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Zero-waste energy-efficient agricultural communities in the GR- Republic of North Macedonia cross-border area - ZEFFIROS

DELIVERABLE 4.1

Public campaign on bio-waste management and the circular economy

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1. Definition of a circular economy

A circular economy is an economic system of closed loops in which raw materials, components and products lose their value as little as possible, renewable energy sources are used and thiknking over new systems' design or systems' redesign/re-definition is at the core.

More than 100 different definitions of circular economy are used in scientific literature and professional journals. The plurality of definitions in use comes as result of the fact that the concept is applied by a diverse group of researchers and professionals (Kirchherr, Reike & Hekkert 2017). A philosopher of science for example, emphasizes a different aspect of the concept than a financial analyst. The diversity of definitions also makes it difficult to render circularity measurable.

Definitions often focus on the use of raw materials or on system change. Definitions that focus on resource use often follow the 3-R approach:

- Reduce (minimum use of raw materials)
- Reuse (maximum reuse of products and components)
- Recycle (high quality reuse of raw materials)

Mobility can serve as a good example. Sharing cars, from entities that would offer such a service to the public, mean that fewer people have to buy their own cars. This reduces the use of raw materials (reduce). If the engine of a car is damaged, it can be repaired or the chassis and interior of the car can be used to make or refurbish another car (reuse). When these parts can no longer be reused, the metal, textile and plastic of the parts can be melted down so that a new car can be made by them (recycling).

1.1. The three elements of a system change

According to (Korhonen, Nuur, Feldmann & Birkie, 2018), definitions that focus on system change often emphasize three elements:

- Closed cycles
- Renewable energy
- Systems thinking (re-definition)

Some researchers argue that social inclusiveness is also a necessary part of the circular economy (Korhonen, Honkasalo and Seppälä, 2018).

Closed Cycles

In a circular economy, material cycles are closed following the example of an ecosystem. There is no such thing as waste, because every residual stream can be used to make a new product. Toxic substances are eliminated and residual flows are separated into a biological and a technical cycle. Producers take back their products after use and repair them for a new useful life. In this system, it is therefore not only important that materials are recycled properly, but also that products, components and raw materials remain of high quality in these cycles.

Renewable Energy

Just like raw materials and products, energy also lasts as long as possible in a circular economy. The circular economic system is fed by renewable energy sources. Because it is not possible to recycle energy, there no reference is made of “energy cycles”, but, instead of “cascade type energy flows”. An example of this is the co-production of heat and power.

Systems thinking (re-definition)

The circular economy does not only require closed material cycles and renewable energy, but also systems thinking. Every actor in the economy (company, person, organism) is connected to other actors. Together, this forms a network in which the actions of one player influence other players. To take this into account, the short and long term consequences must be taken into account in choices, as well as the impact of the entire value chain.

