Rabobank

The potential of the circular economy

Special
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From circular materials cycles to a circular macroeconomy with scenario's for the Netherlands

This Special is produced with the assistance of Tara Jansen.

The term 'circular economy' has become increasingly popular in recent years. The attention of many policymakers has been drawn especially to the reports from the Ellen MacArthur Foundation (EMF, 2012, 2013, 2015), in which McKinsey calculated the potential of the circular economy in economic terms. For the Netherlands, sortlike calculations are made by TNO (2013). Figures for job creation and the economic return from the circular economy apparently have more effect than success stories featuring circular business operators.

The circular economy is actually a misleading term. Circularity does not refer to the macroeconomic process (which is already circular), it refers to making the circuits of materials and goods circular. It is thus not a new economic model, it is foremost about practical and useful thinking to structure an effective economy based on the efficient use of materials and reducing and ultimately eliminating waste flows. The circular economy is thus mainly a way of achieving a different goal, such as sustainable progress or green growth.

The figures on the economic impact of the circular economy are surrounded by a great deal of uncertainty. Besides this great uncertainty, many assumptions have to be made regarding the efficiency benefits that will be realised in order to calculate the potential of the changes to production and the reuse and elimination of waste in macroeconomic terms. Furthermore, assumptions have to be made as to what will be done with these efficiency benefits. For instance, what will consumers do with the money they save if their washing machine lasts longer?

There needs to be a clear distinction between economic or social value (the benefit to society), economic growth (in terms of the production of added value) and jobs.

And here we encounter an essential problem in our analysis. In the macroeconomy, the macroeconomic cycle is the focus of the analysis. Not the materials cycle, or the effect on inventories of natural resources or waste. The National Accounts measure the flows of goods and services, as well as incomes and production. All these three 'flows' count towards Gross Domestic Product (GDP). The gap that this analysis has to carefully bridge is the gap between the macroeconomic conceptual framework and the effects of change as a result of the circular economy.

The analysis in this study is like a three-stage rocket with three directions. The first stage concerns our definition of the circular economy and a clear sketch of the relationship between business models and the macroeconomy. In the second stage, we analyse briefly the extent to which the Dutch economy is already in fact circular, and in the third stage we look at the possible potential of further implementation of the circular economy concept in the Netherlands. This is where the rocket's three directions become apparent, since we analyse the potential using three scenarios.

For these scenarios, we rely heavily on the work of others, such as TNO (2013). The scenarios should be understood mainly as sketches: the uncertainties surrounding the estimated effects are greater than those relating to normal macroeconomic scenarios. We present them anyway for a very practical reason: it is clear that policymakers and politicians are mainly convinced by figures that are relevant to the macroeconomy. In this study, we try to help them move forward in this respect.

We devote very limited attention to the ultimate environmental effects of the various scenarios. This is because our main purpose is to bridge the gap between the circular economy and the traditional macroeconomic conceptual framework.

The Linear Bow scenario is mainly a continuation of the current trend towards sustainability. In the *Circular Go* scenario, use is made of the 'low-hanging fruit' with respect to the circular economy and the materials circuits increasingly become complete. In *Circular Flow*, the last scenario, the Netherlands makes the transition and expertise on the circular economy becomes an export product.

The circular economy: back to the future

It has been known for a very long time that the level of prosperity in the West, and more recently in the rest of the world, will not be sustainable in the long term if the current economic model is retained. The pressure on natural resources, including biodiversity, climate and air quality, is increasing. And despite the sometimes rather optimistic ideas regarding innovative solutions with respect to the replacement or extension of fossil fuels and the possibilities for increasing food production, it is for a long time very clear that the limits of what the Earth can provide are already being exceeded in many areas. Such an overshoot looks likely to occur relatively soon, before 2030, as regards the warming of the Earth and greenhouse gas emissions.

The essence of the challenge

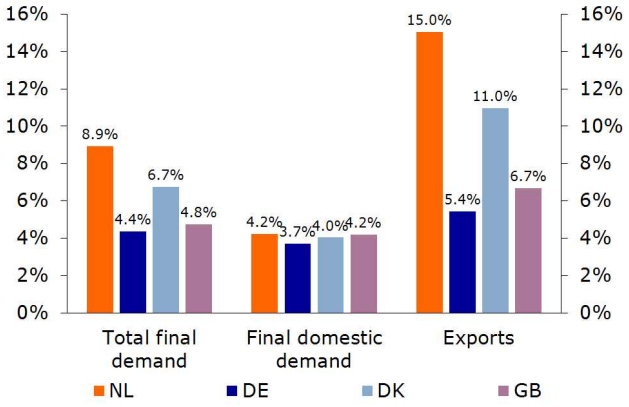
Historical and anthropological studies have shown that the ecological component has been an important cause of the collapse of civilisations (Diamond, 2005, see here also for TEDX talk). If civilisations live beyond their means and cannibalise available natural resources, this ultimately leads to their collapse. Examples include the Mayas, but also the Norsemen who tried to colonise Greenland, or the inhabitants of Easter Island. These are all civilisations that did not survive, among other things because they used more of their natural resources than nature could regenerate. Societies that are no longer circular are not sustainable in the long term.

Since the beginning of the 1970s, there has been a global overshoot (the ecological footprint of the world population is larger than nature can cope with), and now we are using roughly one and a half times the Earth's biocapacity per year.[1] The Netherlands has been using more than its own biocapacity can support already since the beginning of the 1960s. Currently, the ecological footprint is approximately 4.5.[2]

This pressure on the environment has several aspects. Approximately 40% of the indicators in the Monitor for Sustainability in the Netherlands (Statistics Netherlands, 2014) are in the red. The high level of prosperity in the Netherlands and the related high level of consumption in combination with the limited land available mean that pressure on the natural environment is high. There are two specifically Dutch factors that play a role in this. The first is that our country uses a lot of raw materials because the food and agri sector and the chemicals industry are very important industries in the Netherlands. A large proportion of production is exported. As a

result, the use of materials in the Netherlands is high relative to other countries (figure 1).

Figure 1: Proportion of materials use (including energy) in production costs, 2007



Source: PBL, 2013

Secondly, energy housekeeping in the Netherlands is still very much based on fossil fuels. Only 4.5% of energy production in the Netherlands is sustainable, well below the EU average.

So there are good reasons for vigorously searching for ways in which natural resources, materials and commodities can be used more efficiently, establishing what the sustainable alternatives are and how they can be reused in a way that adds value to society economically, ecologically and socially in terms of prosperity and wellbeing. This would create a new system based on circularity: a circular economy. The only difference with society in the past is, not entirely unimportantly, that our level of prosperity is significantly higher. This now increases the requirements that circularity has to meet.

The aim of the circular economy thus mainly concerns prosperity, and a possible increase in prosperity without this being at the expense of finite resources. The success of the circular economy, or the road towards it, is therefore to be measured mainly by the degree of decoupling from economic activity and the use of natural resources.

The circular economy and the macroeconomy

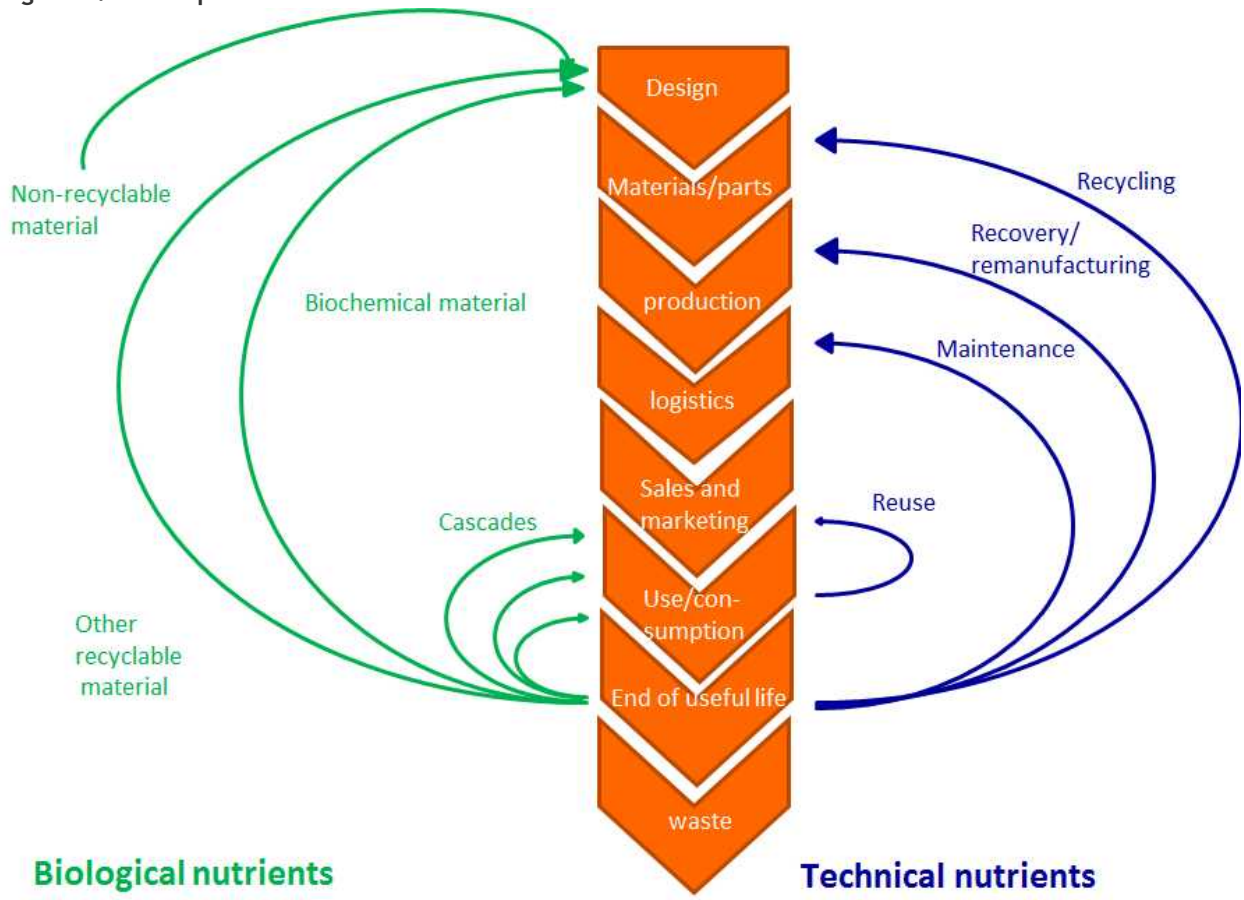
The current analysis of the circular economy focuses mainly on two elements. In theoretical terms, the main focus is on completing the materials circuit, in practical terms on successful circular businesses. The macroeconomic effects of the circular concept and successful business models have received less attention. This section offers an initial look in this direction.

The circular economy according to the literature

The purpose of the circular economy (Braungart and McDonough, 2002) is to encourage the reuse of raw materials and products as far as possible and to limit the destruction of value as far as possible. The more we can make our economy circular, the more sustainable it will become in ecological terms. This idea is also opposed to our current economic model, in which raw materials are turned into products which are destroyed after use. The basic principle of this so-called linear model is that used products no longer have economic usefulness and that their remains can be returned to nature without problems or costs. Not only after use, but also during production.

The idea of the circular economy can be most simply described by using the diagram developed by the Ellen MacArthur Foundation and McKinsey (2012, figure 2).

Figure 2: Linear production and the materials circuit



Source: Rabobank based on McKinsey (2012)

The central axis in the diagram shows the linear production process, with design, production, consumption and waste in a single line. The arrows show the possibilities for circularity with respect to reuse, recycling or upcycling of resources, residual waste, other materials and products. They therefore show the steps on the way to a circular system. Some biological and technical materials are used as input for production in various stages of the chain, biological materials are used more frequently and recycling is very well advanced in a number of countries. The innermost circles of the biological circuit represent various forms of cascading, or multi-stage value use. These are actually successive 'waterfalls', each of which return value to products (upcycling) whereby goods or elements thereof can be reused. The ultimate aim is to remove the last arrow (waste) entirely.

