACH, should expand further to include additional potential risks regarding materials^[100] and end products. This would include requirements for companies to take precautionary action^[142] to assess possible alternatives in case of a scientific controversy concerning materials used in their products.
- With recycling policy, the Netherlands should take the lead in the EU to further improve the waste hierarchy in line with the principles of the circular economy, by aiming at a high quality of recycling materials and cascading while avoiding the incineration of valuable resources.^[101, 102]

4.4 How to proceed

Start with stakeholder fora to set the agenda

The steps described above form a first roadmap into this uncharted territory. To set the wheels in motion and transform the steps into an agenda for coordinated actions by specific stakeholders requires the initiation of stakeholder fora (see step 9). The combined effect of the steps described will greatly accelerate the transition towards a circular economy. Even when the removal of some of the obstacles would be only partially successful or takes more time, the effects on our economy would still be significant.

Besides showing the potential for circular business models, front-running companies should urge governments to change rules and regulations in favour of these business models. Only then has every economic sector the incentive to become regenerative by design. Such incentives will need to be knowledge based and have to acceptable to society at large. This implies an important role for knowledge institutes and NGOs if we want the circular economy to become mainstream.

Consensus and support are growing

Fortunately, consensus and support for the circular economy are growing. Governments increasingly acknowledge the need for a circular economy. China was one of the first countries integrating the circular economy into its national policies (5-year plan), in order to prepare itself for resource scarcity.^[93] Germany has included circular economy regulation in its policy to address future scarcity^[70], while the European Union has similar intentions with its resource efficiency policy.^[85] The Dutch government announced the importance of the circular economy in its latest coalition agreement.^[135] A recent development in the Netherlands is that industry confederation VNO-NCW now supports the concept.

More research reports are due...

To provide further guidance towards the circular economy, several studies are being carried out by other parties in parallel to writing this report. In the Netherlands alone, three studies have recently been commissioned: one concerning existing regulatory obstacles for companies and two on the opportunities for the Dutch economy. Finally, the Ex'Tax foundation is working with the "Big Four" audit firms to investigate the possibility of a tax shift from labour to natural resources.^[110]

Conclusion

The circular economy is becoming a leading concept guiding decisions concerning our common future. Besides providing a route to manage risks for companies and society, it offers considerable opportunities such as cost savings, boosting innovation and creating new jobs. Front-running companies are taking the lead. But cooperation between companies, governments, science and NGOs is crucial.

This report was written for Circle Economy as input for their further actions to accelerate the circular economy. The steps described are meant to guide all stakeholders through the uncharted territory towards a circular economy. First to establish circularity as a niche in a linear world, then to transform our economy so that it can become mainstream.

The combined effect of the steps described will greatly accelerate the transition towards a circular economy. Even when the removal of some of the obstacles would be only partially successful or takes more time, the effects on our economy would still be significant.

To set the wheels in motion, IMSA suggests organising stakeholder fora on circularity, both on the circular economy in general and on specific value chains and themes. This will help create the dialogue needed for a common agenda with specific actions for specific (groups of) stakeholders.

Only imagination is scarce!

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Appendices

Appendix I:

Obstacles on the way to a circular economy

Multiple obstacles block the transition

This appendix analyses the obstacles for the transition to a circular economy. The circular economy is widely embraced as a model for the future of business.^[46] Still, when looking at what actually happens in our economy, a transition seems far away. Given the theoretical economic opportunity, there is quite a large gap between aspirations and practical examples. This gap must stem from barriers that impede change.

In the following section, 22 obstacles are identified and discussed. They are loosely classified into institutional, economic, technological, infrastructural and societal aspects of the transition. While this classification makes it easier to comprehend the total picture, some obstacles return in different categories. Many of the barriers are well-known to impede sustainability and/or innovation. Finally, the list and analysis are not exhaustive but reflect our current understanding of (future) obstacles; e.g., a first sketch for a similar list was published just before this report went into press.^[140]

II Financial obstacles

Obstacle 1 Major up-front investment costs

To shift from linear to circular business models, major up-front investment costs are needed. The hundreds of billions of euros to be gained as identified by macroeconomic analysis in recent reports^[28, 139] still have to be translated into concrete value propositions before they can be turned into return on an individual investment. Decision makers weigh the costs of circular measures based on their understanding of the risks avoided, the business opportunities and the risks of change, in the *current* business environment. This is a *major* bottleneck. It also means the appetite for change will greatly depend on forthcoming analyses of the immediate cost savings from specific circular chains. Not changing creates further lock-in.