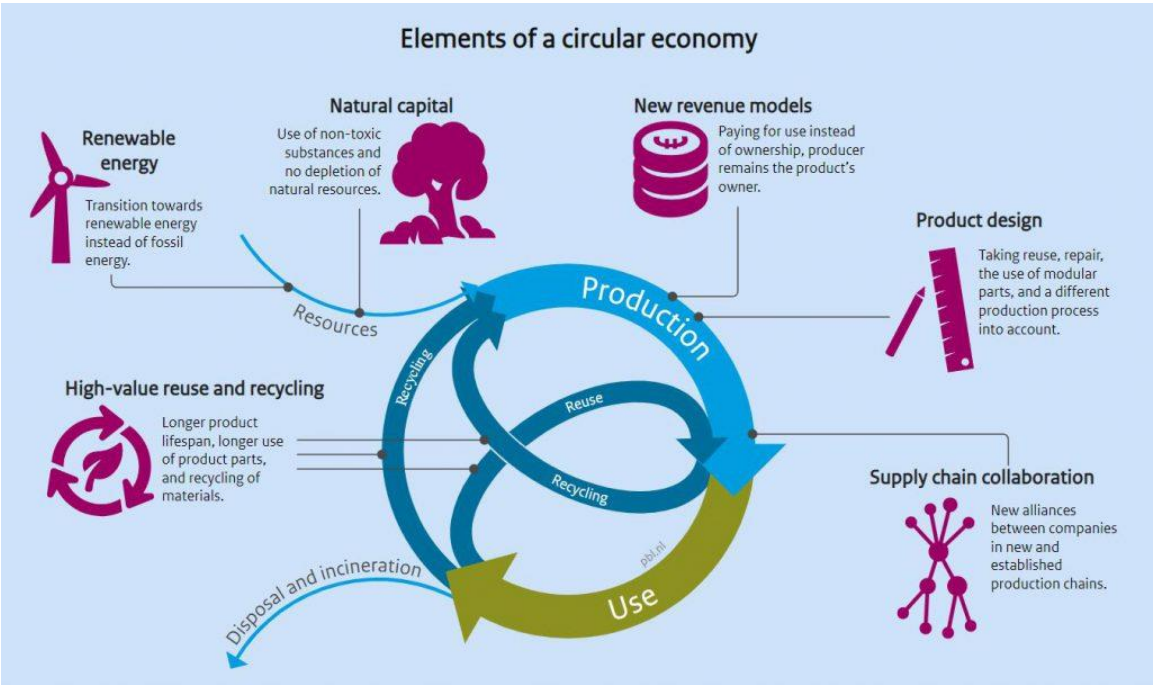

Figure 1. Basic elements of circular economy and their involvement and cross-relations

2. Differences between linear and circular economies

A circular economy is fundamentally different from a linear economy. To put it simply, in a linear economy we mine raw materials that we process into a product that is thrown away after use. In a circular economy, we close the cycles of all these raw materials. Closing these cycles requires much more than just recycling. It changes the way in which value is created and preserved, how production is made more sustainable and which business models are used.

2.1. Value preservation instead of new raw materials

The circular system and the linear system differ from each other in the way in which value is created or maintained. A linear economy traditionally follows the "take-make-dispose" step-by-step plan. This means that raw materials are collected, then transformed into products that are used until they are finally discarded as waste. Value is created in this economic system by producing and selling as many products as possible.

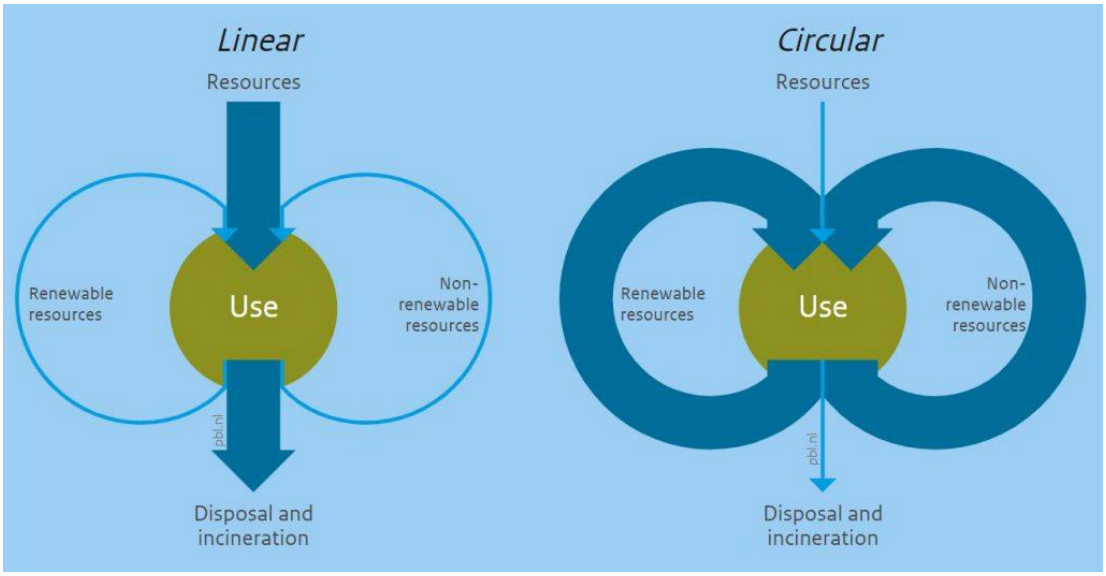

Figure 2. Large Vs small reuse of raw materials between circular and linear economies

It is once again emphasized that a circular economy follows the 3R approach: reduce, reuse and recycle. Resource use is minimized (reduce). Reuse of products and parts is maximized (reuse). And last but not least, raw materials are reused (recycled) to a high standard. This is achieved when we share goods with more people. A mostly representative and successful example of achieving value preservation in the place of consumption of existing or new raw materials is the case where a physical product can be converted into a service, just like "Spotify" sells listening licences instead of physical CDs. In this system, value is created by focusing on value preservation.

2.2. Transition from eco-efficiency to eco-effectiveness

The perspective on sustainability is different in a circular economy than in a linear economy. When working on sustainability within a linear economy, the focus is on eco-efficiency. This is to minimise the ecological impact for the same output. This will extend the period in which the system becomes overloaded (Di Maio, Rem, Baldï, and Polder, 2017). Within a circular economy, sustainability is sought in increasing the eco-effectiveness of the system. This means that not only the ecological impact is minimized, but that the ecological, economic and social impact is even positive, especially in the long-term (Kjaer, Pigosso et al. 2019).

