PBL Netherlands Environmental Assessment Agency

OUTLINE OF THE CIRCULAR ECONOMY

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Photography
Cover: *Dopper* and other reusable water bottles have rapidly become commonplace, in the Netherlands. This has reduced the large numbers of disposable bottles that are produced and discarded, every year.
p. 8 Hollandse Hoogte/ Paul van Riel; p. 9 Nationale Beeldbank; p. 10 Hollandse Hoogte/ Mariette Carstens Fotografie; p. 50 Jean-Paul Opperman; p. 59 Studio Mima.
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MAIN FINDINGS

"Moveable, circular housing ensures more efficient use of fewer materials, as well as a substantial reduction in CO_2 emissions."
Kees Strooper, Heijmans

Summary

Circular economy is receiving a large amount of attention, but overview is lacking

The Dutch Government is looking for ways to accelerate the transition towards a circular economy. To do this effectively, it is important to have an overview of the current state of circular activities in the economy. Until now, such an overview has been lacking. This PBL report provides such an overview of the current state of the circular economy in the Netherlands.

This inventory describes the current situation for the Netherlands, but provides information that may also be of interest to other countries. More countries are willing to change towards a circular economy or to improve their resource efficiency. See, for example, the EU programme 'Closing the loop'. This inventory provides an overview of practical experiences with regard to the circular economy. It shows opportunities and subsequent steps towards achieving a circular economy. In addition, as more of such inventory reports become available, countries may also learn from each other's experiences.

PBL conducted this inventory by examining a database of Dutch companies, holding a survey and conducting internet searches using a web crawler and a self-learning algorithm.

The inventory shows that many companies and organisations already are contributing to the circular economy – either consciously or unconsciously – amounting to around 85,000 activities and involving around 420,000 jobs. To provide some context, this amounts to 5% of the current number of firms and 4% of the jobs within the Dutch economy.

Circularity is already common practice, in certain markets

The circular economy is not entirely new. Many circular activities have been around for a long time, such as bicycle mechanics, shoe repair shops, and the online market for second-hand goods. These activities are often not recognised as being circular, because they have been around for so long. And then there are a number of new products that are contributing to the circular economy and that have rapidly become part of everyday life, in the Netherlands, such as reusable water bottles (e.g. the 'Dopper').

Circl, the circular pavilion of the large Dutch bank ABN AMRO, has been insulated with fibres from old, discarded jeans. The bank is paying for the use of the pavilion's elevator while it remains the property of the manufacturer ('elevator as a service').

1,500 innovative circular initiatives

At this point in time, there are around 1,500 innovative circular initiatives implementing new product designs, business models or technologies. Examples are modular headphones, a subscription to a washing machine, sharing platforms, bottles made of recycled plastic and a bicycle path paved with recycled plastic material.

Circular is combined with other societal objectives

Some circular activities are coupled with other objectives, such as targets related to climate change mitigation or adaptation, new housing developments, and various social objectives. For example, there are small, moveable modular homes that are made with efficient use of resources but also lead to a reduction in CO_2 emissions and reduce housing shortages. Furthermore, companies, such as second-hand shops and the Surplus Food Factory, contribute to a circular economy and provide jobs for socially vulnerable groups of people.

Taking the next step

Current circular activities and initiatives are not sufficient for accelerating the transition towards a circular economy – this requires additional efforts. New circular initiatives are slow in gaining popularity, for a variety of reasons, such as people's persisting old habits, mismatches between circular processes and existing standards, insufficient pricing of environmental pollution and, sometimes, conflicting rules and regulations.

Reuse and repair of passenger vehicles is everyday practice.

The Dutch Government and other, private and public organisations aim to achieve a circular economy by 2050. This objective can only be achieved by finding innovative ways of making far-reaching changes to the way resources are being used. This study provides three recommendations for government, the business community and other organisations for achieving a circular economy by 2050.

1) Attention could be paid to the entire range of possibilities for a circular economy.
- Resource use can be drastically reduced, besides through recycling, by a greater focus on repairing, reusing, sharing and renting, as well as circular product design.
- Circularity can be combined with other objectives, such as climate-related targets and other societal objectives (win-win situations, e.g. small moveable houses and changing production processes).
- Many circular activities have been around for a long time. Lessons can be learned from the success factors of these established activities.

2) A circular economy requires new ways of collaboration in both production chains and clusters. New collaborations in recycling, reuse, repair and services could be promoted.

3) Public support could be increased, as well as the engagement of both citizens and the business community.

- Point to common practices and show that certain circular activities have already been part of everyday life, for a long time (e.g. shoe and car repair).
- Initiatives that combine circularity and local and social objectives can provide solutions to people's problems.
- The circular economy will bring together various parties. The apparent mobilising and uniting impact of circular initiatives on society could be utilised effectively.

Refurbishing by Philips ensures a long lifespan of their medical equipment.

There are hundreds of second-hand shops in the Netherlands.

FULL RESULTS

"We sell subscriptions for mobility services rather than to bicycles."
Richard Burger, Swapfiets

1 Introduction

The circular economy is on the rise, in the Netherlands. This new inventory shows that many companies and organisations are already contributing to this circular economy, either consciously or unconsciously. This concerns a total of around 85,000 activities, involving around 420,000 jobs.