The principles of the circular economy are not new: the concept of an economy in which the lifecycle of products is extended in order to reduce the depletion of natural resources was already described in 1984 by Stahel for instance, and subsequently by Braungart and McDonough (2002). A circular economy is broader because it also involves a redesign of the economy to take account of new collaborations, frequently across different sectors, focused on new product and service concepts that must have a positive impact on people and the natural world. One example could involve bio-based materials that will be used in the construction or the automotive sectors, and the principle of moving from ownership to use, such as leasing washing machines to social housing residents through housing associations. In recent years the Ellen MacArthur Foundation (2012, 2014) has been a prominent proponent of the circular economy, mainly through the study and description of various business models based on the idea of circularity.

The basic principles of the circular economy are:

- **Design for reuse**: waste does not exist if biological and technological components of products are designed so that they can be reused in a new circuit. In other words, they can be disassembled and/or reused. Chain cooperation and new networks, from product ownership to product use whereby 'servicing' the product is the priority, can be of assistance. This raises the interesting question of how much the reuse of materials and semi-finished products and biomass (ultimately via the biosphere) could contribute to traditional economic growth, as measured by GDP, because value would be retained longer through reuse and, where possible, upcycled, which would benefit prosperity (new services, new product combinations, lower environmental impact and toxicity).
- **Resilience through diversity**: Systems which are diverse in terms of connections and scale are resilient in the face of unexpected external influences. Practically, this means heterogeneous businesses and business models, enough diversity and production systems and business networks with sufficient mutual connections, but also with alternative suppliers and customers in order to be flexible. Natural ecosystems can give us examples for such production systems.
- **Energy use from infinite sources**: Reducing the loss of products (by upcycling) requires the addition of energy. There are two primary energy sources available: (renewable) energy and labour. The condition of circularity can only be met by using renewable energy.
- **System thinking**: System thinking focuses on non-linear systems in which feedback loops play a fundamental role. In these systems, the combination of uncertain environmental factors and feedback give an unpredictable outcome. But thinking about these relationships and materials flows is crucial for understanding how the system can be optimised. This requires a long-term focus. At various levels of scale, systems influence each other and relationships of dependency and feedback loops exist that contribute to the resilience of the circular economy.
- **Bio-based basis:** Goods for consumption are increasingly made from biological materials. The 'cascading' principle applies in their use: nutrients are used for various purposes before they return to the biosphere circuits.

Application of these principles can create social value in four ways which, as usual in the literature on the circular economy, have been given nice names (see here)[3]:

-  **Circular materials**: This concerns the more efficient application of production factors and savings in terms of materials, labour, energy, capital and commodities by means of the blue arrows in figure 2 above: maintenance, repair and reuse of goods. The small blue arrows are also relevant: the redesign of the production process can lead to a different division in the chain and more efficient use of inputs. The ultimate goal is to complete the circuit as far as possible.

-  **Longer cycle**: This involves extending the lifespan so that the cycle as a whole is slowed down. This can be seen in the circular economy diagram in figure 2 in the feedback loops of reuse, maintenance and recovery. In practice this means that less has to be produced. Products can also go through a cycle more times if they are more easily restored.

-  **Multi-stage value use**: Besides the repair and reuse of products, it is also possible to use parts, materials or waste products for the manufacture of other products. This works if the waste flows form a commercially attractive substitute for the materials that were originally used. There are now countless examples of this: rubber bands turned into slippers, coffee grounds as a nutrient medium for mushrooms and plastic bottles as material for car parts.

- **Liquid markets:** New transaction and usage models can limit the waste of goods in markets. More users can then benefit from the same quantity of goods. A condition for this is good access to products (from ownership to use, the sharing economy, see the box).

These forms of value creation have a social, a macroeconomic and a commercial component. According to Accenture (2014), 40% of the social value comes from circular materials, 30% from a longer cycle, 20% from multi-stage value use and 10% from liquid markets. The basis for these figures is not clear.

But social value is not the same as economic growth or a commercial earnings model. For example, using less fossil fuels is good for the sustainability of the system from an ecological perspective. In macroeconomic terms, it may mean lower production and contraction. Businesswise, more efficient use of materials leads to lower production costs and possibly higher earnings potential, but it will also lead to the bankruptcy of businesses still using the linear production model. It could also lead to new and possibly more labour-intensive business models and create more jobs. These three components of the gains from the circular economy – the environmental benefit, the earnings model and the macroeconomic gain – are frequently confused.

The business economics of the circular economy

Everything we have just said implies different business models. The basis of these business models is an earnings model, meaning a personal return for the business operator. The social return does not necessarily have to play a role at all, nor does a good business model necessarily contribute to job creation and economic growth at the macro level. Actually, many new business models will be a substitute for 'traditional' businesses and therefore do not have to add either growth or jobs on balance to the economy as a whole. The earnings models are associated with management and maintenance, repair, reuse and distribution, refurbishment (using parts in new equipment) and finally recycling materials as far as possible. The business models are ultimately the driving force behind the creation of the circular feedback loops.

To clarify this we show the production chains in figure 2 in a circular way in figure 3. Ideally, this circle should be complete. This would mean that all waste and residual materials would become materials for a new cycle. Several types of business model can be distinguished on the basis of examples and analyses:

A. Circular input models: These business models are designed for the creation of materials and inputs that are suitable for the circular economy: completely renewable fuels and the production of biodegradable and recyclable inputs. This forms the basis for circular production and consumption. The earnings model exists due to the fact that alternative materials are more affordable or better than traditional materials. The model experiences accelerated flows if (1) materials prices are high and (2) the certainty of supply of materials is reduced.

Example: Nova Lignum

Nova Lignum makes sustainable roofing material exclusively from plant residues. Aubergine fibres, roadside grass, reed or pruning waste: all of these are perfectly suitable for the production of Ceranex sidings. The Ceranex product line combines the advantages of timber, fibre cement and plastic. Using the fibre component of plants and a geopolymer, an unparalleled façade cladding product has been developed with a very unique combination of properties:

- 100% recyclable: only natural raw materials, no oil-related or chemical additives, extremely long life, water stable (no shrinkage or expansion), weatherproof, rot-proof and ;

- Easy to use and install: can be worked like wood, safe, acid-environment resistant and non-corrosive on metals, extremely fire resistant, low CO_2 footprint, very energy-efficient production process and recyclable;
- Fully recyclable for reuse: plant fibres are not burned or composted, but are laid down for the long term.

The production process can be compared to the fossilisation of old wood in the ground, under the influence of minerals. Nova Lignum copies this process with plant fibres above the ground (bio-mimicry).

B. Waste value models: Waste value models are the closest to the cradle-to-cradle approach[4]. Recycling and upcycling play a crucial role. An earnings model is achieved through the creation of a market for waste: turning a cost item into a profitable business. This can lead to waste from one production process becoming useful as a material for another production process. This is a useful model for businesses with sizeable waste flows, or where residual waste from products can be processed into new materials.

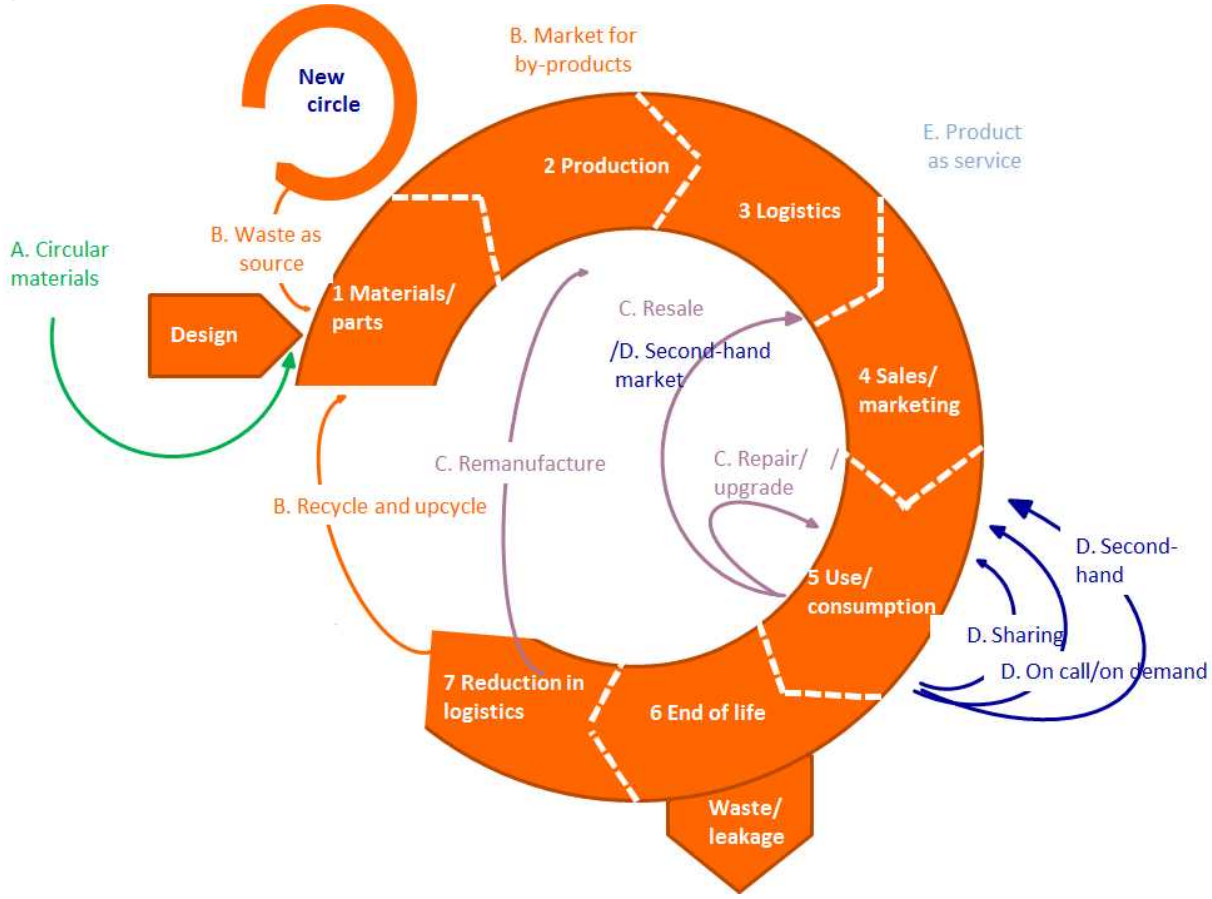
Example: QCP Polymers

QCP is building a plastics factory at the Chemelot Industrial Park in Sittard-Geleen. QCP stands for 'Quality Circular Polymers' and is a new company that will produce high quality materials for the plastics processing industry on the basis of used plastics originating from households and industry. A production location at which new products will be made innovatively based on used plastics that can replace conventional plastics. By combining the knowledge of the parties involved with investment in research and development, QCP is able to produce these materials in large quantities and with consistent quality. This is unique in the European market

Example: Schmitz Cargobull

Together with trailer producer Schmitz Cargobull, DLL has developed a new earnings model in which used trailers are converted into scrap and the materials are used for the production of new trailers. Some parts like lorry canvas are upcycled into bags by the luggage manufacturer FREITAG, instead of ending up in the incinerator. This creates a complete circuit of materials, Schmitz Cargobull increases the average useful life of the products and the company is raising the quality of trailers in the market. This active withdrawal of volume from the market creates new opportunities for the sale of new trailers.

Figure 3: Circular business models



Source: Rabobank based on Accenture (2014).

C. Lifespan models: Extending the lifespan of products can be achieved in various ways: repair, upgrading, remanufacture or remarketing of the same product. Repairing defective products speaks for itself. And the more the design is focused on this and the more valuable the product is, the faster this happens. Upgrading, replacing a part, or updating software, also only works if the total product is still valuable enough and the product has been designed with this in mind. Remanufacture goes a step further. This involves a new product being launched in the market on the basis of parts of old products, possibly with the addition of new parts or software. Remarketing (also known as recommerce) only works if the identical older product still has a market value. In markets where new products are so much better than their predecessors, it is highly likely that products in this market will not have any (economic) value. One alternative might be to offer these products in a different and less developed market.

The earnings model has a number of aspects. This concerns services (repair, replacement, updating), and to some extent it concerns the fact that the residual value is used again commercially (in case of reselling).

Example: Repair Café

The Repair Café is actually a meeting place for people that are skilled at repairs and less skilled neighbours who have broken items. The condition is that you have to work together on the repair. This makes people aware that repair can often be quite simple and fun, and they come back next time with another defective product.

Example: ACE Re-use Technology

Among other things, ACE Re-use Technology overhauls components, such as electric motors of copiers that can be returned to use without loss of quality. An important precondition for the success of this concept is that customers have a system for the return of the products. The savings for the customer can range from 20 to 50% of the new value. The ecological footprint of the products can thus often be reduced by 50%.