This difference can be illustrated with the production of beef. Raising cows for beef results in emissions of methane gas, a strong greenhouse gas. In a linear economy, the production of beef is made more sustainable by changing the way cows are fed, so that they emit less methane gas for the same amount of meat. This makes production more eco-efficient. In a circular economy, production is made more sustainable by not making beef from cows, but by imitating it as a meat substitute. For the beef substitute, plants are then grown that contribute to biodiversity, employment and landscape management. In this way, the ecological, economic and social impact of the same production of 'beef' is increased.

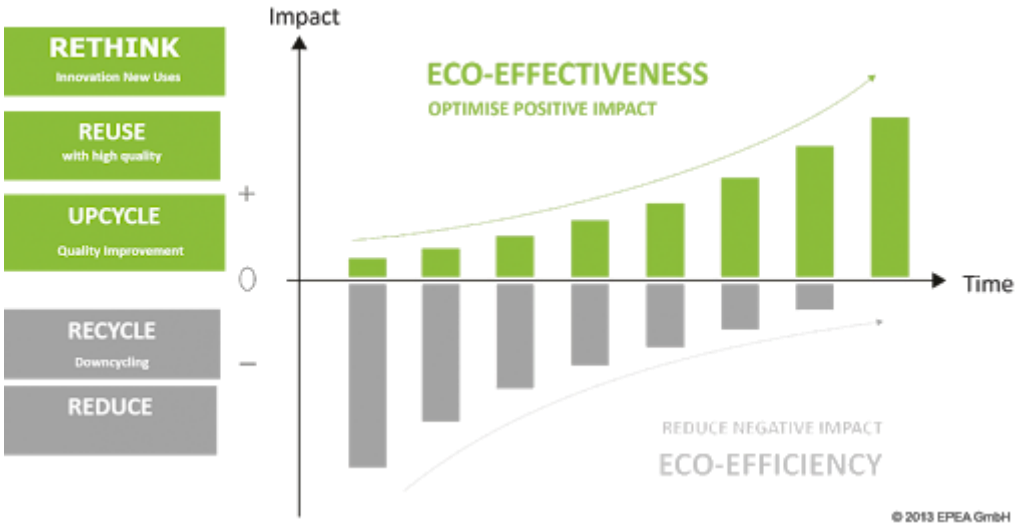

Figure 3. The difference between eco-effectiveness and eco-efficiency (EPEA GmbH, 2013)

In order to achieve eco-effectiveness, residual flows must be reused for a function that is the same (functional recycling) or even higher (upcycling) than the original function of the material. As a result, the value is fully retained or even increased. For example: concrete is ground into granules that are used to produce the same or a stronger wall again. This is different in a linear economy. An eco-efficient system typically works on downcycling: a (part of a) product is reused for a low-grade application that reduces the value of the material and makes it difficult to reuse the material flow again. For example: concrete residues are processed in asphalt in the road surface.

2.3. On business models

A linear model deals with raw materials in an inefficient way, because the emphasis is not on their conservation. In a circular economy, this is the focus. This means that various, newly established, business models are applied in a circular economy, giving emphasis on services rather than products. An example of a model that facilitates the transition to the circular economy is a product-service combination (Product-As-A-Service System), which is seen as a model to integrate products and services (Michelini, Moraes & Cunha et al., 2017). A widespread example of a product-service combination is a recently established Xerox printer system, in which companies receive a printer free of charge and pay per copy. This system fits well within the circular economy, because as a manufacturer, Xerox has an interest in ensuring that the printer will last a long time, by being able to repair and update it. In the linear sales system, the manufacturer often benefits if the product breaks down quickly so that it can then sell a new product.

2.4. Linear Vs Circular - Outline

Table 1. Recap of differentiation spots between Linear and Circular economies

	Linear	Circular
Step plan	Take-make-dispose	Reduce-reuse-recycle
Focus	Eco-efficiency	Eco-effectivity
System boundaries	Short-term from purchase to sales	Long-term, multiple life cycles
Reuse	Down-cycling	Upcycling, cascading and high grade recycling

3. Materials' flow in a circular economy

In a circular economy, materials circulate (flow) in two separate cycles: the bio-cycle and the techno-cycle. The distinction between these cycles helps to understand how materials can be used in a long-lasting and high quality way. A general rule of thumb is that the less process steps a material has to go through for reuse, the higher the quality of the material it can contain.

3.1. Technical and organic materials

Organic materials follow a different reuse process than technical materials. Technical materials are also called synthetic materials. Because of this difference in the reuse process, it is important that

after use, organic and technical materials can be properly separated from each other after use (see Fig. 4).