However, an acceleration of the transition towards a completely circular economy, as envisioned by the Dutch Cabinet and the European Commission, is not yet in sight. Achieving this will require more than the current new 1,500 circular initiatives, which are also facing a number of barriers. How could those barriers be overcome? What could the government do to achieve the targets set by Cabinet and the European Commission?

1.1 Why have a circular economy?

Over the past century, the amount of resources used around the globe has seen an eightfold increase. This is particularly related to global income and population growth. These trends are projected to increase over the coming decades (Krausmann et al., 2009; UNEP, 2011, 2016). Without additional policy, this will lead to an increase in the environmental burden.
Moreover, the increasing use of resources leads to scarcity, which in turn means that the risks related to security of supply are growing. Such scarcity usually is not due to physical depletion of resources, but rather because those resources are extracted from areas that are difficult to access, or are used for geopolitical purposes, or because they are affected by large fluctuations in price.

A circular economy centres around the more efficient use of resources, which has a positive impact on the environment, as fewer new materials such as plastics and metals are required, greenhouse gas emissions are reduced, biodiversity loss decreases, or because there is less pollution of soil, air and water caused by, for instance, litter and/or an excess of nutrients.
More efficient resource use also reduces the risks to security of supply of, for example, precious metals (needed in high-tech products such as wind turbines and smartphones) and phosphates, which are crucial in the production of biomass and food.

A circular economy is aimed at keeping resources within the production chain for as long as possible, through optimal use and reuse – with the greatest value to the economy and the least amount of damage to the environment (Rood and Hanemaaijer, 2017).

1.2 Circular economy is receiving much attention, but an overview is lacking

The concept of circular economy is continuing to gain momentum. It features on both political and societal agendas. For example, the European Commission has an ambitious political policy agenda (European Commission, 2015; European Council, 2016), and the Dutch Cabinet is aiming for a circular economy by 2050, in collaboration with companies and other societal partners (EZ and IenM, 2016; IenW, 2018; LNV, 2018).

The Dutch Government is studying the possible next steps for accelerating the transition towards a circular economy. In this respect, knowing the current state of affairs is crucial. Without having an overview of current activities related to the circular economy, it is difficult for the government to guide the transition effectively into the desired direction, collaborate with stakeholders and determine which activities will be supported and which will be hampered or even obstructed. Various overviews exist that show between a few dozen and hundreds of circular activities within the Dutch economy (e.g. Circle Economy 2018; Nederland Circulair 2018; Utrecht Sustainability Institute 2018; and websites of various large cities, such as Amsterdam and Rotterdam). However, so far, one comprehensive overview has been lacking.

This PBL report provides the first inventory of circular activities in the Netherlands, across the board. It yields a rich overview, with a broad spectrum of companies and organisations whose activities, either consciously or unconsciously, contribute to the circular economy. Examples include waste recycling, the reuse of refrigerators, bicycle repair, as well as reductions in food waste, and substituting fossil resources with biomass residues (e.g. bioplastics). This overview is intended to inspire policymakers to further shape their policies on all levels (local, national and international), and support their policy-making processes. In addition, it shows businesses and other stakeholders the many possibilities, or 'beckoning perspectives'.

This report not only maps circular activities, but also shows barriers and the options for taking action available to government authorities and other stakeholders who are working on the transition from our current economy towards one that is circular.
This summary report is an abbreviated translation of the full Dutch report 'Circulaire economie in kaart', which provides further and more detailed information (PBL, 2019).

"A certain amount of good quality food is being wasted, each year. A large share of this food cannot be sold, because it consists of undersized or misshapen fruits and vegetables, heels and stalks. 'The Surplus Food Factory' (*De Verspillingsfabriek*) 'rescues' a share of this fresh produce and turns it into soups and sauces, which are prepared by people with a distance to the labour market. Because also talent should not be wasted."

Bob Hutten, De Verspillingsfabriek

2 Methodology

2.1 What makes a circular activity?

A circular economy, in essence, uses as few new resources as possible (Potting et al., 2018; Rood and Hanemaaijer, 2017). This reduces not only the resource-related burden on the environment, but also the dependence on international resource suppliers and, thus, lowers the risks of scarce resources no longer being available. For this study, we considered all activities that contribute to more efficient resource use to be circular. We focused on the activities of a wide variety of stakeholders, including businesses, societal organisations, government authorities and citizens' initiatives. Activities of individual citizens and households were not included.

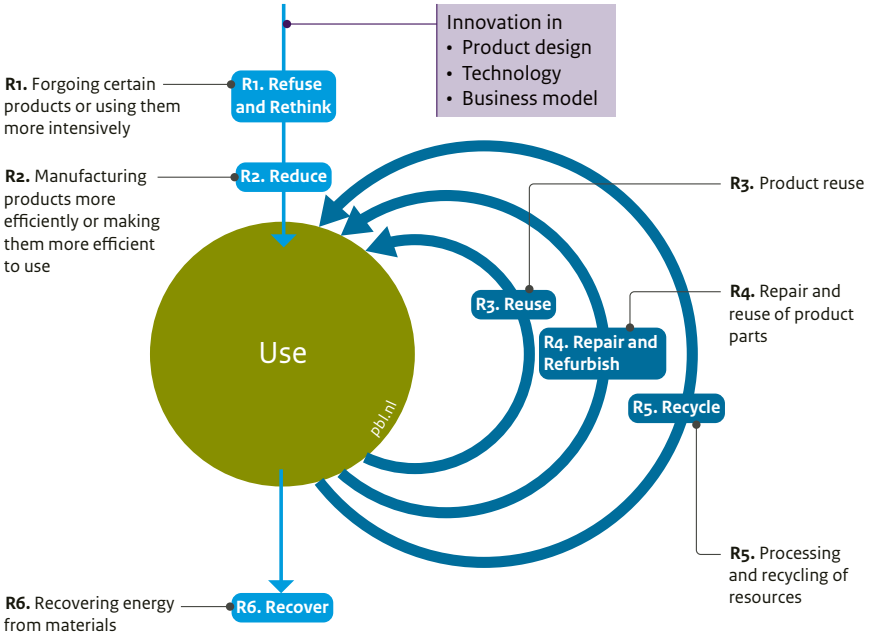
We set up a circularity ladder; a so-called R-ladder, in which various strategies are described that contribute to a reduced use of new resources (Figure 1). The strategies are:

- R1: Refuse and Rethink. This strategy concerns forgoing certain products (Refuse) or using them more intensively by sharing them or through multifunctionality (Rethink).
- R2: Reduce. Reduce concerns a more efficient manufacturing of products or making them more efficient to use.
- R3: Reuse. The lifespan of products can be extended by using them again (reuse).
- R4: Repair and Refurbish. This strategy is also about extending the lifespan of products, but in this case by repairing them (Repair) or, reusing certain parts (Refurbish), or adapting them to new standards.
- R5: Recycle. This strategy concerns the processing and reusing of resources (Recycle). This includes processing and separation of so-called residual flows (or waste flows) and reusing them.
- R6: Recover. The Recover strategy concerns recovering energy from certain materials.

Our R-ladder is based on various R-ladders in the literature (Cramer, 2014; EMF, 2013; Potting et al., 2016; Reike et al., 2018; Rli, 2015; Rood and Hanemaaijer, 2016). As a rule of thumb, circularity strategies higher up on the ladder require fewer materials, which reduces the resource-related environmental burden. In general, strategies higher up on the ladder (such as those for rethink, reduce, reuse and repair) require fewer resources. Recycling becomes an option at a later stage, when other R-strategies are no longer possible.

R-strategies can be combined with innovations such as new product design, technologies and business models. Generally speaking, the largest environmental benefits are obtained if resource-reduction innovations are considered early in the production chain. Product

Figure 1
R-ladder of circularity strategies



Source: PBL

design, for example, has an impact on lifespan and repair options, as well as on the possible use of secondary resources (recyclate) and how easily products can be recycled.

In order to grasp what the various stakeholders are doing to achieve a circular economy, we compiled the broadest possible inventory. Whenever one of the R-strategies is applied in a certain activity, this may contribute to reducing resource use and, therefore, according to our 'definition', the activity is regarded as circular. This definition applies to both old and new activities, those with an R-strategy as their main goal or sub-goal, and those that stakeholders themselves may not consider circular but that do utilise R-strategies.

2.2 R-Ladder for biomass and food

We created a separate ladder for the production and use of biomass and food. This was necessary, because certain strategies, such as reuse (R3) and repair and refurbish (R4) generally do not apply to food or biomass. Moreover, for food and biomass, there are specific aspects of circularity in relation to their production process (Rood et al., 2016).

The strategies for biomass and food, and their relationship to the strategies depicted in Figure 1, are as follow.

R1: the optimal use of natural resources (e.g. soil, water and biodiversity). Another possibility is that of producing products that will replace those with a large environmental impact.
R2: reduction in food waste
R5: the reuse of residual flows of food, feed, materials and fertiliser/compost.
R5.1 – Residual flow used in food products and animal feed
R5.2 – Residual flow used as a resource in industry
R5.3 – Residual flow used as fertiliser and compost
R6: the use of residual flows to generate energy.

For R5 and R6, it is important that minerals are returned to the agricultural cycle (in the form of fertiliser or animal feed) after the organic compounds in products have been used or converted.

2.3 Data sources

This inventory was created in collaboration with Royal Haskoning DHV and is based on multiple data sources. The largest source is the LISA data set, which contains all businesses and organisations in the Netherlands with staff in paid employment (LISA, 2018). Data are recorded for each company, including job numbers and locations. We categorised companies on the basis of their main activity, if that activity is explicitly related to an R-strategy, such as in the category 'repair of computers and ancillary devices' (repair) and 'shops in second-hand goods' (reuse).

However, not all circular activities can be derived from the LISA data set, because not every category explicitly names an R-strategy although it nevertheless contains a circular activity. For example, Philips is categorised under the category 'manufacturing of computers and electronic and optical equipment', but Philips also sells the concept of 'light as a service' (in which users pay for the amount of light they use, instead of for the lamps), and also refurbishes medical equipment. Furthermore, in addition to the businesses, others such as government authorities, knowledge institutes, citizens, NGOs and collaborating parties, may also initiate circular activities, but those are mostly invisible in the LISA database.

This is why we also used other data sources for our inventory. For example, we used existing overviews of circular activities, conducted a survey and made an inventory of circular activities on the internet, using a self-learning algorithm – a form of artificial intelligence that is increasingly capable of estimating which search results are likely to contain circular activities and which R-strategy may apply to those activities.