D.Platform models: An important way of using things more efficiently is making goods that are not used available to others. This can be on a temporary basis from one consumer to another, either for payment or not (sharing models), by leasing services whereby existing goods can be used (on-call and on-demand economy), or by changing the ownership of items not or no longer used (the second-hand market).
The earnings model sometimes consists of an intermediary function (bringing supply and demand together for a payment), sometimes of the residual value of the goods, sometimes of the offering of new or existing services in order to use existing goods more effectively.

Example: Snappcar

In the Netherlands, eight million cars are not used for an average of 23 hours a day. This is a waste, especially since many people do not have a car. SnappCar brings car owners and people without a car together. “Rent a car from your neighbour” is the idea. The earnings model is based on the intermediary function.

Example: SiSo

Together with engineering consultancy firm Royal Haskoning, SiSo (controls ICT lifecycle) has set up Recover-E that identifies business risks relating to scarcity of materials and the circular economy. With Recover-E, both partners intend to complete the ICT circuit and encourage reuse and innovation in recycling. Parties can place their surplus equipment in management with this foundation at an attractive fee for a reuse programme and recycling. The principle is that as members, business consumers can manage how products and materials purchased are dealt with in the chain.

E. Product as service model: Instead of selling goods, the business continues to own the product. The product is made available to one or more users, either through a lease contract or a rental fee. Traditionally it has been mainly intermediaries such as leasing companies that use this model. An increasing number of companies however are using this type of model. This can lead to a bigger market, since renting or leasing costs are lower than the cost of purchase. These concepts can also be more attractive to businesses if the disassembly and reuse of products is well organised, so that the residual value after economic use is still high and therefore depreciation is relatively low. This model therefore combines well with lifespan models.

There are plenty of feasible alternatives. Bed manufacturers that sell sleep services instead of beds (lease beds), washing machine manufacturers that sell service washes rather than washing machines with a collect

and delivery service.
This kind of shift to selling a service has consequences for funding (more goods on the balance sheet) and also for labour intensity (usually more work due to more service provision).

Example: Technogym

Technogym, a producer of fitness equipment, overhauls business assets at product level. For an A-brand like Technogym, supplying the right quality is hugely important: the performance of the product indeed determines its value. After a first life the products are frequently still in excellent condition and the equipment is withdrawn, overhauled at the factory in Italy and then given a second life for a new customer, possibly in a different market segment. Separate parts of the equipment are also reused without loss of quality. Overhaul and reuse is still relatively new for many manufacturers, but for Technogym it is 'business as usual'.

Example: Desso

Desso, an international manufacturer of carpets, carpet tiles and playing fields, has been applying the cradle-to-cradle principle since 2008 by designing its products so that at their end of use they can be safely disassembled and recycled.

One of the conditions for bringing about this change is the offering of innovative new service models, in particular types of leasing. The customers no longer own a product, they see it as a service provided by a supplier who takes the product back at the end of its useful life in order to recycle it. As a result of the partnership with DLL initiated in 2013, Desso now offers a full-service leasing option for its carpet tiles including installation, cleaning, maintenance and ultimately removal. This also makes it easier for Desso to withdraw the carpet tiles at the end of their useful life and complete the circuit.
The partnership between DLL and Desso is a ground-breaking step on the way to the circular economy. The customised, full-service lease solution also perfectly suits the aim of DLL to further develop its lifecycle asset management and its mission of encouraging new and sustainable models in which profitability and social and environmental benefits go hand in hand.

All these earnings models add social value, but also monetary value: these are sustainable bussines models. They are frequently substitutes for already existing business models. With unchanged final demand, the transition to this type of model involves, as does every wave of innovation, creative destruction for many businesses: old non-circular businesses will suffer if the new models turn out to be superior. In macroeconomic terms, this means that the success of circular business models will not automatically translate into economic growth and jobs.

The elements of the sharing economy: various transaction models and macro effects

The sharing economy is attracting a huge amount of attention. Firstly, this is because of the number of companies whose business is now based on sharing. However, what these companies do exactly does make a difference, including whether their business really involves sharing. Generally, all these

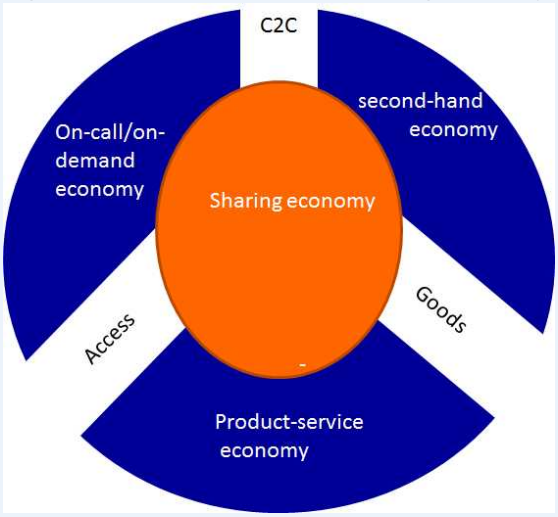
models lead to better use of existing goods, or to liquid markets.

Here we assume the definition of Meelen and Franken (2014): “The phenomenon that consumers allow each other to use their under-utilised consumer goods, possibly for payment”. So, this could mean hiring out your own car, bicycle or chainsaw, lending your garden chairs and large barbecue for a family party. The sharing economy is as simple as that, as it existed before the term was coined. Lending things that you did not need at the time.

This definition has three elements. The first is consumer to consumer (C2C). The second involves the temporary transfer of ownership (therefore not a sale). The third aspect concerns unused goods and not services.

Based on these elements, Frenken et al. (2015) have created a classification into types of transaction models that do not really involve the sharing economy (figure B).

Figure B: Subdivisions of the sharing economy



Source: Frenken et al. (2015)

Product-service economy: The sharing economy involves sharing between consumers. Renting or leasing from a company instead of purchasing is often referred to as the sharing economy, but this is and will continue to be a transaction between a business and a consumer (B2C). The transaction in that case involves a rental or leasing service, while the business retains the ownership. The difference therefore concerns a shift from goods to services. This can be good for the circular economy, since it leads to (1) a longer lifespan, (2) reuse and (3) less waste for products. However, this is not necessarily the case. From a macroeconomic point of view, this is essentially no difference from a flow of goods that is replaced by a flow of services (figure A). The only macro-economic effect might be a difference in de value added produced.

Second-hand economy: Sharing concerns giving temporary access to physical goods between consumers. A transfer of ownership, such as the sale of second-hand goods, is not sharing. It concerns the sale or gift of goods. If goods change ownership for no payment, this has no macroeconomic effect unless it leads to a situation in which people will purchase less as a result. This would mean a contraction in the economy. If the transfer of ownership involves a payment, it then depends on who the seller is. If it is also a private person, then according to the statistics this will not generate any new added value. If it is a business, then the profit the seller makes will end up as ‘growth’ in the national accounts. Less rapid discarding of goods could lead to a more sustainable economy. Unless ultimately people continue to consume the same amount (in monetary terms), in which case the sustainability effect is unclear.

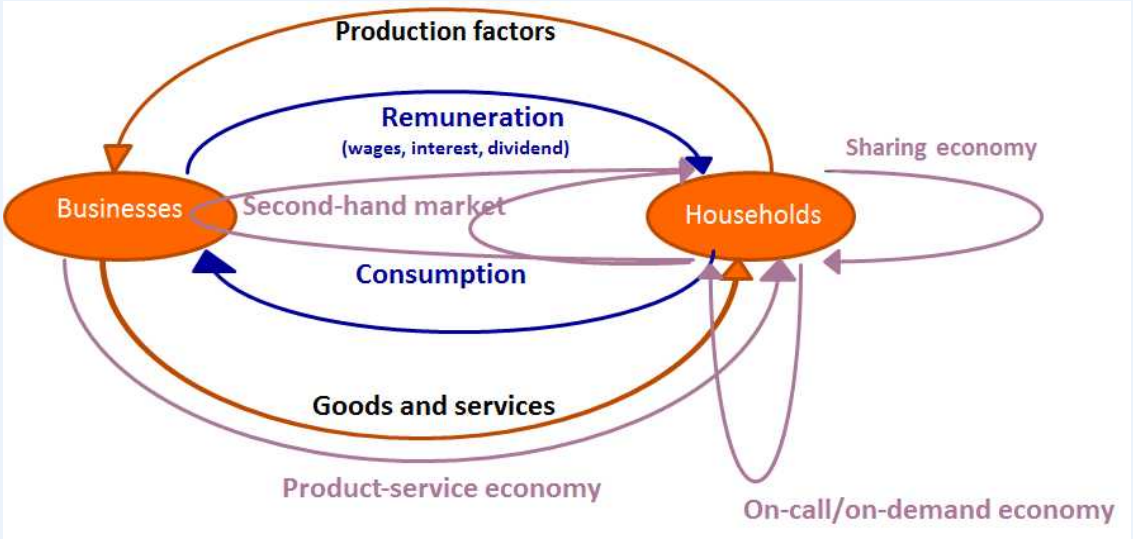
On-call and on-demand economy: The sharing economy does not concern services. Goods can be unused, but people cannot – based on the standard assumption that time by definition has a value. Internet platforms that bring people together to provide services to each other are therefore cited as expressions of the on-call and on-demand economy. The macroeconomic effect is not immediately clear. If the service is provided for free, such as on wehelpen.nl, then it has no significance for economic growth. If it concerns a paid-for service such as the Uber taxi service, the macroeconomic effect is virtually the same as a product-service economy, only it is between private citizens. Furthermore, if it is not registered anywhere, it will also not be visible in macroeconomic terms. There may be an effect in the form of displacement of regular services, such as taxi journeys and hotel stays.

Sharing economy: The sharing of goods, whether for payment or not, is and will continue to be a transaction between consumers for which there is no production. In macroeconomic terms, no new added value is created.

We can offer an example to clarify all this. You can buy a second-hand car through the Internet (the second-hand economy), you can rent a car (the product-service economy), you can hire someone to transport you (the on-call and on-demand economy) or you can rent a car from a private person (the sharing economy).

All these types of collaborative consumption can lead to a more sustainable economy. From the point of view of sustainability, better use of existing goods is a positive development, whether it involves a producer that retains the ownership (product-service economy), a private person that increases the use of his property (on-call and on-demand economy and sharing economy) or a product that has a second, third or fourth lifespan. The effects for sustainability very much depend on the ultimate model and the consequences for the behaviour of the consumer. One can therefore question whether Airbnb contributes to sustainability: for many consumers it offers a cheaper alternative for a city break, and therefore ultimately leads to increased air travel.

Figure A: Macroeconomic sharing



Source: Rabobank

The macroeconomy of the circular economy

The circular economy as described above is still difficult to define in macroeconomic terms. The central issues

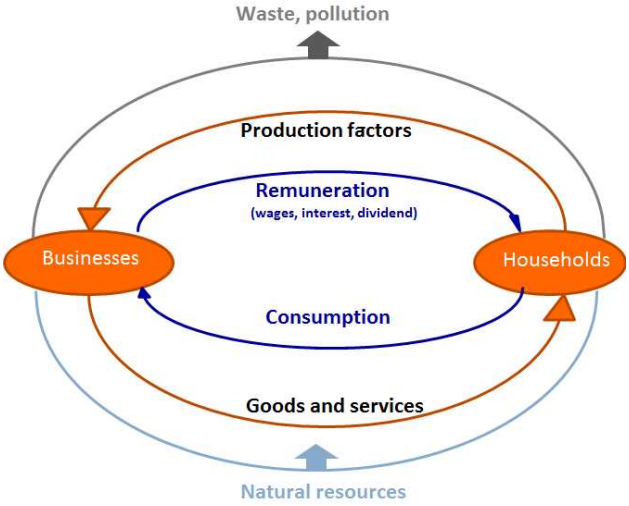
concern the materials circuits and the production ‘circuit’: how can goods and services be generated, and how can materials be dealt with as effectively and efficiently as possible (with product design taking account of value retention and value addition). The measure for this is based on the use and consumption of materials. The exact consequences of this in the real economy are not so easy to establish. We will try to bridge this gap in this section.

The ‘standard’ economic circuit is shown in figure 4. Households and businesses make production factors available, businesses produce goods and services that are then consumed by households and businesses.