Technical materials such as fossil fuels, plastics and metals have limited availability and cannot easily be recreated. In the techno-cycle it is important that stocks of such finite materials are properly managed. In a circular economy, these materials are only used instead of being consumed. After use, materials are recovered from residual flows at their original value.

Organic materials such as wood, food and water can be incorporated into the ecosystem and re-generated through biological processes. In the bio-cycle it is important to let the ecosystem do its work as well as possible. Consumption may take place during this cycle (fertilization, food, water) as long as the streams are not contaminated with toxic substances and ecosystems are not overloaded. Renewable organic raw materials can then be regenerated.

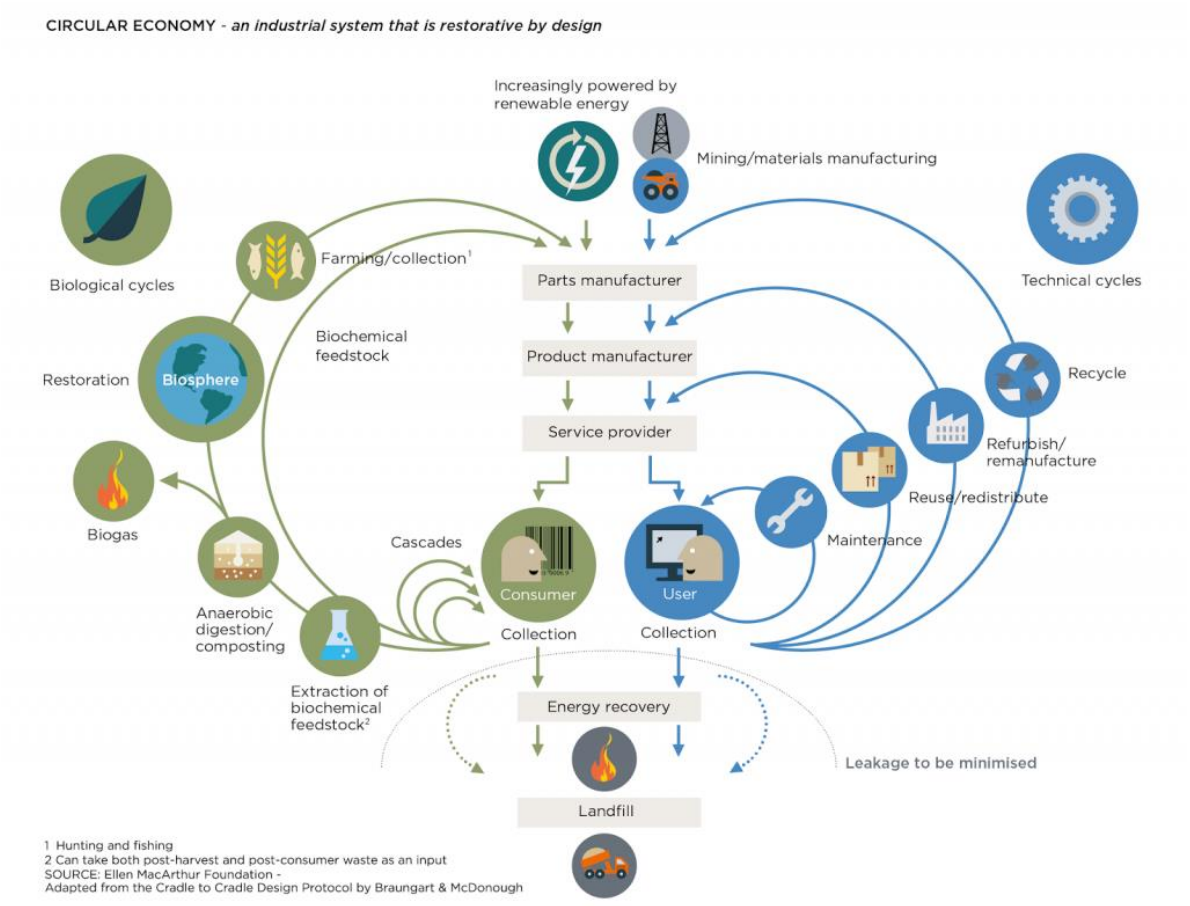

Figure 4. Techno and bio cycles as a 'butterfly diagram' (EMAF, 2015a)

3.2. Reuse in the techno-cycle

Within the techno-cycle there are different levels of reuse (see the right side of Fig. 4). The rule of thumb is that the smallest or inner circle is preferable to larger cycles, because these require less

processing, labour, energy and new material to be of original value again (Ellen MacArthur Foundation, 2015a).

The different reuses within the techno-cycle are:

- Maintanance (& repair): Repair and maintenance during use to extend the lifespan.
- Reuse/redistribution: Direct re-use by re-marketing a product.
- Refurbish/Remanufacture: The thorough refurbishment and repair of a product by the manufacturer.
- Recycle: Retrieving parts or materials from the product for reuse.