"We offer modular headphones as a service. Why as a service? Well, to provide our customers with worry-free enjoyment of their headphones. Moreover, it enables us to develop headphones that break less often and can be repaired more easily, and so that we can reclaim and recycle them. We firmly believe that this is the new way of product development."

Marrit van Nattern, Gerrard Street

3 Inventory: there are many circular activities in the Netherlands

This inventory is the first to present an overview of circular activities in the Netherland, across the board. This includes companies and organisations that, for instance, recycle waste material, sell used refrigerators, repair bicycles or offer subscriptions to washing machine services, as well as manufacturers and restaurants that reduce the amount of food that is being wasted or producers that substitute biomass for fossil fuels (e.g. in bioplastics) (Figure 2).

3.1 Circularity already commonplace in certain markets

The above examples show that 'circular' practices are commonplace, in certain Dutch markets. Circular activities, often, are not recognised as being 'circular', because they have been around for such a long time, such as bicycle repair shops. Over 70,000 of those types of activities concern product repair, such as of bicycles, cars, furniture, shoes and computers (Figure 3). The companies involved mostly use handcrafted workmanship and have been part of the economy for many years. A number of new products that contribute to a circular economy have also become part of daily life, such as reusable water bottles (e.g. the 'dopper' bottle).

3.2 Around 1,500 new circular initiatives

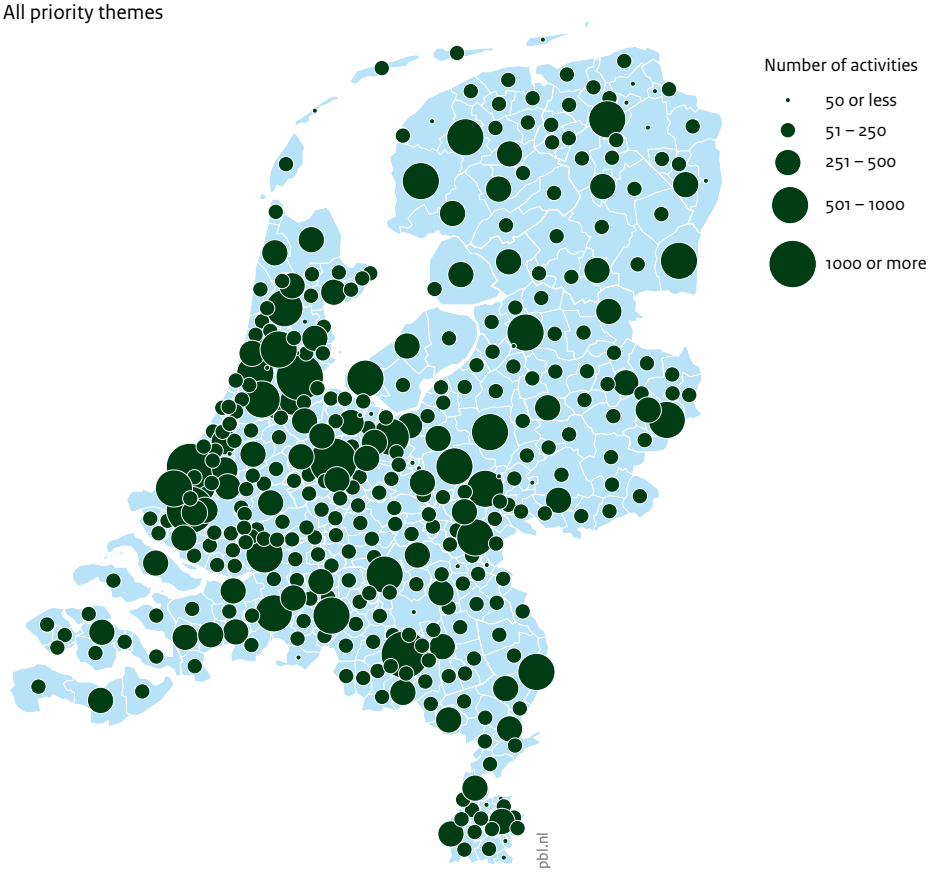
Most circular activities in the Netherlands are everyday, well-established practices or ones that build on tradition. The number of innovative initiatives is much smaller, i.e. around 1,500 (Figure 4), although this number is substantially higher than estimated in previous inventories.

Innovating initiatives concern product design, technologies or business models, or new applications of existing designs, technologies or business models. Examples of innovative design are modular headphones, of which the cord and ear pads can be replaced, and smartphones with replaceable cameras and speakers. These types of design have enabled the practice of replacing broken or outdated parts, which extends the lifespan of those products.

Figure 2

Circular economy activities per municipality, 2018

All priority themes

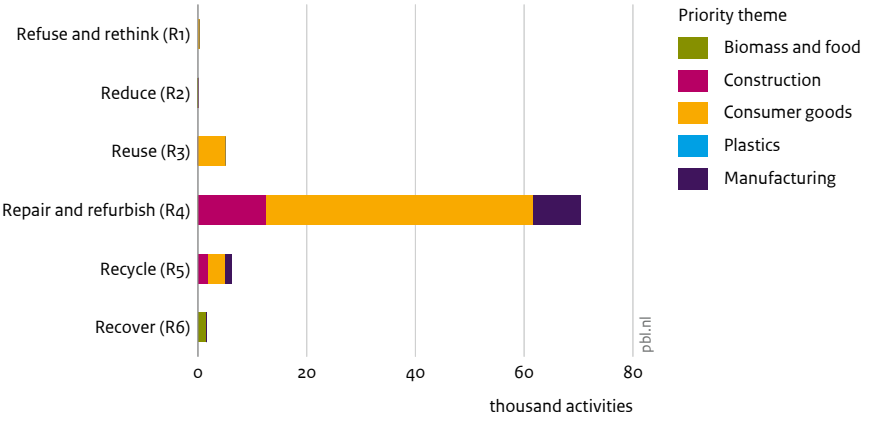


Source: PBL

Innovative technologies have been used, for example, to construct bicycle paths made of recycled plastics, and play houses made of hemp, bark and potato peels. These technologies use residual flows as resources for new products.