In addition, product service systems models⁶, like a lease construction, require considerable more up-front investment than the transaction model (sale). New methods of financing needed for new business models are not yet available.^[103] Now that access to financial capital is already more difficult for business-as-usual, it is even more so for circular economy propositions.

⁶ A product-service system (PSS), also known as a function-oriented business model, is a concept developed by academia, which is aimed at providing sustainability of both consumption and production, and in which consumers become users, while producers often retain ownership and responsibility over the material.¹³⁸

Obstacle 2 Environmental costs (externalities) are not taken into account	<p>In general, the costs for society and the environment resulting from negative impacts such as illness or environmental damage (externalities) are not incorporated in the price of products. This leads to a discrepancy between material flows and financial flows. In many products, material costs are only a small fraction of the total costs, due to the low prices of resources.^[104]</p>
	<p>Fully internalising externalities is difficult. Take the EU Emission Trading System, which is now fully ineffective due to the extremely low price for carbon emissions. The political will to repair the trading system is lacking in most member states. When a true price is lacking, there is little or even negative financial incentive for businesses to pay attention to the impact of materials in their products.</p>
Obstacle 3 Shareholders with short-term agenda dominate corporate governance	<p>Generally, companies are urged to grow. In recent decades, there has been a shift from corporate governance based on the Rhineland model towards one based on the Anglo-Saxon model. This development has given shareholders more power. Since they have limited liability, short-term financial benefits by annual profit maximisation are more important than long-term benefits.^[105, 106] In practice, the shift has led to a focus on quarterly financial results at the expense of a long-term agenda. According to Feike Sijbesma, CEO of DSM, business should value sustainability and well-being as highly as profit. Creating shareholder value should no longer be the sole objective of a company.^[107] Shareholders can effectively block long-term circular company policies or replace visionary management with linear thinkers. A shift towards a more long-term vision of major investors is visible however, both in the Netherlands and elsewhere.^[108]</p>
Obstacle 4 Recycled materials are often more expensive than virgin ones	<p>The circular economy is an approach that originates from scarcity, from cyclical thinking: it is about flows of materials. Recycled materials often have a higher cost price than virgin materials due to costs of collection and due to low recyclate quality, which results from the small scale at which recycling companies work.^[71] It must be noted that countries in especially North-West Europe (including the Netherlands) have been able to achieve recycling percentages in the range of approximately 70-90 per cent, using proven policies such as recycle fees (e.g. the Dutch "verwijderingsbijdragen"). The challenge here is how to overcome remaining barriers towards higher percentages. In the rest of the world, the recycling percentages are much lower and main challenge is how to achieve the North-West European levels to begin with.</p>
Obstacle 5 Higher costs for management and planning	<p>The circular economy requires more effort in innovation management, distribution planning, inventory management, production planning and managing a reverse logistics network^[24, 108], leading to higher costs in the current economic system.</p>

Obstacle 6 Unlevel playing field created by current institutions	Although many politicians show sympathy for the circular economy, the official rules and legislation obstruct it in a fundamental way. There is no level playing field for circular business. ^[97] The Dutch government, like many others, blocks innovative business models with its legal system, which is based on linear thinking. ^[36] This is illustrated in the following obstacles.
<hr/> Obstacle 7 Financial governmental incentives support the linear economy	The financial governmental incentives such as value added tax (VAT) stimulate high material consumption above service, because labour is relatively highly taxed, leaving materials relatively cheap. ^[8, 54, 109, 110] Subsidies for incumbent industries often have the same effect. ^[111]
<hr/> Obstacle 8 Circularity is not effectively integrated in innovation policies	Another aspect is innovation policies. They often foster the position of incumbent companies and in fact inhibit development and exploration of new business opportunities. A circular vision of the government seems lacking in this respect. ^[112, 113]
<hr/> Obstacle 9 Competition legislation inhibits collaboration between companies	Collaboration between companies, within the chain and cross-chain in order to realise circular design of products and reverse infrastructure, is hindered by legislation. In the current paradigm, exchange of information concerning detailed business processes undermines a company's competitiveness. Extensive collaboration within product chains can be seen as cartel formation or abuse of dominant positions. This is forbidden under current (European and Dutch) law in order to protect consumer interests. ^[99] The role and responsibilities of the Dutch competition authority NMa regarding sustainability issues are under debate. ^[114]
<hr/> Obstacle 10 Recycling policies are ineffective to obtain high-quality recycling	Another issue appears in waste policy. The Netherlands seems to perform well in its waste management: 80 per cent is recycled. ^[115] However, there is no incentive to obtain high quality of materials. Moreover, many recyclable materials are incinerated due to the overcapacity and low price of incineration. ^[101]

Furthermore, 80 per cent of e-waste from industrialised countries is transported to Asian or African countries for recycling, because it is cheaper there (labour costs) and recycling and environmental regulations are often weaker.^[70] However, e-waste often contains heavy metals and other hazardous compounds.