3.3. Cascading in the bio-cycle

Within the bio-cycle, reuse takes place in cascades. Cascading means 'using (part of) a product for another application'. When a product is no longer able to perform its initial function, it is passed on for reuse. During cascading, the quality of the material is reduced and energy is consumed (Ellen Macarthur Foundation, 2013a).

Cascading differs from ordinary re-use and recycling in that it changes function and the extent to which the product is processed. A cotton T-shirt can serve as an example. When reused, a worn T-shirt is sold in a second-hand shop. When recycled, the T-shirt is shredded into cotton fibres, which are then spun into new yarn. Cascading is the use of old T-shirts as cushion filling.

3.4. Ensuring long-term cycles

For both the bio-cycle and the techno-cycle, the lifespan of a product must be made as long as possible. The lifespan of products can be extended by:

- Ensuring that a product is used longer, thereby 'slowing down' the process, for example by focusing on emotional attachment to a product, lasting fulfilment of a need and adaptability of the product, so that it can keep up with the times.
- To ensure that multiple consecutive cycles of direct reuse are followed, by facilitating the interchangeability of products and by properly maintaining products so that they can be used for a long time without repair (Ellen MacArthur Foundation, 2015a).

3.5. The importance of pure material flows

For both the bio-cycle and the techno-cycle, residual flows that are not contaminated with other materials are the easiest to collect and re-use. By ensuring that materials are easily separated from

each other after use and that residual flows are collected in such a way that they are not contaminated with toxic substances, residual flows are the most useful in a circular economy (Ellen MacArthur Foundation, 2015a).

Within the bio-cycle, orange peels can serve as a good example. The dutch company 'PeelPioneers' collects orange peels from catering establishments and extracts essential oils from them. If there is food residue in the peelings, the essential oils are polluted and cannot be used for cosmetics production, so the value decreases. Within the techno-cycle, plastic toys can serve as a good example. If the toy is completely made of polyethylene, it can be completely melted down and reused. If the toy also has polyester components, these must first be separated before the toy can be recycled at high quality (Peelpioneers, 2019).

4. Circularity and sustainability

Circularity contributes to a more sustainable world, but not all sustainability initiatives contribute to circularity. Circularity focuses on resource cycles, while sustainability is more broadly related to people, the planet and the economy. Circularity and sustainability stand in a long tradition of related visions, models and theories. Together with referencing some examples, the fit of circularity with the Sustainable Development Goals (SDGs) of the United Nations is briefly presented.

4.1. Performance Economy

Walter Stahel developed the vision of a closed-circle economy, including the principles of life extension, product repair and waste prevention. Selling services instead of products is an important part of his thinking: everyone pays for the performance of a product. This leads to the concept of the performance economy (Stahel, 2010).

4.2. Cradle-to-cradle

In the cradle-to-cradle model, developed by Michael Braungart, materials in industrial and commercial processes are considered as raw materials for technological and biological reuse. Design is literally from cradle to cradle – in the design process the entire life cycle of the product and the raw materials used are considered. Technical raw materials do not contain any components that are harmful to the environment; biological raw materials are completely biodegradable (Cradle-to-Cradle).

4.3. Industrial Ecology

Industrial ecology is the science of material and energy flows, where waste within industrial cycles serves as a raw material for a subsequent process. Production processes are designed in such a way that they resemble ecological processes (Journal of Industrial Ecology).

4.4. Biomimicry

Biomimicry is an approach, developed by Janine Benyus, in which inspiration comes from nature. Biomimicry imitates designs from nature and applies these to solutions in human society (Biomimicry).

4.5. Green Economy

The Green Economy, defined by the United Nations Environmental Platform (UNEP), is an economy that results in increased well-being and increased social equality, while at the same time greatly reducing environmental risks and ecological scarcity (UNEP Green Economy).

4.6. Bio-based Economy

A bio-based economy is an economy that does not run on fossil fuels, but an economy that runs on biomass as a raw material. Biobased economy is about the use of biomass for non-food applications (Biobased Economy).

4.7. The circular economy and Sustainable Development Goals

Circular economics is also a way of implementing the Sustainable Development Goals (SDGs). In particular, there is a strong relationship with SDG 6 (clean water), SDG 7 (affordable and clean energy), SDG 8 (work and economic growth), SDG 12 (responsible consumption and production) and SDG 15 (life on land). Aspects of the circular economy, such as recycling of household waste, e-waste and waste water, provide a 'toolbox' to comply with the SDGs (Schroeder, Anggraeni, and Weber, 2018).