Examples of initiatives of innovative business models include sharing platforms or subscriptions to household appliances, such as washing machines, clothes dryers and dishwashers (e.g. see the Dutch company *Bundles*), bassinettes and cots. Other examples of this kind of 'product as a service' include lighting and elevators for companies (Philips, Mitsubishi). Citizens are also using local sharing platforms (such as Peerby) to use each other's goods, such as ladders, electric drills or cars. Such innovative business models focus on usage instead of ownership. This means products are used more intensively

Figure 3
Circular activities per R-strategy, 2018



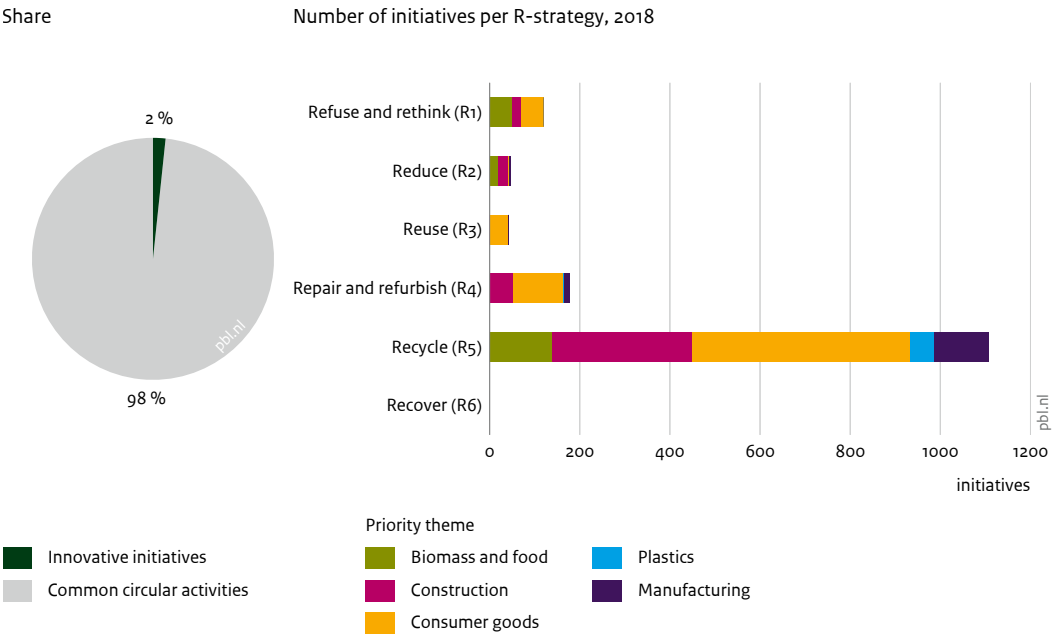
Source: PBL

– instead of sitting on a shelf somewhere, they are shared and put to use, or returned to the supplier who then refurbishes them so that they can be supplied to the next customer.

A notable observation is that most innovative initiatives focus on recycling (around 1,200, Figure 4). Over 600 of them focus on innovative technologies to replace fossil resources by biotic residual flows and recyclates. In construction, for example, residual biomass flows are used in biobased materials, such as hemp concrete, and recycled plastics are used in road construction.
For plastics, new technologies are used in manufacturing granulate made of beet pulp, and filament of a recycled thermoplastic material is used in 3D printing. Examples of circular consumer goods are skateboards made of discarded bottle tops, leather made of fruit waste, children's building blocks made of sugercane waste, and rugs made of recycled polyester.

Only 26% of the innovative initiatives have an R-strategy that ranks higher than recycling, such as online platforms for sharing cars and tools. Other examples include media streaming services (e.g. Netflix and HBO). Because of these services, consumers are able to listen to music and watch movies without the need for physical CDs or DVDs. The innovative character of these types of initiatives lies in the business model rather than the technology, as they offer a service (use) instead of a physical product (ownership). Such business models can also be regarded as innovative when they are applied in new markets – think of the use of bicycles as a service (the Dutch Swapfiets, or the 'OV-fiets' which is

Figure 4
Innovative circular initiatives, 2018



Source: PBL

comparable to the internationally operating Nextbike UK) and subscriptions to washing machines and children's clothing. The general idea of renting or leasing is not new, of course, but, for these markets, this type of business model is innovative.

Other examples of innovative initiatives that rank high on the ladder include tiny houses (small moveable homes) and vertical farms (growing food in an indoor system of vertically stacked layers within existing buildings, which reduces the required surface space). Innovative repair initiatives use new product design, among other things; examples include modular smartphones, spectacles and headphones. Modular headphones, for instance, are fitted with replaceable cord, ear pads and headband. The modular design means these parts can be replaced relatively easily, without having to replace the entire product.