GDP is measured by registering these three flows in the economic circuit. [5] In this case, this concerns the innermost arrows (blue and orange) in figure 4. No account is taken here of use of finite stocks, such as natural resources and external side-effects of production such as pollution.[6] This also applies to additions to inventories, for instance through the production of knowledge, infrastructure or renewable inventories.

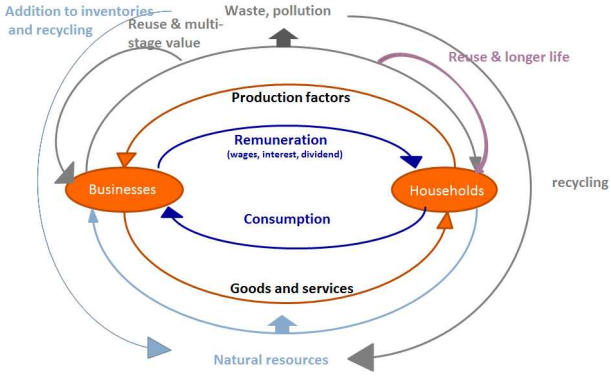
If we compare this simple diagram with the materials cycle in the circular economy (figure 2) or the circular earnings models (figure 3), actually it is only the link between sale and consumer/user that is important in a stylised version of the economic circuit. The rest of the chain until the end consumer consists of ‘businesses’. Then there is the point that if a product or service is ‘used’ without a financial payment, this is not relevant in terms of GDP. However, the ways in which value is created in the transition to a circular economy, as described above, do have consequences for what happens in macroeconomic terms.

Figure 4: The economic circuit



Source: Rabobank

Figure 5: Circular macroeconomy - 1



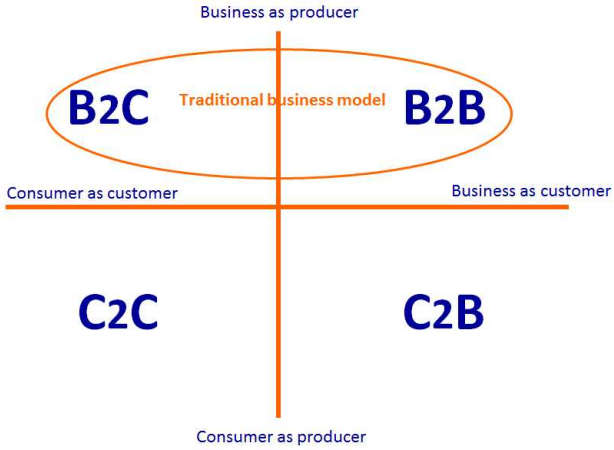
Source: Rabobank

The value created by circularity of materials in practice means reduced use of materials and reduced production of goods. This leads to less added value in terms of GDP growth. Since natural resources are not measured, in the macroeconomic circuit this means that the arrows relating to recycling are outside the diagram (the grey arrow to the right and the blue arrow to the left, figure 5). To the extent that this creates a market (in the sense that waste materials now have a value whereas they used to be valueless) recycling does however affect the economic circuit (the grey arrow to the left). Leaving efficiency and substitution out of consideration, this would lead to higher GDP.

Extending use and lifespan in itself does not add anything to the economic circuit (the purple arrow). Everything that remains in the households sector and is not paid for in the market is after all not relevant to the macroeconomic circuit. There would most likely be a reduction in the volume of goods produced (which is economic growth). On the other hand, we would have repair services, for example.
It is difficult to represent multi-stage value use in a macroeconomic figure. To some extent, this is the grey arrow to the left. Furthermore, this process happens mainly in the businesses sector. To the extent that this

creates new markets, and therefore also a new valuation of what used to be waste, this is economic growth. But if it leads to less use of other materials, this will also negatively affect economic growth.
One final element here consists of the various new transaction models of the 'liquid markets' (see box).

Figure 6: Different transaction models

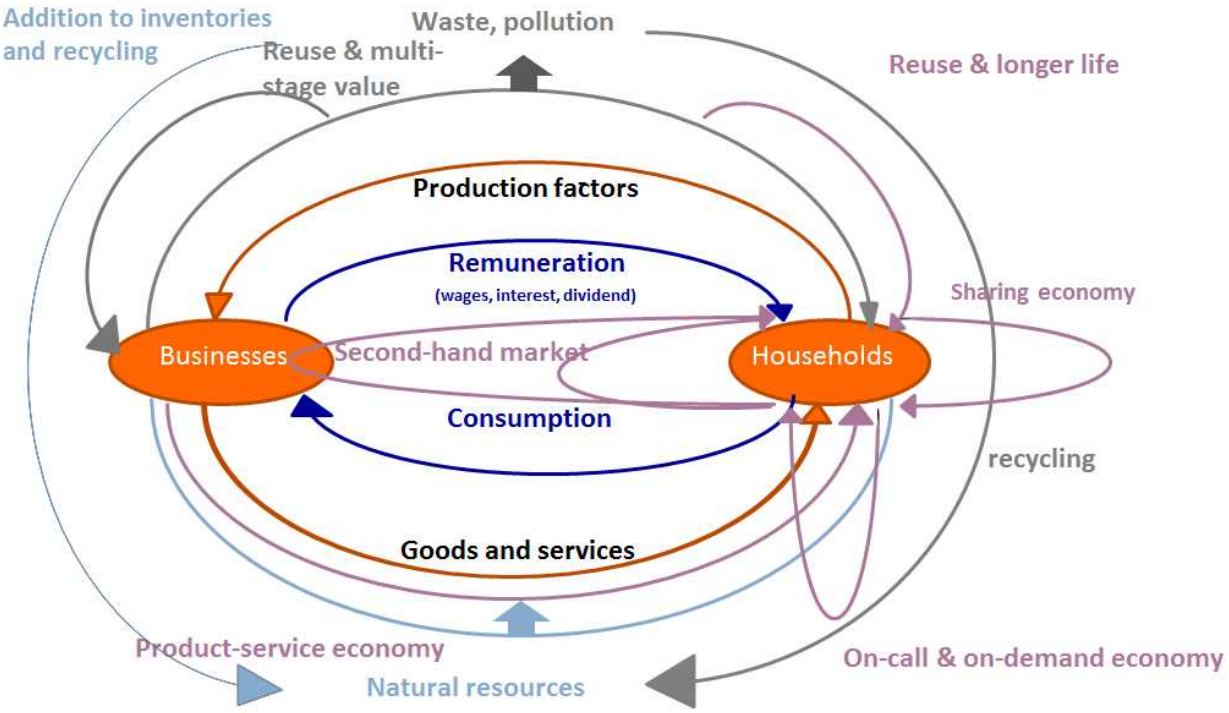


Source: Jonker, 2014

The basis of this type of business model is to some extent a non-traditional transaction model: from consumer to consumer instead of from business to consumer or from business to business (figure 6). In addition, ownership of the product will change: in some cases it will involve the leasing or loan of goods. This will involve trade in services instead of goods.

All the possible effects are summarised again in figure 7. The numerous arrows make one thing clear: a large part of the new 'value' is mainly social value: better use of materials, better use of produced goods and reuse of materials and products and product parts. All that is economically relevant, and certainly from the point of view of well-being, but it will not be measured as growth in Gross Domestic Product. Moreover, the amount of goods (and possibly also services) that flow regularly from businesses to households will decline in a circular system.

Figure 7: Circular macroeconomy - 2



Source: Rabobank

We need to remember here that this is what is known as a first-order effect: since goods last longer and materials are reused more frequently, logically the production of goods will decline. This may well be accompanied by more work in repairs, maintenance, etc..

A practical example: Let us assume that a person decides to buy mainly second-hand clothing instead of new clothing. As a result, this person's spending on clothes is half what it used to be when they bought new clothes. So what happens then? Ultimately people will either buy more second-hand clothing or spend the money they have saved on something else. In both cases the second-order effect will contribute to additional economic growth, but there is also a less positive effect of the circular economy in terms of the environmental burden.

However this is still not the whole story. Let us now assume that businesses, in a closed economy, produce less – indeed, one of the effects of the circular economy. This ultimately means less income for consumers. And so, in an ultimately balanced situation, there will be less consumption and less economic growth. Therefore, the extent to which this second-order effect occurs very much depends on the openness of the economy. In an economy such as the Netherlands, the negative effects on economic growth will be less. This is due to two factors. Firstly, efficiency in the use of imported materials and substitution with renewable alternatives will lead to lower imports and also as a first-order effect to more economic growth. Both ecologically and from the point of view of the macroeconomy in the Netherlands, this is good. The losses will be borne by the (foreign) producers of fossil materials and fuels.
The second factor concerns the circuit of technical products. If goods that are mostly produced outside the Netherlands (from washing machines to computers to clothing) last for longer or are reused, most of the losses in production will not be borne in the Netherlands. The higher the ratio of imports, the greater the final second-order effect will be. Dutch employees will not lose their jobs and thus will have disposable income left over. Depending on their spending, the environmental effect will probably be less, and the effect on GDP will be greater.

How can one measure the benefits of the circular economy?

It is essential when considering the circular economy to distinguish between social benefit, business and

commercial benefit and the effects on economic growth and jobs. These three aspects are far from being logically correlated. The effects of good circular models cannot thus be simply 'added up' and translated to the macro level. There may be substitution for less circular products, meaning loss of jobs and declining production in other areas of the economy. The social return in many cases is also not the same as the return in terms of GDP. The value of reduced use of materials does not appear in the calculation of economic growth.

The economic effects of the circular economy are therefore not restricted to an analysis of the different business models and more efficient materials. An important effect for the macroeconomic circuit relates to where the savings are made.
Regarding the social benefits, ultimately it is the effects on the materials circuit and the environment that ultimately have to be considered: therefore, the use of materials, the extent to which materials are reused, etc.

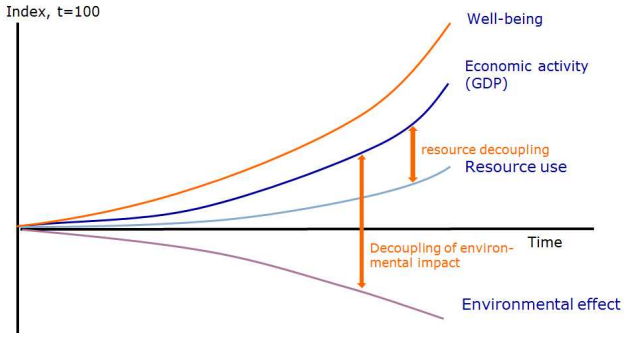
The circularity of the economy

We have already started the journey towards a more circular economy. The 'greening' of the economy is an important concept in this context. The Netherlands is doing excellently in some areas, for instance in waste management. However there are other areas in which Dutch society scores less well. What is more, there are plenty of aspects remaining that make it difficult to measure the extent to which the Dutch economy is moving towards circularity.

Greening, decoupling and environmental effects

The aim of the circular economy ultimately is to complete the circuit: waste as material and the use of renewal resources. The way to achieve this is to make the economy green (PBL, 2013). Greening means the significantly more frugal use of natural resources and limiting the adverse effects on the environment in which we live. Natural resources are a broad assembly of renewable and non-renewable sources, from fossil fuels to water, land and biotic materials such as timber. By greening the economy, 'good' progress will be decoupled from the negative environmental effects associated with progress (figure 8; OECD, 2015). In practice, the measurement of decoupling concerns establishing the relationship between economic growth, or progress, and relevant variables for environmental effects. Here we explicitly make a distinction between economic activity as measured by GDP and well-being, whereby we use a wider definition of prosperity. As we have shown in the previous section, it is indeed very possible that the transition to a circular economy will lead to less use of materials and less environmental impact coupled with lower GDP due to less production. If one only looks at the relationships between GDP, use of materials and environmental burden, the actual decoupling could be underestimated. A broader definition of prosperity, based on well-being, is a better expression of the experienced development of prosperity.

Figure 8: Macroeconomy, well-being and the environment



Source: OECD

Green growth is usually defined in terms of the relationship between economic growth and parameters such as intensity of resource use or environmental burden. This concerns a relative decoupling if the increase in economic activity is paired with a relatively lower increase in the environmental burden. Absolute decoupling occurs if economic activity increases while the burden on the environment is unaffected or declines.