As long as regulation and circumstances are internationally unbalanced, and common standards are lacking, these practices will continue. Furthermore, there is no international certificate system on second-hand markets.^[8]

Obstacle 11
Governance issues concerning responsibilities, liabilities and ownership

Current value chains are highly complex and production and consumption often takes place in different countries. Value chains are likely to become even more complex in a circular economy.^[116] Circular propositions therefore often involve legal complexities. And even when trying to replace sale by lease, contracts may become so complex that existing clients prefer sale.^[69] National governments do not have the ability to regulate all activities along value chains. A circular economy requires room for self-regulation as an element of circular governance^[117] in which businesses and societal actors are key.^[118] Many governance questions need to be resolved before effective circular business models can be widely applied, such as ownership and the share of costs and benefits. Who will have what responsibilities and liabilities within the value chain? To what extent will each party accept extended producer responsibility? How will chains as a whole be managed and optimised? As long as these questions remain unanswered, they inhibit the development of a circular economy.

I.III Infrastructure: obstacles within the value chain

Obstacle 12
Limited application of new business models

Many circular propositions are not yet competitive in the current linear economic system. The lack of successful examples of circular business models leads to uncertainty and higher costs for introducing circular products and services. Current business models emphasise the value of selling products, or the transaction model. There is little attention for incorporating performance within these models.^[36] Some producers see product service systems as a threat to their production business.^[119] Also, contracts will become more complex. Circular propositions often demand new pricing mechanisms and involve financial and logistic complexities. Another issue regarding consumers is how they will use or take care of products. In practice, their behaviour is not always consistent; in general, unexpected rebound effects can increase the products' footprint.^[18]

Cook et al. (2006) mention that business models such as product service systems receive more attention from scientists than from companies.^[65] There is thus a lack of practical knowledge. New business models need to be developed by means of experimentation.^[36] Although there are some pioneering initiatives (e.g. Turntoo), the scale of their success is limited.^[120]

Obstacle 13 Lack of an information exchange system	The lack of an information and material exchange system is blocking the exchange of materials between actors. As Interface points out: how do you know where "left over" is (carpet) and how to collect and distribute this? ^[50]
Obstacle 14 Confidentiality and trust issues hamper exchange of information	Confidentiality and trust issues hamper exchange of information. This barrier is closely related to the lack of an information exchange system and to competition legislation inhibiting collaboration between companies. In addition, growing from a local to a wider scale requires trust and most often reduces the quality of the information. Cross-cycle and cross-sector information exchange is very complex. Confidentiality issues regarding access to information form one of the most important topics and certainly require further discussion. ^[24] Since trust is a condition for value co-creation ^[144] , lack of trust often forms a barrier for co-creation and open innovation. Finally, the possibility that the outside world may deduct information concerning a company's profit margins from increased transparency concerning e.g. business processes, added value and environmental costs, may deter companies from sharing this information.
Obstacle 15 Exchange of materials is limited by capacity of reverse logistics	Reverse infrastructure is underdeveloped compared to forward infrastructure: the capacity is lower and there are fewer channels available. Cost-efficient, user-friendly and high-quality reverse collection systems with guarantees, together with infrastructure that maintains the quality of the products, are missing. ^[8, 24] However, today, value chains are geared for linear economy. Adding reverse logistics makes existing value chains even more complex. ^[108] Furthermore, health and safety issues may appear in reverse logistics and limit recycling. ^[71]
I.IV	<u>Societal and value-related obstacles</u>
Obstacle 16 Lack of awareness and sense of urgency, also in businesses	Public awareness of the importance of the circular economy is limited. Material consumption is highly embedded in our society. Product ownership has become part of peoples' self-esteem. ^[73] Non-financial aspects of our economy are less valued by our society. ^[36] This is severely hampering the transition, because it prevents the circular economy from being a political priority. As a result, mainstreaming top-down governmental measures like a tax shift are currently impossible. In addition, while more and more companies show circular economy leadership, many business leaders are either not yet aware of the urgency of the transition towards a circular economy or refuse to believe the scientific evidence (see Chapter 2). This limits the speed of the transition from the bottom up.