This inventory shows that there is a wide variety of innovative initiatives, although most concern recycling, rather than reuse, alternative design or new types of business models.

3.3 Types of circular activities and initiatives in the Netherlands

We made an inventory classified according to the various strategies to reduce resource use, as shown in the circularity ladder (Figure 1). Examples of such activities are provided below.

R1: Refuse and Rethink
An example of *refuse* is the so-called *tiny house*. *Tiny houses* are small, moveable homes that are fully equipped, permanent residences. Large amounts of construction materials are being avoided by choosing these smaller homes over their bigger, traditional counterparts. And platforms for sharing, for instance, cars or tools ensure that those products are used more intensively. One shared electric drill could be enough for 10 households (instead of them each buying their own drill).

R2: Reduce
Water recycling showers ('circular showers', such as by *Xenz* and *Hamwells*) are examples of *reduce* because they reclaim the water they use, refresh it and subsequently reuse it during the same shower session – a practice that saves large amounts of water, compared to the traditional showers. Another example is the provision of 'light as a service' by Philips, which promotes a more efficient use of resources, as there are incentives on both sides: for suppliers to supply the demanded amount of light using as few lamps as possible and with low-maintenance fixtures that have a long lifespan, and for customers to use only the light they truly need, as this keeps their light bill to a minimum.

R3: Reuse
Used products on offer in second-hand shops and via online websites, such as eBay, are examples of *reuse*. They reduce the demand for new products. In addition, renting out children's clothing and cots (e.g. by *Hulaaloop* and *Bettje*) means that these products return to the supplier, after which they can be rented again by another customer.

R4: Repair and Refurbish
'Repair cafés' offer people tools and knowledge and the opportunity to bring their broken goods along to repair them on location, which means they will then postpone buying new versions of those products. This strategy may also include services, such as those that combine the maintenance and use of, for example, office furniture and bicycles. In addition, remanufacturing may mean that certain parts of outdated products are replaced to comply with contemporary standards, such as Philips is doing by refurbishing medical systems, and Ricoh by refurbishing printers.

R5: Recycle
This strategy also includes the use of residual flows. Residual flows may consist of, for example, grass cuttings, sawmill scraps and wood waste, biodegradable waste, produce auction waste, and used coffee grounds. Or the retrieval of critical materials from discarded mobile phones, the manufacturing of traffic barriers made from residual flows from the agricultural sector, products made of recycled plastics, such as the *Bar-le-Duc* bottle made from 100% recycled plastics, and a *Gispen* designer sofa made from 95% recycled plastics.

R6: Recover
And finally, examples of *recovery* include waste incineration installations, which convert waste flows into heat and power.

Biomass and Food
Furthermore, we found various activities for biomass and food, which can be illustrated with the following examples for the strategies in Section 2.2.

R1: Refuse and rethink
An example of an activity that reduces some of the burden on agricultural land is that of growing crops on rooftops – a form of urban agriculture. Another strategy is replacing animal-based proteins (with a large environmental impact) with plant-based proteins such as vegetarian meatballs (e.g. by *Unilever*) and other meat substitutes, such as fungi and algae.

R2: Reduce
For example, reduced food waste, such as by restaurants who use food products that would otherwise be thrown out (e.g. by *Instock*). Other examples include initiatives that use 'rescued' vegetables and fruit (that cannot be sold because they do not meet the visual quality requirements for regular food outlets) by processing them into soups and sauces (e.g. by *Kromkommer*).

R5: Recycle
This includes the reuse of residual flows of food, feed, materials and fertiliser/compost, such as leftover bread that is used in beer brewing.

R6: Recover
Examples include the use of residual flows to generate energy, such as through fermentation, and pellet heaters that convert residual flows mostly into energy. Fermentation equipment can also be used in the production of fertilisers (recycling), but because they were originally designed to produce energy, we categorised them under 'recover'.

3.4 Combination with other societal objectives

Some of the circular activities in the Netherlands are linked to other objectives, such as climate and housing issues, social objectives or local issues in the physical environment. Examples are small, moveable homes (tiny houses), the construction of which uses fewer materials and also emits less CO_2 and could also be a solution for reducing housing shortages.

Various initiatives also have a social or local environmental objective. For example, there is an initiative around 'orphaned boats' – where abandoned boats are cleared away and, subsequently, refurbished for reuse by people with a distance to the labour market. At *I-did*, long-term unemployed people are making bags and interior decorating products from old, no longer wearable clothing, and at 'The Surplus Food factory' (*De Verspillingsfabriek*), people with a distance to the labour market are making soups and sauces from rescued vegetables. Second-hand shops and repair cafés are also involving people with a distance to the labour market or local residents in their initiative. This also applies to certain initiatives on local and sustainable food production, such as urban agriculture. Then there are others that focus on issues that affect the local residential environment, such as litter, and there is an app by *iKringloop* that draws the attention of local residents to bulky waste items that could still be used.

Although, because of their smaller scale, these activities are likely to have only a limited impact on reducing total resource use, they are literally creating circularity within society. In addition, they may also contribute to the level of general support for the transition. The public feels positive about such initiatives – and therefore also about the particular R-strategy – because they are contributing to solving certain social or local problems.