The routes to greener growth are also the routes of the circular economy: efficient use of materials, reuse of

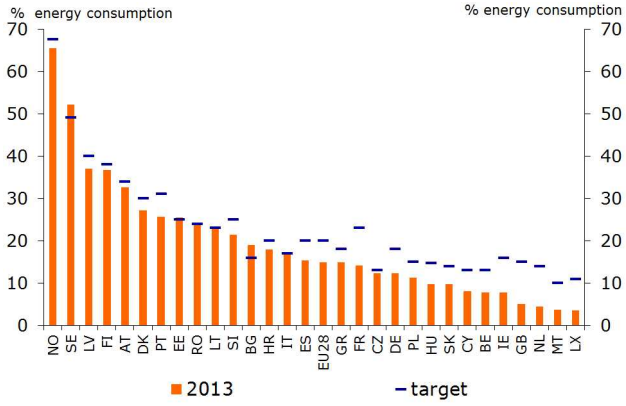
goods and materials, longer product lifespans, searching for sustainable substitutes for polluting or scarce materials and consumption of less polluting goods and services.Measuring the degree of ‘circularity’ and the development of this therefore also concerns these areas.
One can quantify the circularity of the Dutch economy from two angles: firstly in terms of production and secondly in terms of environmental effects. We will now briefly address these two aspects.

Circular production

The first way of quantifying the circularity of the Dutch economy as it now stands is to analyse the extent to which renewable resources are being used, and to establish how resources are consumed in the Netherlands and the extent to which feedback loops such as recycling are featured in the system. Insight can also be gained from innovation indicators.
We will start with the use of resources. The Netherlands does not score well in the field of renewable energy (figure 9). Not only is the Netherlands’ score of 4.5% of energy consumption from renewable sources in 2013 one of the lowest among the European Member States, the country is also falling well behind its (self-imposed) target of 14% in 2020. Both in absolute terms (an increase of 9.5 percentage points of consumption from renewable energy) and relatively (more than a tripling of the current share of renewable energy), the Netherlands faces the biggest challenge of all the European Member States. We would note here that the fossil energy mix makes a significant difference in terms of environmental effects. Coal is indeed much more polluting than natural gas. Looked at from this perspective, energy consumption in the Netherlands might be somewhat more sustainable than is the case in Germany, for example.

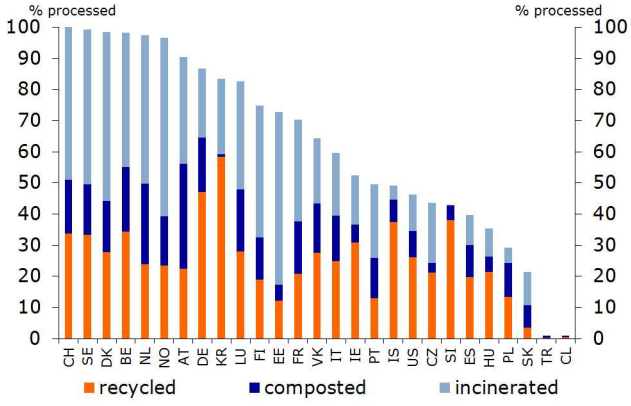
Secondly, the degree of recycling. In terms of the extent to which municipal and other waste is recycled or processed in an environmentally friendly way, the Netherlands is one of the leading countries in an international context (figure 10). More than 97% of waste in the Netherlands was recycled, composted or turned into energy by means of incineration in 2013.

Figure 9: Renewable energy consumption, 2013



Source: Eurostat

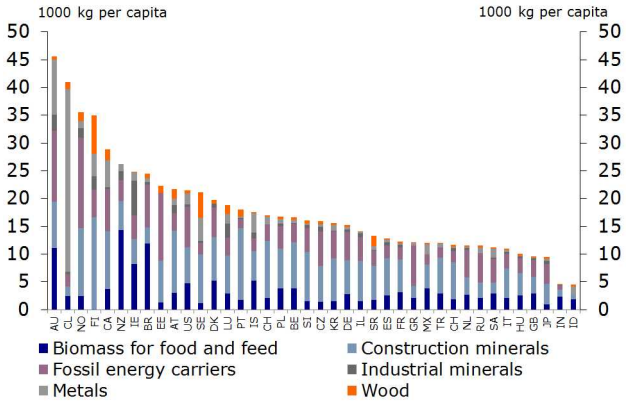
Figure 10: Recycling



Source: OECD

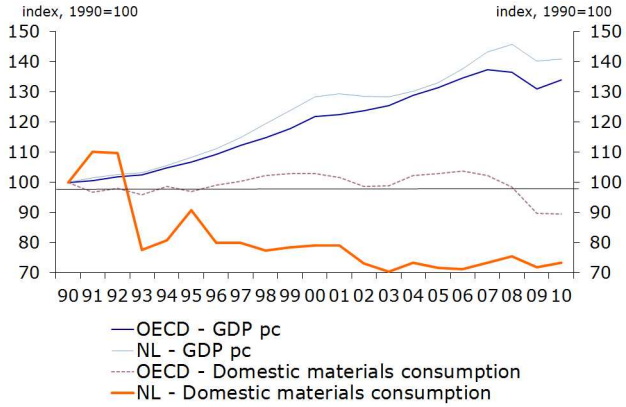
Recycling is however only a small part of the story. Clearly, it all starts with the use of natural resources per capita. We can obtain an impression based on consumption of resources per capita (figure 11). However this figure does not present a clear picture. Countries with more natural resources mainly consume more natural resources, most probably because their domestic materials prices are low and they have relatively high living standards as a result of income from exports. The proportion of fossil fuel use is also generally higher in countries with higher GDP per capita. There has however been a decoupling of economic growth and consumption of natural resources throughout the OECD countries since 1990 (figure 12). Currently, less resources are used with a higher GDP.

Figure 11: Consumption of natural resources



Source: OECD

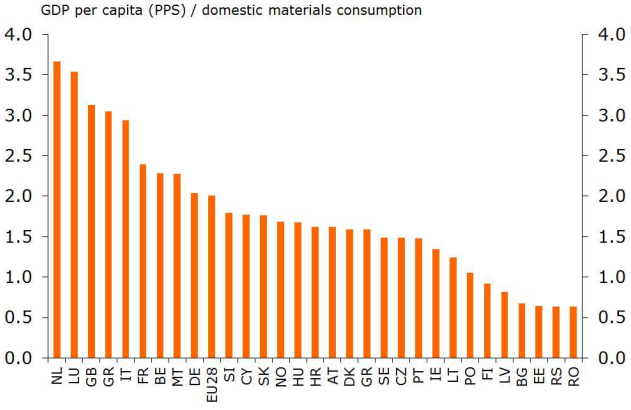
Figure 12: Decoupling of consumption of materials per capita compared to GDP per capita



Source: OECD

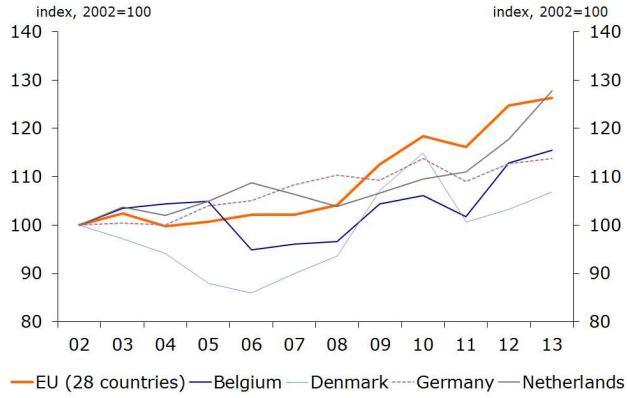
An important reason for this is increased efficiency with respect to the use of materials (figures 13 and 14). In Europe, the Netherlands is the country that adds the most value per unit of domestic materials consumption. Production efficiency has significantly increased in virtually all countries in the past 10 years (figure 14), which shows that the economies are slowly but surely moving towards more efficient use of materials.

Figure 13: Efficiency in use of materials



Source: Eurostat

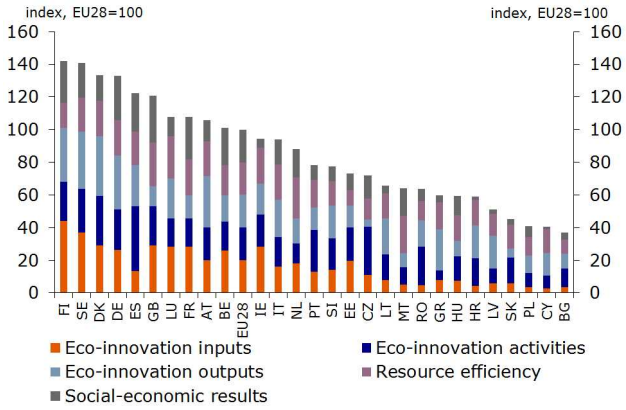
Figure 14: Development of efficiency in use of materials



Source: Eurostat

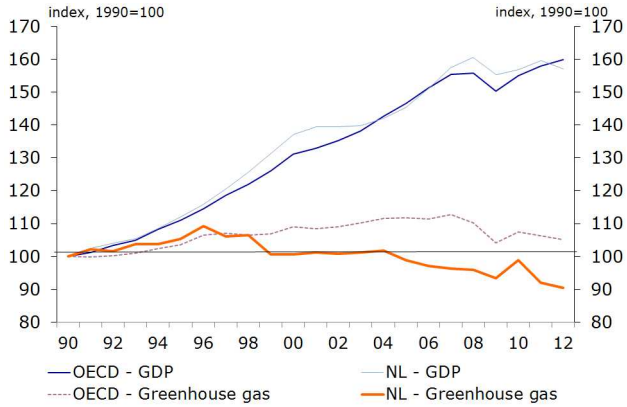
An important role here is reserved for ‘green’ innovation. The ‘eco-innovation index’ shows the degree to which various European economies are becoming more sustainable on the basis of a large number of indicators. The Netherlands scored below the European average on the basis of this indicator in 2013, but well above average in 2012 (figure 15). The indicator thus requires very careful interpretation. The Netherlands scores relatively well on the sub-indicator ‘resource efficiency’, but below the European average on the other sub-indicators. The Netherlands’ score on the sub-indicator for eco-innovation activities is relatively low. The question is, how should one interpret this score, since it concerns activities that combat waste in production. And since the Netherlands already scores highly in this respect, one can question whether one can expect a similar effort to be made as in other countries.

Figure 15: Eco-innovation index



Source: http://www.eco-innovation.eu/

Figure 16: GDP development and greenhouse gas emissions



Source: OECD

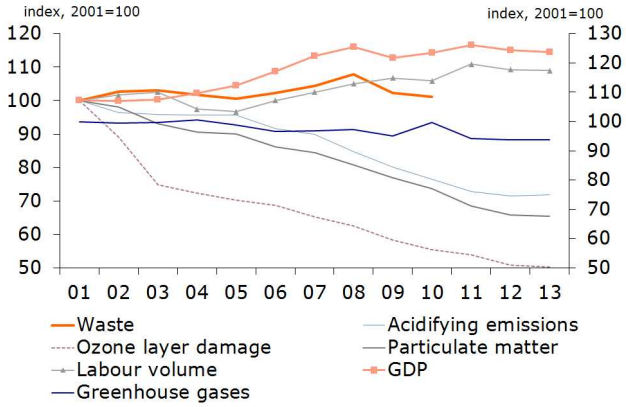
A number of other factors in the production process or changes in the economy are not accurately measured. For instance, no one knows the extent to which things are reused, the size of the second-hand market or the importance of the platform economy. The only thing that is known apparently is that this is increasing in size.

All in all, for the Netherlands it is a mixed picture. The economy is becoming more circular, but it still features high use of fossil fuels and materials and it is not engaged in eco-innovation in all respects.

Circular in environmental effects

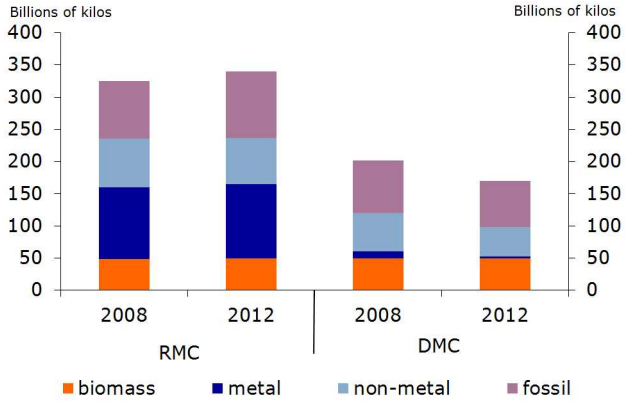
An economy that meets the requirements of circularity features little or no waste, and it will never use more natural resources than nature can provide.
While in the previous paragraph we could conclude that the economy is producing in much more 'circular' fashion, when we look at environmental effects we can also conclude that the direction is right, but we still have a long way to go. There are plenty of environmental indicators that show that in any case since 2001 there has been complete decoupling between economic activity as measured by GDP and environmental effects (figure 17). It is mainly in the reduction of materials that damage the ozone layer where some success has been achieved, as well as the reduction of emissions of particulate matter and acidifying emissions, albeit to a lesser extent.