Obstacle 17
GDP does not show the real progress or decline of our society

The Gross Domestic Product (GDP) is the most important macroeconomic indicator. It is rather straightforward, relatively easy to measure and has become a goal in itself. Yet many researchers acknowledge that this approach falls short of showing true progress or economic welfare.^[36, 88, 89, 90, 121, 122] Since the GDP measures the flow of money through the economy, car crashes, oil spills and floods all increase the GDP. Furthermore, it disregards the way in which the output is distributed inside society, and it ignores unpaid work, inputs of cultural and natural capital, and depletion and pollution.^[90, 91]

It is difficult to measure circularity. There is a lack of knowledge on material and energy indicators, no transparent auditing, and no standardisation on measuring social impacts.^[93] As long as there is no standardised indicator, reporting actors may pick “the cherries” in order to show off their circular achievements.

Obstacle 18
Resistance from powerful stakeholders with large interests in status quo

Vested interests will hinder the transition. Those companies that cannot adapt to an economy where true pricing is the norm are at risk of having stranded assets. Every new business cycle leads to creative destruction. Policy options to put a price on externalities or remove resource subsidies are therefore likely to be resisted by high-interest stakeholders.^[123]

In addition, institutions and rules tend to become self maintaining, and a change of rules and regulations causes turbulence and uncertainty that is not in everyone’s interest. The established order will typically seek to improve existing technologies and use strategic action to fight off a new development.^[124]

To illustrate this, current Dutch policies and legislation consistently support the traditional energy sector financially (subsidies) and legally^[111], due to powerful lobby of actors from this sector.^[128] Also, the cement industry has obstructed policies that would support the distribution of recycled building material.^[129]

IV Technology, knowledge and data

Obstacle 19 **Limited attention for end-of-life phase in current product designs**

A first technological obstacle is that *current* products are often not designed for reuse and recycling, while separation technologies are limited in their ability to sort out complex waste streams.^[130] Second, there is a lack of knowledge on circular design. System thinking, which is a key principle of the circular economy, is insufficiently applied in current business practices. Often, within product development, engineers tend to focus on physical attributes of the product and forget the user, while developers of circular business models forget about the design aspects of products.^[131]

Obstacle 20 **Limited availability and quality of recycling material**

The availability and quality of recycling material is limited. Currently, recycling often leads to downcycling.^[132] At the same time, there will always be a need for virgin materials, due to delay in production and discarding. Moreover, if products last longer, it takes longer before the resources therein can be recycled.^[110] Litter is often lost in the environment.

Obstacle 21 **New challenges to separate the bio- from the technocycle**

In addition to existing limitations for recycling complex materials and products, new developments aiming for circularity can lead to new challenges for separating materials belonging to the biocycle from those belonging in the technocycle. For instance, biodegradable plastics need to be separated from traditional plastics in order to be optimally recycled.^[133] The preferred end-of-life treatment would be composting, recovering both nutrients and possibly energy in the form of biogas. However, this would require separate collection or automated sorting of biodegradable plastics from the waste streams, and both are lacking.^[130] As a result, bioplastics are often contaminating the recyclate of ordinary plastics or incinerated.

Obstacle 22 **Linear technologies are deeply rooted**

Linear technologies are deeply rooted in our society. Institutions, infrastructure and the enormous body of knowledge on existing technologies keep the economy locked into its current configuration. Consider for example the energy policy in the Netherlands: the whole energy infrastructure in the Netherlands is geared for fossil energy use; this makes it more difficult to scale up renewable energy systems.^[134] It is difficult to shift towards transforming regulations and actions, because decisions from the past determine the room to manoeuvre with decisions of today; also called path-dependence.^[134] Regulation on sustainable production and consumption focuses mainly on efficiency and incremental innovation. Our current way of thinking is inhibiting the shift towards the circular economy, because we keep following the same track.^[29] Despite the proposed building blocks, there is no clear “off-the-shelf” alternative that could replace the “once-through” production and consumption model.^[87]

Appendix II:

List of consulted experts and stakeholders

In the course of writing this report, we received helpful input through meetings, interviews or direct feedback from the following experts and stakeholders who we hereby thank for their contributions:

Ton Basteijn, TNO
Peter Bex and Rob Blank, Sira Consulting B.V.
Ivo Bonajo, De Groene Zaak
Reinier Grimbergen, DSM
Femke Grootenhuis, Ex'tent
Douwe Jan Joustra, Oneplanetarchitecture institute (OPAi)
Wilko Kistemaker, Dutch B.V.
Robert-Jan van Ogtrop and Guido Braam, Circle Economy
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Colophon

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