> “Bar-le-Duc manufactures its bottles from 100% recycled plastic. The resource material is the plastic of bottles that are collected according to a deposit-refund system. This means that no new plastics need to be produced. In this way, Bar-le-Duc is aiming for the lowest possible impact on the environment.”
>
> *Bram Pluijm, Bar-le-Duc*

4 Circular economy barriers

Despite the many circular activities, there are still rather large barriers to achieving a fully circular economy. Resources and products are often relatively cheap, as the environmental impacts of production and/or consumption are not fully incorporated in the price (Vollebergh et al., 2017; SER, 2016). The relatively low price of resources does not exactly encourage producers to invest in more efficient resource use.
However, although the pricing of environmental effects may stimulate circular activities, it will not remove all of the barriers, such as in the transition towards a circular economy, which also calls for innovation. However, such innovation is not always in line with existing rules and regulations, standards and commonly held beliefs (Raven et al., 2017; Scott, 2018). In addition, in order for circularity to become mainstream, structural changes in the economic system and society will also be needed (Geels, 2002; Hekkert et al., 2007; Schot and Geels, 2008; Lodder et al., 2017).

Recycling of certain residual flows, for instance, is often hampered by existing regulations, as those are not attuned to circular products. For example, biomass may be used as a construction material, but it is applied only rarely, because there are no standards for this type of building material in the Netherlands – which, in turn, makes customers hesitant to buy these products.

Furthermore, circularity may also be hindered by a negative reputation, such as in the case of second-hand products and parts and recycled materials (e.g. plastics), which is why both consumers and businesses often prefer to buy 'new' (Tukker, 2015; Wyman, 2017). Habits also play a role; people mostly stick to a certain purchasing behaviour (Schneider and Hall, 2011), and many of them discard broken products because that is what they are used to doing, while repairing them may also have been an option. This type of behaviour also applies to corporations. Even if, in principle, they are willing to reuse old products, as the foundation *Stichting Recover-E* found out; the foundation takes used business laptops and rents them out to other users. The original owners are insufficiently aware of the residual value of these devices, as often, the laptops are carelessly returned to the foundation in stacked piles, the collective weight of which breaks those at the bottom of the stack (Remmerswaal et al., 2017).

New collaborations between companies from differing sectors are not formed naturally and rarely run smoothly from the start. They are often faced with obstacles related to regulations, cultural differences and unfamiliarity.

In addition, in many cases, the core business model is that of selling products with a planned obsolescence (Allwood et al., 2013; Jonker et al., 2016). Switching to a new service model is not easy. It calls for other capabilities among staff members, such as dealing with complex contracts and caring for a product for longer periods of time (repair and maintenance) and at a set price (Tukker, 2015). And, finally, investors are seen to be less eager to invest in circular business activities because they are unfamiliar with the concept of circularity, or because they consider circular initiatives to be less profitable.

"We believe in a social and circular society. This is why we like to help people find employment who have been on a social security benefit for a long time. We also discovered that worn, old clothing can be a new resource, too. We use our recycled felt, for example, to make beautiful bags and interior design products that improve the acoustics of indoor spaces."
Michiel Dekkers, I-did

5 Conclusions - the next step towards a circular economy

This inventory shows that the Netherlands already has a tradition of repair and recycling. The Netherlands is one of Europe's front runners, with respect to recycling (Rood and Hanemaaijer, 2017). It aims to contribute to the ambitious European policy agenda (European Commission, 2015; European Council, 2016), with the Government-wide programme for a circular economy: 'a circular economy in the Netherlands by 2050' (EZ and IenM, 2016). In order to achieve this objective by 2050, the Dutch Cabinet is collaborating with about 400 companies and other organisations (IenW and partners, 2017). Our inventory provides them with three recommendations for making progress towards achieving a circular economy by 2050.

5.1 Recommendation 1: pay attention to every opportunity to achieve a circular economy

Attention for higher ranked R-strategies

Most of the innovative initiatives in our inventory place their emphasis on recycling. In addition, a relatively large amount of policy attention is also focused on recycling, in both the Netherlands and the EU. Other forms of innovative circularity – such as product reuse and repair, and subscriptions to services or leasing rather than buying a product – are receiving less attention (Figures 1 and 4).

If the government is serious about wanting to accelerate the transition towards a circular economy, it should pay attention to each and every form of circularity: the so-called R-strategies (Figure 1). The R-ladder provides a systematic view of circular strategies other than merely recycling (e.g. reuse, repair, leasing and sharing). It may be used for setting up and shaping concrete initiatives and policy action.

The government may consider, for instance, to pay more attention to R-strategies that are ranked higher on the ladder, such as those of reuse and certain services (Figure 1). Government authorities (national government, provinces, municipalities and implementation bodies) may focus on reusing products and product parts in their purchasing behaviour, tenders and maintenance. This is also true for companies.

They could save on resources, for example, by considering other types of product design or by providing customers with used products. All R-strategies are needed to achieve a fully circular economy.