Figure 17: Absolute decoupling of growth and environment



Source: CBS

Figure 18: The materials footprint compared to direct materials use



Source: CBS

This is the positive side of the story. Footprint indicators give a less rosy picture. A footprint indicator relates national consumption to the environmental pressure that is brought to bear throughout the world by considering the environmental pressure in the production chains. This means that the environmental pressure caused

outside national borders for the production of import goods and services is included for the Netherlands as well, while the environmental pressure coming from the production of export goods and services within the Netherlands is left out of consideration. Various footprint indicators have been developed in recent years that are important for sustainability policy.

The carbon footprint[7] has remained more or less stable in the past 15 years; the biodiversity footprint[8] has declined slightly (thus less pressure on biodiversity, CBS, 2014).

The materials footprint (Raw Materials Consumption, or RMC), which shows the volume of materials needed globally for consumption in the Netherlands, has risen by around 4% between 2008 and 2012 (figure 18), and thus contrasts starkly with materials used directly for domestic production (Domestic Materials Consumption, or DMC) that we discussed in the previous paragraph, which has fallen sharply (see also figure 12). The reason for this is that products involving intensive use of materials are increasingly being produced abroad. And this immediately becomes a warning for the transition to a circular production system in the Netherlands: if consumption does not change, the environmental effects may not be as favourable as they at first sight might appear.

Three macro scenarios for the circular economy in the Netherlands

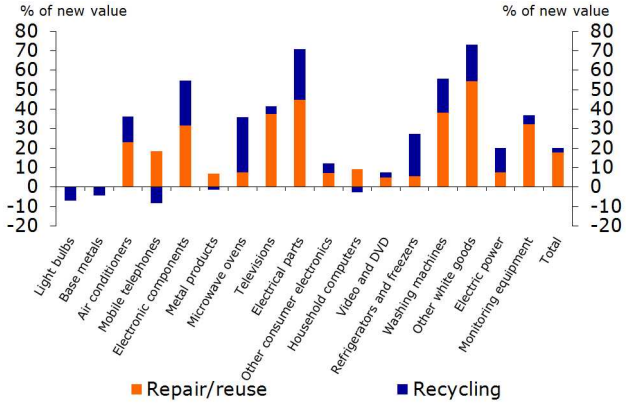
The Netherlands is already on the way towards a circular economy. The development of sustainability of the economy is however not measurable or visible on all fronts. With this in mind, it is a very ambitious task to say something in quantitative terms regarding the macroeconomic effects of further transition to a circular economy. Nonetheless, we will make a very tentative attempt using three scenarios. The environmental effects, which by definition are positive, are ignored here. From a business and social point of view, the further transition towards a circular economy appears to be obvious. For the Netherlands, it is also the case that we are very well positioned to make a success of this in terms of economic activity.

Methodology

A number of estimates of the effects of a transition to a circular economy have been made for various countries and regions in recent years.[9] The findings of these studies however offer very little comparability. The differences are very large, both in terms of focus – some focus mainly on materials efficiency in certain chains, while other studies look mainly at innovation or a transition to a use economy – and in terms of time period, the variables that are measured, the region studied and the methodologies used.
However, the main message is generally the same: transition to a circular economy will deliver more jobs, more social value and reduced CO_2 emissions.

For the calculation of the various scenarios, we use the effects on the economy as previously calculated by EMF (2012, 2015) and TNO (2013). We focus on the Netherlands, and the base scenario is largely based on the effects as calculated by TNO. Briefly, the method is based on calculating and reasoning the potential effects of the transition to a circular economy for a limited number of sectors, after which the results obtained are scaled up to the economy as a whole. The contribution to the economy of a transition to sustainable energy is left out of consideration. From the perspective of making materials circuits more circular, this is an essential feature of the circular economy. It is more difficult to estimate what the effects will be in macroeconomic terms. This depends on what form the substitution takes; a transition from imports of oil for instance to domestic generation of sustainable energy will have a positive effect, while a transition from domestically produced natural gas to imported green energy will have the reverse effect in economic terms.

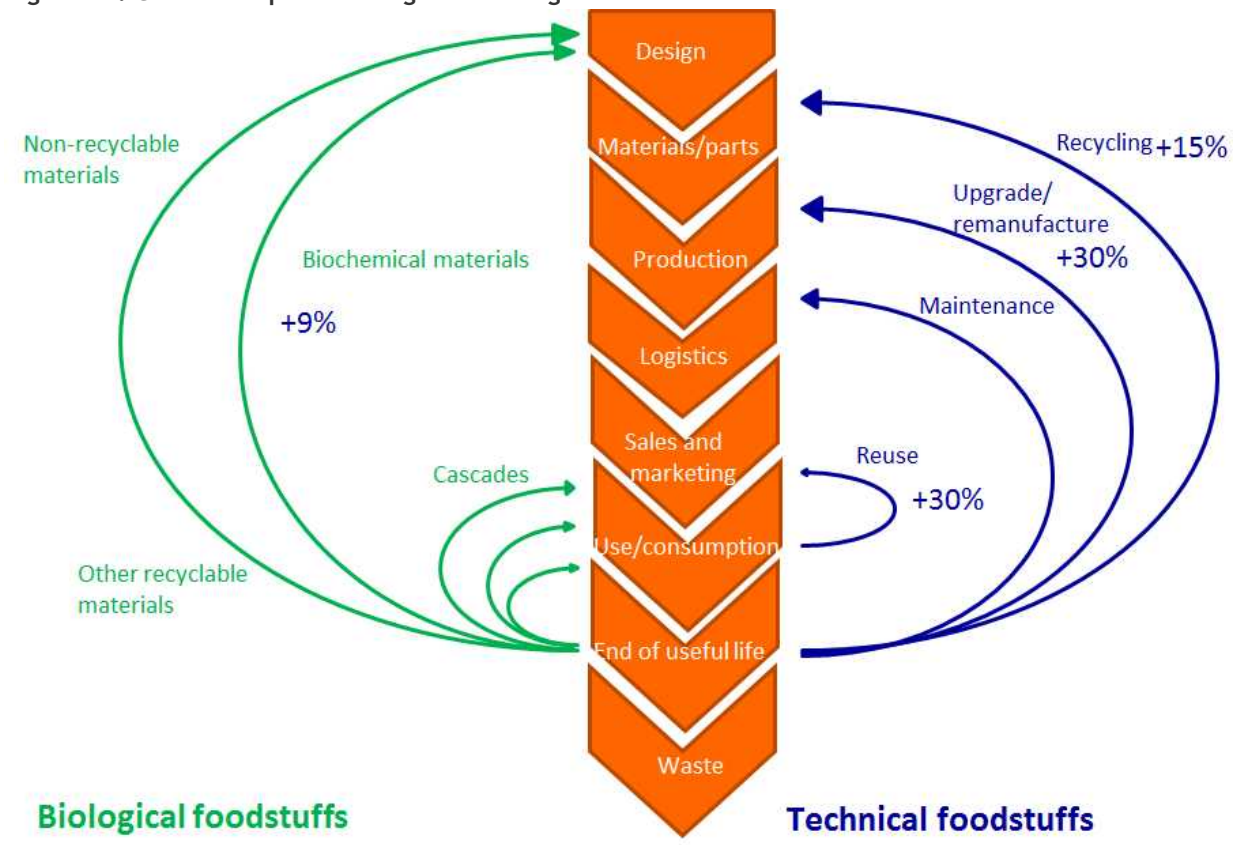
Figure 19: Current value of feedback loops in the metals and electrical engineering sector



Source: TNO, 2013

The analysis by TNO follows the circular feedback loops of technical products (figure 20): reuse of products, reuse of components, repair and recycling. The feedback loops relating to biological materials are also considered. The figures on which the size of the current feedback loops are based are constructed on the basis of scarce and in some cases out-of-date sources. Most of these figures are not systematically collected. Based on the figures for the metals and electrical engineering sector, TNO comes to a total circularity value of EUR 3.3 billion (figure 19), with the highest values obtained for repair and reuse, and negative values in some cases, (for instance, recycling) since collection costs money (for example, light bulbs and computers).

Figure 20: GDP development and greenhouse gas emissions



Source: OECD

The important thing here is to connect this with the economic circuit in figure 7. The value as calculated by TNO consists of the sale price of reused articles in the second-hand market. This mainly involves trade between consumers and therefore this value is not relevant as regards GDP growth, although it is socially relevant. The situation is already less clear when it comes to the reuse of components: part of this will involve trade from businesses to consumers, and so it will be relevant to GDP growth.

TNO bases its valuation of repair on the value of the number of articles presented for repair (in an unrepaired state). This is indeed a social gain. But it is not new production in terms of GDP growth. Only the repair service counts towards this.
Lastly, for recycling the calculation is based on the costs and benefits associated with this. This is relevant for

both social benefit and GDP growth. Actually it counts as production of new goods.

A similar approach is used for biotic residual flows. Three types of residual flows are distinguished:

- Primary residual flows: Residual flows released from harvesting, storage and transport prior to first processing;
- Secondary residual flows: Residual flows released during the primary processing in the agricultural industry;
- Tertiary residual flows: Residual flows released after production or during or after the intended use/intended consumption by the end user.

TNO estimates that these residual flows currently represent a value of EUR 3.5 billion. At EUR 2.1 billion, the largest value component is processing to produce animal feed. Unlike the values in the technical circuit, these values are all relevant to GDP growth.

The assumptions regarding the potential gains in the various links in the chains are in most cases based on 'expert judgement'. Partly because of this, and given the experimental nature of the circular economy, the estimates of the macroeconomic and social benefits are highly uncertain. The changes as calculated by TNO fit a picture of an economy that will essentially remain the same, but in which the existing feedback loops, as shown above, will be strengthened. In view of the uncertainty we have created three scenarios for these effects.

Here too, the differences between social value, economic growth and finally the implications for employment in the technical circuit need to be carefully analysed. TNO calculates the value of the circular economy by taking the value of an increasing number of goods that will be repaired or reused. This indeed represents the social value. However it does not add to GDP growth, since no new products are produced. The value of repair services is certainly relevant to GDP. The same applies to recycling: the GDP value lies in the service provision, plus the value of the recycled materials when sold.

TNO adjusts this value for the fact that fewer new products will be sold. It assumes that reuse and repair will lead directly to lower sales, and that the reuse of parts will reduce new sales by 75%. To the extent this concerns value produced in the Netherlands, this value is deducted from the calculated social value.

We take a slightly different approach in our analysis. Apart from the fact that less will be produced as new value, the savings made by consumers will ultimately be used to purchase other products. An example may help to illustrate this point.

Let us assume that a new pair of trousers that a consumer would normally buy costs EUR 80. If this consumer decides not to spend EUR 80 on a new pair of trousers and purchases a second-hand pair for EUR 20 instead, he has saved EUR 60. This EUR 60 becomes the maximum amount for the potential second-order effect, in which there are many options at the micro level. For instance, the consumer could put this money into a savings account. Or, he might spend it on more second-hand clothes. Or a plane ticket with Ryanair. Or donate it to a good cause.

So, the effect at micro level is completely unknown. Things are easier at the macro level. The marginal consumption ratio for large groups is quite high. It is therefore highly likely that under normal circumstances the money will be used for other consumption. Unless we assume a change in behaviour (which we do in one of the scenarios), this second-order effect will be quite significant.