5. Disadvantages of the current linear economy

The linear economy results from business practices that assume a constant supply of natural resources. This has resulted in the take-make-dispose mentality. This mentality is based on the extraction of resources, the production of goods and services and the disposal of post-consumer waste. However, this approach is coming under increasing pressure because of its environmental and economic disadvantages.

5.1. Ecological disadvantages

The ecological disadvantage of the linear economy is that the production of goods is at the expense of the productivity of our ecosystems. Excessive pressure on these ecosystems jeopardises the provision of essential ecosystem services, such as water, air and soil cleaning (Michelini, Moraes et al., 2017).

All three steps of the "take-make-dispose" mentality affect ecosystem services in different ways. The collection of raw materials leads to high energy and water consumption, emissions of toxic substances and disruption of natural capital such as forests and lakes. Product formation is also often accompanied by high energy and water consumption and toxic emissions. Eventually, when these products are discarded, space is taken up from natural areas and toxic substances are often also emitted.

5.1.1. The plastic soup example

A lot of plastic is only used for a short period of time, so you can quickly go through the take-make-dispose step-by-step plan. As a result, more than 300 million tonnes of new plastic are produced worldwide each year. Of this, 5 million tonnes ends up in the oceans. This consists of plastic waste that is dumped on land, in the sea or in the sewer system.

Most of this plastic is originally dumped on land, but washes to the sea via rivers and canals. Another category is microbeads. These are tiny granules of plastic that are used in care products, such as shampoos and scrubs. Eventually, the plastic is divided into smaller particles by degradation and fragmentation. Toxic substances may be released during this process. In addition, all kinds of animals see the plastic waste and the microbeads for food. In this way, the plastic disturbs the food chain of fish, which can also damage our own health. In this way, the production of plastic in the "take-make-dispose" step-by-step plan harms the supply of fish as an ecosystem service for the oceans and seas (Plastic Soup Foundation, 2019).

5.2. Economic disadvantages

In addition to the damage caused by the linear economy to the provision of ecosystem services, this economic model also jeopardises the supply of materials. This uncertainty is caused by fluctuating raw material prices, scarce materials, geopolitical dependence on different materials and increasing demand. These problems are solved in a circular economy. A quick reference to the risks is made below.

5.2.1. Fluctuating raw material prices

Since 2006, the level and fluctuation of raw material prices have signficantly increased. This not only creates problems for diggers and buyers of raw materials, it also creates greater risks in the market.

This, in turn, discourages investments in the extraction and processing of materials, which can ensure that raw material prices continue to rise over time. In addition, these price fluctuations prevent companies from making price forecasts, which gives them a weaker competitive position than companies that are less material-dependent (Circle Economy, 2018a).

5.2.2. Critical materials

Another disadvantage of the current linear economic system is that much is produced with scarce materials. A number of industries make intensive use of critical materials for their production processes, such as indium and chromium. These materials are only available to a very limited extent. In particular, the metal industry, the computer and electronics industry, the electrical equipment industry, and the automotive and vehicle industries make use of these raw materials.

5.2.3. Interdependence

As a result of the increase in trade, the geopolitical interconnectedness of products has become increasingly strong. For example: countries with water scarcity but a surplus of oil trade oil to buy grain. As a result, these raw materials are, as it were, linked to each other. In addition, the production process of many goods depends on water and fuels. As a result of this interdependence, the scarcity of one raw material will have a widespread effect on the prices and availability of many more goods (European Commission, 2018a).

5.2.4. Increase in material demand

In addition to the limited supply of raw materials available anyway, a significant increase in demand for materials is also predicted. As a result of population and welfare growth, the number of middle class consumers (with a higher demand for material consumption) will increase by three billion by 2030. In addition, the lifespan of products has decreased dramatically in recent years. This is one of the driving forces behind the increasing consumption of materials in the Western world. Product lifespan is still decreasing, because there is a process of positive feedback: consumers want new products faster and therefore use their “old” products shorter. This in turn means that less quality is needed in a product’s lifecycle, which in turn leads to consumers wanting new products even faster (Circle Economy, 2018 , Linear risk report).

6. Economic benefits of the circular economy

Circularity has several advantages for the economy. Globally, the economy would benefit $2 trillion a year from more effective resource management. This is because the cost of raw materials will decrease substantially, while promoting employment and innovation.

6.1. Substantial resource savings

While the attention for the circular economy is increasing, the extraction and prices of primary raw materials are still increasing (see Fig. 5). According to Circle Economy calculations, 9% of all raw materials were fully recycled by 2019. In 2018, this percentage was slightly higher at 9.1% (Circle Economy, 2019). In theory, in the circular economy, 100% of all raw materials are fully recycled, and no new virgin raw materials are needed. It will take a very long time for this scenario to be achieved, because methods will have to be found to fully recycle materials that are currently used in products (Fellner, Lederer, Scharff, and Laner, 2017).