Attention for combining objectives

In addition, government authorities, companies and other organisations may also develop initiatives that have multiple objectives. Resource recycling, reuse of products, and changing product design and production processes in order to reduce the use of new resources may also yield substantial reductions in CO_2 emissions along the production chain. Pursuing a circular economy may also contribute to other societal objectives, such as removing and finding new purposes for bulky waste items that have been left out in the street or in other public spaces and providing employment for the long-term unemployed (as happened with the 'orphaned boats'). Companies such as *I-did* and 'The Surplus Food Factory' (*De Verspillingsfabriek*) are contributing to a circular economy, as they manufacture bags and make soups from otherwise discarded resources (worn-out clothing and imperfectly shaped vegetables, respectively), and they also employ people with a distance to the labour market. This creates a win–win situation that may also accelerate the transition towards a circular economy.

Attention for common circular activities

We can learn much more from common circular activities than is currently the case. In addition to showing us the existing possibilities, they can also teach us about the elements of success or failure. For example, there are close to 20,000 auto repair shops in the Netherlands, and only 1,000 repair shops for consumer electronics (Figure 3). Why is repairing cars more attractive than repairing household appliances? And what lessons could be learned that could be applied to other products? Here, price certainly plays a role, but so do other aspects, such as the convenience of repair, the availability of spare parts, and transparency. The overarching question, here, is: what would be needed to implement systems of reuse, repair and services to a large variety of products, in various market segments?

Possible instruments

In addition to rules and regulations, such as on pricing and waste management, also other instruments, such as circular procurement, innovation deals, regional deals and the *Versnellingshuis*, can be used by government authorities to promote circular initiatives. In addition, the possibilities could be studied for employing the Extended producer responsibility (EPR) system, also for repairing, refurbishing, reconditioning and reuse, in addition to recycling. In order to achieve this, the existing EPR system would need to be adjusted. This also applies to subsidy schemes, such as the MIA (Environmental investment rebate) and Vamil (Arbitrary depreciation of environmental investments). All these instruments could also be employed to develop new collaborations (Recommendation 2).

EU involvement

The European Union also plays a role in circular initiatives. The European Commission, for example, strives to achieve a transition of the EU's internal market towards a circular economy (EC, 2015). This inventory could show possibilities ('beckoning perspectives') to other EU Member States. If, in addition, similar inventories would also be conducted for other countries, lessons could be learned from the experience with circularity in those countries. Furthermore, coordination on EU level is necessary if regulations need to be changed. EU regulation on resources, products and waste also have an impact on the possibilities for circular initiatives in the Netherlands. This is also of interest to the business community. For example, greening the regulations for the European Single Market will offer opportunities for circular innovation, as well.

5.2 Recommendation 2: pay attention to new collaborations

If we are to realise new forms of recycling, reuse, repair and product-as-a-service, new collaborations are needed. These collaborations do not create themselves, nor do they work perfectly right from the beginning. Companies along the chain need to work with new stakeholders, align their strategies and reach an agreement about their – possibly joint – revenue models. Our inventory shows that by far most companies and organisations are focused on changing their own business model, rather than on collaboration or alignment with other parties (e.g. other suppliers or customers). Differences in culture and jargon as well as lack of familiarity may stand in the way of new collaborations.

This calls for the government to recognise the importance of such new collaborations, and to encourage and promote learning, for instance, by organising regional clusters. Front runners and government authorities may start by setting up and trying out new collaborations. The government, furthermore, may provide certain deals (e.g. Innovation Deals) to help initiators, permit-issuing authorities and municipalities in setting up new circular initiatives. Lessons learned may be applied in follow-up projects and such collaborations may help to overcome the barriers caused by rules and regulations, popular beliefs and habits.

5.3 Recommendation 3: focus on increasing public support and engagement

Further development of the circular economy calls for both citizens and businesses to revise their habits and opinions. Although past experience has shown that such changes usually are difficult to bring about, it is not impossible. Examples are the increasingly

popular platforms that provide a wide variety of services (e.g. Netflix and Spotify), and sharing platforms for cars, tools and bicycles (e.g. *Snappcar, Peerby* and *Swapfiets*). Achieving such changes on a large scale requires more support and engagement of citizens, businesses and government authorities.

Create awareness of circular activities in everyday life

This inventory of circular activities offers recommendations for increasing the support for a circular economy. The government can, for example, point to already existing activities, showing citizens that circularity can be found in everyday life (Figure 3). This type of perspective may help to concretise the circular economy among the public at large.

Organisations and businesses that combine circular practices with local and social objectives help to firmly embed circularity in society. These initiatives are part of people's daily lives, as they provide solutions to the local problems that people are facing. Examples include the 'orphaned boats' initiative, mentioned earlier, which not only ensures those discarded boats will be reused, but also cleans up the canals and offers employment for people with a distance to the labour market. Another example of an initiative that also kills two birds with one stone is that of the already mentioned 'The Surplus Food Factory' (*De Verspillingsfabriek*), where rejected vegetables and fruits are processed into soups and sauces – work that is also performed by people with a distance to the labour market.

Lead by example and bring people and businesses together

The Dutch Cabinet and other government authorities (e.g. municipalities, Rijkswaterstaat and local permit issuers) can play a stimulating role with respect to the circular economy. Together with front runner businesses and citizens, circular possibilities can be demonstrated; the circular economy brings various parties together. It is all about utilising the apparently mobilising and uniting power of circular initiatives within society.

"The impact of car sharing is demonstrated by way of two vases filled with miniature cars. On the left, the number of shared cars in the city of Eindhoven. On the right, the number of cars that would have been on the road if those shared vehicles would not be used. The difference is gigantic."

SnappCar

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