We have created three tentative scenarios: *Linear bow, Circular go* and *Circular flow*. The basic parameters originate from TNO; in all cases we will discuss the structural effects. A number of factors lead to differences in scenarios:

- **Materials prices**: In a world in which materials are rising in value and development of their prices is also more volatile, there will most likely be a need to move to more circular business models. Uncertainty regarding the supply of materials and rising prices are therefore considered by us to be circularity accelerators.
- **Government policy**: Policy designed to facilitate circular earnings models can contribute to a circular economy. This concerns the role of government as a customer, but it also needs to design the incentives in tax legislation and regulation in such a way that making production processes more sustainable is rewarded. This includes the role of taxation. The subsidisation of fossil fuels and taxation of labour are slowing the transition to a circular economy. The government must also provide room for experimentation.
- **The financial sector**: It is important that circular business models, which are often innovative, can also be funded. This concerns not only banks, but also capital providers that can fund businesses in the initial phase.
- **Innovation:** The speed and degree of innovation in circular processes, and innovations in relation to materials and products will ultimately hugely influence the speed of the transition to a more circular system. This speed will however be significantly determined by other factors: policy, funding and materials prices.
- **Sentiment**: This variable is difficult to estimate, if not impossible. But, a society in which reuse, use instead of ownership and lower consumption increasingly become the norm will move faster towards a circular economy. Very difficult to quantify or predict, but ultimately decisive for the success of the circular economy.

Circular go

In this base scenario, we stay close to the assumptions of TNO. As TNO itself says, its assumptions are quite conservative, but they are in the direction of an increasingly circular economy. In this scenario, the factors stated above that could make the difference with respect to the circular economy are in the moderately positive situation: materials prices are higher than today, government policy remains as it is, good circular business models are succeeding in attracting funding (the financial sector is accommodative, but not pioneering) and sentiment is more or less as it is today: there is a small group of people who believe in sustainability while the majority of the population is concerned with other matters. All this leads to a limited degree of innovation: no radical breakthroughs in the use of materials, no general change to business models.

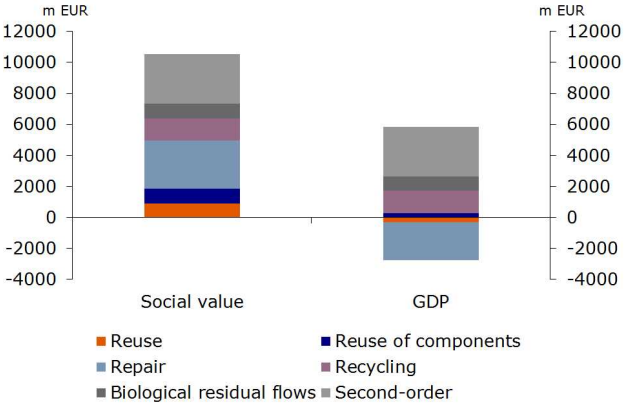
All the above gives us the title of *Circular go*. TNO arrives at an increase in the value of reuse and repair of approximately 31%, for recycling an increase in value of 15% and for the totality of biotic residual materials at a value increase of 9%. The circularity of services also increases by around 0.2%. In total and over time, this delivers a gross added value of EUR 11.3 billion, adding value of almost two percentage points to GDP.

In terms of economic growth, the calculation is somewhat different. Only the increase in services, biotic residual flows, recycling and possibly half of reusage by consumers are relevant to economic growth. This amounts to roughly EUR 3.8 billion, and clearly is much lower (figure 21).

When considering employment, we have to take this lower figure. The employment effect would then, due to increased circularity, amount to approximately 28,500 jobs with productivity corresponding to the current averages in the sectors concerned.

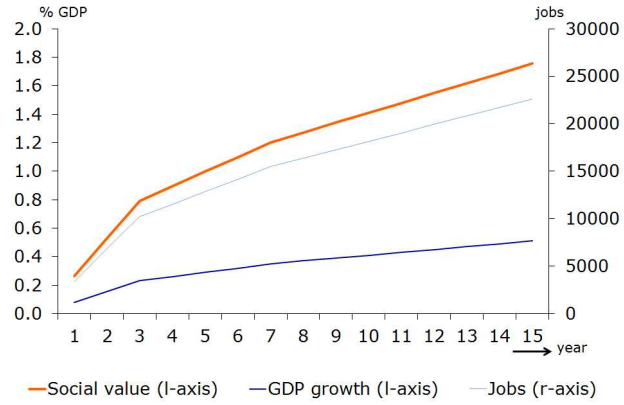
There are at least two other factors to consider. Firstly, the effect of lost production. The number of new products will diminish due to reusage and repair[10]. In this scenario, this represents a loss of EUR 4 billion, with therefore a corresponding loss of jobs. In terms of GDP growth and jobs, the total effect would thus be nil. But this leaves EUR 4 billion in spending in the economy ‘pending’. We assume in this scenario that 80% of this will be spent on domestic consumption, thus providing over EUR 3 billion in additional consumption. The effect on the environment would probably be negative, depending on what is consumed. Figure 21 summarises these structural effects. For employment this would, on the basis of the assumptions of TNO, amount to 23,000 additional jobs in the Netherlands. Note however that the number of jobs elsewhere in the world would most likely decline.

Figure 21: Social value and GDP of Circular go



Source: Rabobank

Figure 22: Macroeconomic development of Circular go



Source: Rabobank

TNO assumes that the effects will occur over a period of around 15 years, meaning that the effects actually include a delay (figure 22). This relates to the times at which the effects occur in TNO's calculation. This in itself is a counter-intuitive assumption: one would actually expect the circular economy to have more effect if it had a broader base and more experience with it had been gained.

In terms of external effects, this scenario predicts a reduction of CO_2 emissions of around 8%. Note however that energy use has still not become sustainable. If the share of sustainable energy in energy use according to the EC target of 14% in 2020 is included in this scenario, greenhouse gas emissions would, depending on the energy mix, be significantly further reduced. Achieving the target of a 20% reduction in comparison to 1990 by 2020 is however a remote possibility.

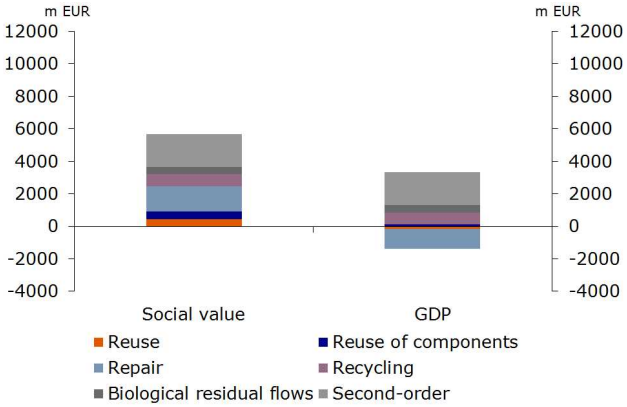
Linear bow

The second scenario is not actually a real circular transition, it is a small deviation (or bowing) of the current linear path. Government policy is not focused on sustainability, materials prices are still relatively low and the certainty of materials supply is not keeping anyone awake at night. The financial sector is still not involved at all in funding the circular economy. Partly as a result, innovative ideas are not gaining traction.

This is why we have chosen the title *Linear bow*. We have halved the effects as quantified by TNO in this scenario, on the assumption that things will not turn out like that. We also assume that people will spend the money they save: no value will be placed on sustainable behaviour, consumers will spend all the money they save on other things and on average this will cause just as much pollution as their normal consumption would have done. The effects over time are also linear: so no acceleration at the beginning, and certainly not at the end.

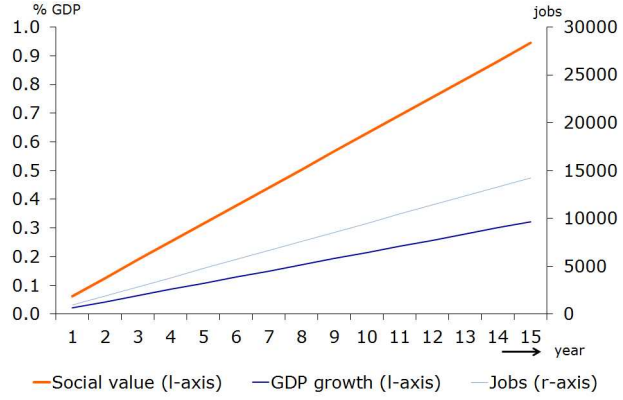
Obviously, this scenario delivers the least benefit in social terms (EUR 5.7 billion), in GDP growth (0.3% increase in GDP volume) and in the number of new jobs (just over 14,000). This is also shown in figures 23 and 24. The difference between social value and GDP value is also the lowest in this scenario. For certain elements (such as reuse) the effect on economic growth is again negative: less will be produced, while the social value is not relevant to GDP.

Figure 23: Social value and GDP Linear bow



Source: Rabobank

Figure 24: Macroeconomic development Linear bow



Source: Rabobank

In terms of the rate of change, this scenario perhaps even assumes a slower move towards a circular economy – or greening of the economy– than we have actually seen in previous decades. It may not be likely, but for instance the sharply lower prices of materials in recent months together with a macroeconomic policy that is mainly focused on variables such as economic growth, reducing government and household debt and accommodative monetary policy could bring about a situation in which such a scenario becomes reality.

In such a case there would not be a rapid shift towards a truly circular system, the economy and society would continue to progress in its presently slow road of very small steps. Obviously, the environmental effects in this scenario would also be very limited.

Circular flow

The final scenario is the opposite of the preceding scenario: not a small diversion from the linear path, but a radical shift to a circular economy. The driving force behind this is government policy focused on the successful realisation of the circular economy. There is also an ambition to make the Netherlands a hot spot for the international circularity movement. Reduced subsidisation of polluting energy sources, reduced taxation of labour (especially at the lower end) and tax and other incentives for more sustainable production and consumption. This requires a financial sector that is willing to assist circular business models instead of simply accommodating them. For example, making funding, knowledge and networks available and using innovative funding products for these models. It would then become easier to create new markets, for example for waste, improve and maintain circular networks and share knowledge of successful circular models.

This scenario is also partly based on the *Growth Within* scenario of the Ellen MacArthur Foundation (2015). This scenario assumes extremely rapid innovation, whereby mobility for instance takes a completely different form. Instead of owning a car (which stands idle for 92% of the time), transport will become a service. Smart and sustainable design of built-up areas will be an important basis for this. Multi-functional use of sustainable buildings, flexible forms of working and an efficient infrastructure will also be required.

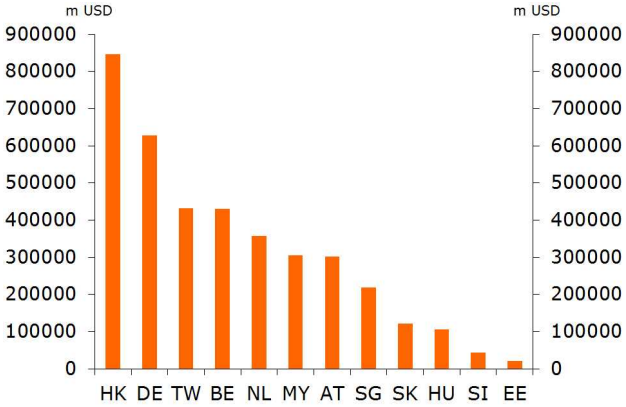
Materials prices would rise in this scenario, but they would remain extremely volatile. Everyone will thus be aware of the importance of less dependence on materials. Innovation will be abundant and mutually reinforcing, through learning effects on the basis of experimentation facilitated to some extent by government and funded by the financial sector. The final element would be a turn of sentiment towards a more circular kind of consumption. Use and reuse instead of ownership, consumption focused on less pollution and numerous initiatives that will lead to a shift from production to service provision.

In the structural situation, we have tripled the effects as calculated by TNO. However, this would only be achieved gradually. We assume there would be an acceleration in the system: as a result of these effects and their scale, circularity will be accelerated. The circular economy would become a flow: *Circular flow*.

Secondly, we assume that only half of the savings realised in consumption would be used for new spending. This would mean that consumers would really change their behaviour and buy fewer new things. In an advanced and developing circular economy this is possible, since business models moving from ownership to use would become increasingly important and an increasing share of consumption would consist of services.

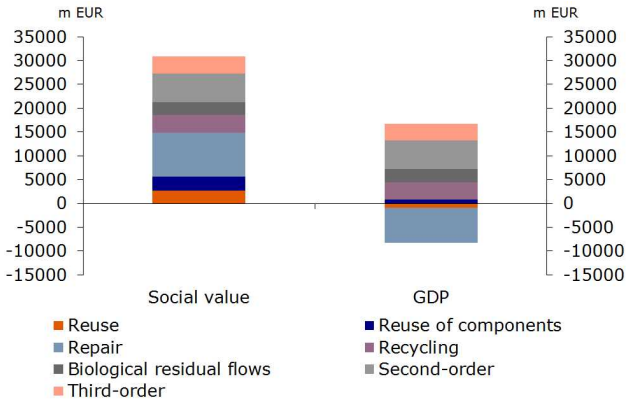
There would also be relatively more jobs, partly due to this effect, but also due to more repair services and reuse services. We have estimated the effect of this by assuming a 25% reduction in salary costs.