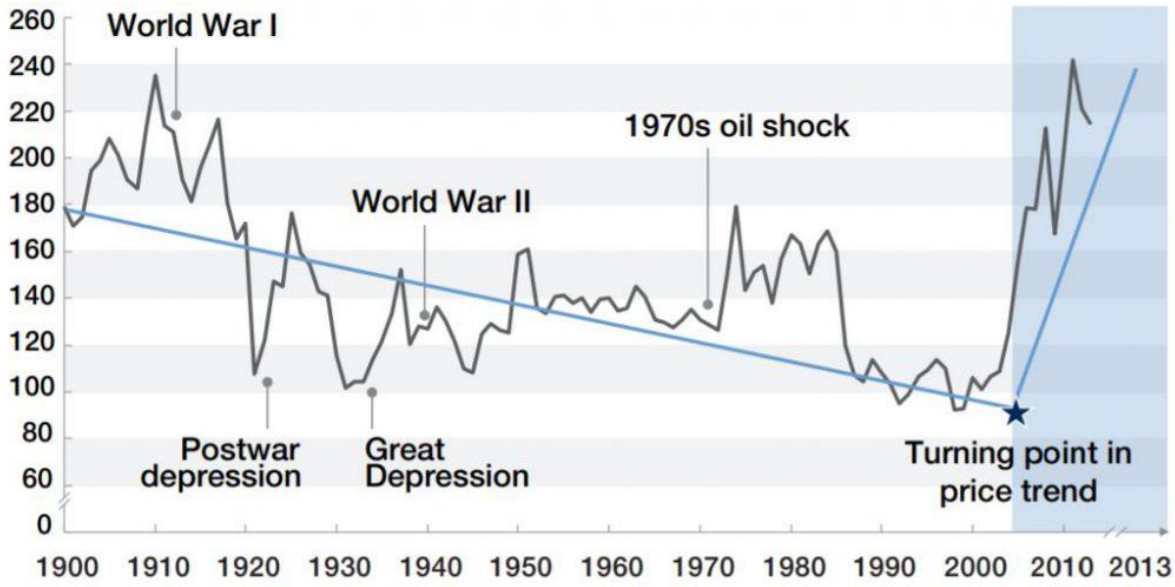

Figure 5. Sharp increases in commodity prices since 2000 have erased all 20th century price declines, following the McKinsey Commodity Price Index (WE Forum, 2017).

6.2. Economic growth

An important principle of circular economy is to decouple economic growth from the consumption of raw materials. As a result, the economy is not hampered by the shortage of raw materials to grow. It is assumed that a move towards the circular economy will promote economic growth. The United Nations Environmental Plan (UNEP) calculated that in 2050 the global economy would benefit from more effective resource use by $2 trillion a year (UNEP, 2017). In a circular economy, this gain would certainly be achieved. On the one hand through increased turnover from new circular activities and on the other hand through the creation of more functionality from the same number of materials and means of production. The development, production and maintenance of these circular products requires a specialised workforce, which will increase these jobs. On the other hand, there will be less demand for the extraction and processing of raw materials, which will reduce

the number of less specialised jobs. This will increase the value of labour, which is good for employment and GNP (WE Forum, 2017).

6.3. Growth of employment

In a circular economy, labour is valued more than raw materials. As a result, employment is growing. These jobs will expand for labour-intensive recycling and high-quality repairs; jobs in the logistics sector through local product take-back; new enterprises through innovation, service economy and new business models (WE Forum, 2017).

6.4. Innovation stimulus

Circular economics challenges innovative solutions based on a new way of thinking. That means thinking about circular rather than linear value chains and striving for optimizations for the entire system. This results in new insights, interdisciplinary cooperation between designers, producers and recyclers and therefore also in sustainable innovations (Kraaijenhagen, Van Oppen & Bocken, 2016).

6.5. Changing demand

A very important factor in the economic benefits of circular economy is the change in and better understanding of the demand side. How companies deal with their customers and the role they play throughout their lives ultimately leads to less use of raw materials, less waste generation and changing production (WE Forum, 2017).

7. Environmental benefits of the circular economy

The initial goal of the circular economy is to have a positive impact on the ecological systems, which will not deplete or overload them. This is reflected in the ecological benefits of the circular economy. For example, a circular economy emits less greenhouse gases, the soil, air and water remain vital and nature reserves are preserved.