Figure 25: Share of materials imports top 10 countries



Source: Rabobank

Figure 26: Social value and GDP Circular flow



Source: Rabobank

Secondly, we tentatively take account of a third-order effect. This concerns the export of knowledge of the circular economy to other countries. This will mainly be interesting for countries with high dependence on materials whose economy does not yet operate as efficiently as the Dutch economy, but which have a sufficient high level of income.[11] These countries are shown in figure 25, in which the Netherlands is prominently featured. We assume that 2.5% of the value of these import flows can be realised by Dutch businesses as added value in the coming 15 years through the application of knowledge of the circular economy elsewhere. This would amount to roughly EUR 3.5 billion, and represents about half of what is currently earned from knowledge regarding water management.

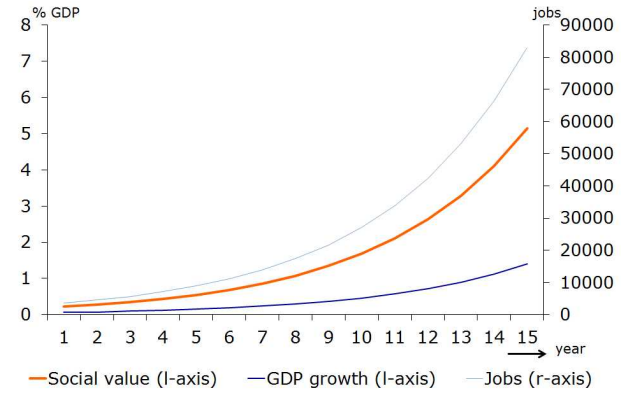
We only include this effect in this scenario because the Netherlands would become a hot spot for the circular economy.

The separation of the structural effects in relation to the creation of social value and GDP growth are shown in figure 26. The social value of the circular economy would rise in this scenario to around EUR 31 billion, or 5.1% GDP. The size of the economy would increase significantly less, by about 1.4% or EUR 8.4 billion. The most important difference is due to the relatively minor second-order effect (people actually consume less) and the fact that a large part of the circular effect in the technological circuit will not increase GDP, it will reduce it.

The effects become stronger over time (figure 27): the economy will adjust to the paradigm, whereby the structural effects as regards social value will not yet be reached after 15 years. Another positive effect in this scenario is the decoupling of the number of jobs from the development of GDP due to more trading in services and less in products. Job creation in this scenario comes to around 83,000.

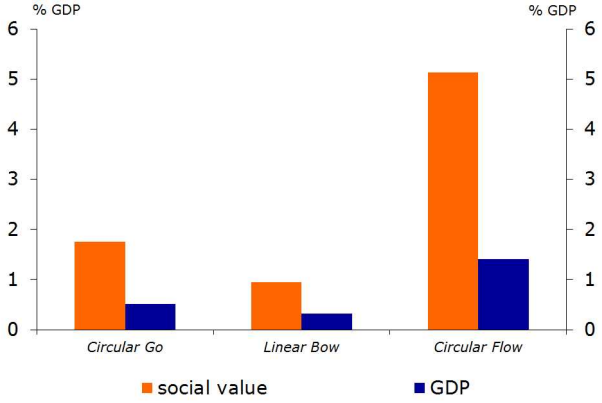
Obviously, this scenario would also bring the greatest effects for the environment. Our tentative estimate is that greenhouse gas emissions would be reduced by around 23% after 15 years. If the proportion of sustainable energy were also to reach the level in 2020 as in the energy agreement (14%), CO_2 emissions in 15 years' time would be approximately 30% lower than they are today. However, due to the accelerating development of the scenario (relatively few effects at the start), CO_2 emissions in 2020 will not be 20% below the level in 1990.

Figure 27: Macroeconomic development Circular flow



Source: Rabobank

Figure 28: GDP effects and added value in three scenarios, final effect

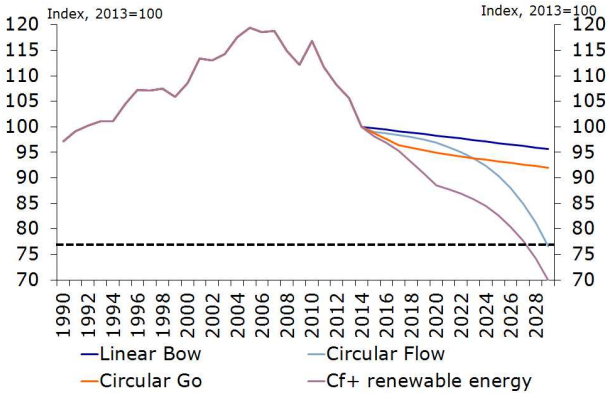


Source: Rabobank

The three scenarios give a wide range of the potential macroeconomic effects of the transition to a circular economy (see also figure 28), as well as the environmental effects (figure 29). All the figures stated here should therefore be treated with great caution, since the level of uncertainty is very high. However, a number of conclusions can be made on the basis of the analysis above:

- Even in the minimum variant (*Linear bow*), the circular economy is good for employment and GDP. The effects are however obviously small, and well within the margin of error of any forecast.
- In all the scenarios there is a difference between social benefit and economic growth. This difference is the greatest in the most circular scenario (*Circular flow)*. In the extreme case, a transition to a circular economy could involve a contraction of GDP. This is further evidence that economic growth is a poor measure for the circular economy.
- The effects on employment will become greater once the economy really enters transition. It will then be easier to achieve a shift to service provision, with a relative increase in employment.
- The export value of the circular economy is difficult to estimate. This will clearly be greatest when the Netherlands can become a 'guide country' for the circular economy and thus market the experience it has gained in other countries. We have included this only in the last scenario.
- The environmental effects are potentially significant. Perhaps more importantly than the effects on economic growth and job creation, a more circular system of production, use of goods and treatment of waste could offer an efficient way of significantly reducing greenhouse gas emissions.

Figure 29: Development of greenhouse gas emissions in the three scenarios



Source: CBS, Rabobank

Conclusion

The circular economy is and will continue to be an awkward term. It is not a new model. It mainly concerns

structuring the economy in a sustainable way with the priority being to use materials efficiently and reduce and ultimately eliminate waste flows. The materials cycle is the central issue.

In this special, we started by showing that this approach could lead to very positive and sustainable earnings models. But also that these business models would not necessarily contribute to increased prosperity in macroeconomic terms.
Secondly, we showed that our economy, albeit too slowly perhaps, is making greater progress towards circularity in terms of production than in terms of consumption. The Dutch economy scores highly in terms of materials efficiency, and the use of materials, while still very high, is diminishing. Things are less rosy when it comes to consumption. We consume a lot of imported goods with a relatively large ecological footprint. A circular economy at home does little to ameliorate this.

With a number of interim steps, we ultimately created three very tentative scenarios as to how the circular economy would translate into economic growth, social value and jobs. Once again, we stress that the figures are mainly illustrative and are all tentative. However, in view of the importance attached to the figures stated in other studies, such as those of the Ellen McArthur Foundation (which are at least as tentative), we think their addition is useful. We have considered two channels whereby the circular economy will have an effect that have till now been ignored. Firstly, what will happen to the money consumers may save as a result of increased reuse, repair and longer product lifespans. If they use this for consumption, this will to some extent negate the positive environmental effects. Secondly, we gave a very tentative estimate of the potential positive effects of the circular economy as an export product. We think this could amount to an export value EUR 3.5 billion.

The results of the various scenarios vary significantly. In the *Linear bow* scenario there is little effect on growth, employment and social value; in the *Circular flow* scenario the effects are structurally significant, with around 83,000 new jobs and a social value amounting to roughly EUR 31 billion (5.2% GDP). The effects on economic growth will be significantly less, at EUR 8.4 billion (1.2% GDP). This is because many of the effects of the circular economy will not generate more growth, and also because in this scenario we have assumed that people will actually consume fewer new products.

The relevant question is then, how do we get into the *Circular flow* scenario? Or, to put it another way, what policy, what change in behaviour by all actors in society do we need to make this most circular scenario a reality?
Let us begin with business. It is repeatedly the case that innovative business operators are able to ‘discover’ circular business models that are also sustainable in the long term. By sharing knowledge, forming networks and reinforcement, these models can become more generally accepted. This concerns the five business models: circular input models, waste value models, lifespan models, platform models and product as service models. Many businesses use a combination of these models to create value. This created value is in the first instance a sustainable earnings model, but also a social value that contributes to the sustainability of the economic and ecological system. Each of these models require different things in order to move forward further. For instance, platform models frequently rely heavily on ICT. The success of the platform depends heavily on volume: the more sellers and buyers, the more transactions there will be. Recent history shows these businesses can become big very rapidly, but that they can also collapse just as quickly.
Waste value models benefit from the discovery or creation of new markets. More than other businesses, they depend on the rest of the chain and need cooperation as one of their critical success factors.
The financial sector also has an important role here, both in its primary role (as the financier of circular business operators) and in a secondary role as a network partner and supplier of knowledge. Cooperation in the chain is essential for many circular business operators, and the financial sector can be helpful here. By explicitly including non-financial values in loan application procedures, the banks could perhaps give priority to circular business models.
Consumer behaviour is ultimately the decisive factor. Particularly when it comes to reuse, longer use and lower consumption, consumers will have to change their current behaviour. So far, no way has been found as to how to achieve this. Despite the success of platform sites like Marktplaats, Snappcar, Peerby and Airbnb, the purchase of new and environmentally damaging products and services has not been systematically reduced. So

far, consumers use the money they save on certain products mainly to purchase new products and services. This does not ultimately lead to a circular economy.

Clearly, there is a huge role for the government in all this. And not only the Dutch government, since an approach at European or preferably global level would be far more effective. But we will limit ourselves to the Dutch government: the point is to give the right incentives for both businesses and consumers. This could be through taxation of environmentally damaging activities, and in any case not subsidising polluting energy sources. Reducing taxation of labour, especially at the lower end, would help repair activities and other kinds of services in a circular economy. Business models should ultimately be profitable without subsidies. Finally, regulation needs to be adjusted to circular business models. This will frequently require a change to existing regulation.

But if there is one country that should be able to embrace the circular economy, it is the Netherlands. We have the geographical position, we are already efficient in production and we also have a level of prosperity that means that more efficient use of materials is perhaps more important than more product consumption. And we have already been moving towards a circular economy for more than 20 years. Let us accelerate this movement.

Footnotes

[1] http://www.footprintnetwork.org/en/index.php/GFN/page/footprint_basics_overview/

[2] The ecological footprint (also known as the global footprint, or 'the footprint' for short) for a particular year is a figure that shows the quantity of biologically productive land and water area a country uses in that year to maintain its level of consumption and process the waste it produces. It is a hypothetical figure, measured in global hectares. http://www.footprintnetwork.org/en/index.php/GFN/page/trends/netherlands/

[3] Classification inspired by Ellen MacArthur Foundation and Accenture (2014).

[4] Cradle-to-cradle can be seen as the first principle of the circular economy (Braungart and McDonough, 2002). The central principle of the cradle-to-cradle philosophy is that all materials used after their life in one product can be usefully applied in another product. The first difference with conventional reuse is that there is no loss of quality, and no residual products that still have to be got rid of. The saying 'waste equals food' refers to this circuit.

[5] To simplify our analysis, we have left international trade, the government and the financial sector out of consideration. While all three play a crucial role in the operation of the economy and also in the transition to a more circular economy, this is not relevant to the central thrust of the analysis at this stage. In the various scenarios, we consider the role of the government and the financial sector.

[6] For a more detailed description, see Stegeman, 2014.

[7]The carbon footprint measures the greenhouse gas emissions of carbon dioxide, methane and nitrogen oxides resulting from consumption in the Netherlands.

[8] The biodiversity footprint shows the loss of global biodiversity resulting from consumption in the Netherlands (including the imports needed for this).

[9] EMF (2012, 2015) and EU (2014) for Europe; TNO (2013) for the Netherlands; Wijkman and Skaberg (2015) for Sweden, WRAP (2015) for the UK.

[10] Repair services are classified as economic growth.

[11]As shown in figure 13, the Netherlands produces the most added value with respect to inputs.

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