7.1. Less greenhouse gases

By following the principles of the circular economy, greenhouse gas emissions are automatically reduced on a global scale. Climate change and the use of materials are closely linked. According to Circle Economy calculations, 62% of global greenhouse gas emissions (excluding those from land use and forestry) come from the extraction, processing and production of goods to meet society's needs; only 38% are emitted in the supply and use of products and services (Circle Economy, 2019). For example, emissions from industry in the European Union would fall by 56% in 2050 if the circular

economy were to become a reality (SITRA, 2018). The reduction in emissions measured on a global scale will be even greater, because the European Union will no longer import primary raw materials from countries outside the Union, which will also reduce greenhouse gas emissions in those countries.

7.2. Vital soil, air and water bodies

The application of circularity in the economy creates vital ecosystems such as soil, air and water bodies. These ecosystems provide services such as cleaning, products such as fertile farmland, pollination and clean drinking water. In a linear economy, these services are ultimately depleted by constant withdrawal of products or overburdened by the dumping of toxins. If these products are used in a cycle and the services are not burdened by toxic substances, the soil, air and water bodies remain resilient and productive (SYKE, 2018).

A good illustration of this is the agricultural system, which is highly dependent on ecosystem services such as water cleaning, nutrient recycling and pollination. In Europe, for example, a circular approach to European food systems can lead to an 80% reduction in the use of artificial fertilisers. This restores the natural balance in the soil (Ellen MacArthur Foundation, 2016). Adopting this outcome, the Dutch Ministry of Agriculture, Nature and Food Quality was among the first to present a vision on Agriculture, Nature and Food under the name: 'Valuable and Connected' in 2018. The vision states that the future of the food supply can only be secured if we switch to recycled agriculture.

7.3. Conservation of nature reserves

The extraction of raw materials and the dumping of waste have a negative impact on nature reserves. These nature areas are important for the preservation of ecosystem services, natural and cultural heritage. At the moment, many governments and organisations are mainly involved in protecting nature from extraction and the dumping of raw materials and waste. In order to systematically preserve nature, this extraction and dumping must stop in general. This is achieved within the circular economy (SYKE, 2018).

8. Benefits for businesses

The benefits of the circular economy translate into opportunities for entrepreneurs. This creates new profit opportunities, a more stable supply of materials, a growing demand for certain services, and strengthened customer relationships.

8.1. New profit

As a result of the transition to the circular economy, companies are reducing material costs and developing completely new markets where profits can be generated. In many sectors, raw materials are a high cost item. The extraction of new raw materials and the uncertainty about their supply in a linear economy are driving up the price of these materials. Circularity can therefore offer new profit opportunities through lower costs, increased security of supply of raw materials, tighter chain cooperation and a more robust supply chain. In addition, the organisation's image is strengthened by showing that sustainability is being put into practice (Vermunt et al., 2019).

8.2. Stable material supply

A circular economy ensures that the company uses fewer new raw materials and more recycled raw materials, and that the value of these raw materials is maximised over their entire life cycle. As a result, an entrepreneur will incur relatively lower material costs than labour costs, which means that the costs and availability of materials have less influence on the stability of the business model. With more stability, a company can make more favourable and targeted long-term investments.

8.3. Growing demand for services

Within a circular economy there is a demand for new services, where there are opportunities for employees and entrepreneurs. Such new jobs and services include the followingare according to the (Ellen MacArthur Foundation 2015a):

- Reversed logistics companies that collect, transport, repair and redistribute products after use in order to be reintroduced into the market;
- Marketers and sales platforms that facilitate longer product life and higher utilization rates;
- Experts in remanufacturing and product repair who facilitate reuse and repair

8.4. Optimized customer relations

The circular economy offers new business models and opportunities to retain customers. The transition from product delivery to services, leasing models and rental creates a long-term relationship between customer and supplier, because there is increased contact during the life of the product. When the supplier remains responsible for the delivered product, interim service, maintenance, repair, this robust communication can not only result in customer satisfaction but also in customer loyalty, a fact that ensures that the customer will buy products again after any contract expiration (Kraaijenhagen, Van Oppen & Bocken, 2016).

9. Benefits for the European area

In recent years, the European Commission has tried to promote the transition to a circular economy with the Circular Economy Action Plan. An important reason for this is that the transition could bring the European Union 7% extra economic growth in 2030 and 170,000 new jobs in 2035. In addition, the transition will substantially reduce the ecological footprint. Nevertheless, the European Commission itself states that a lot of policy is still needed to achieve all the benefits of a circular economy.

In 2015, the European Commission approved an action plan to accelerate the transition to a circular economy in Europe. Since then, the Commission has introduced 54 measures to make the life cycle of products circular: from the production and consumption phase to waste management and the market for secondary raw materials. In order to speed up the transition along the entire value chain, five priority sectors have been identified. These are plastics, food waste, essential raw materials, construction and demolition, and biomass and materials of biological origin. The measures emphasise the development of an environment in which investment and innovation can flourish (European Commission, 2019).

9.1. Growing Economy

If the European Union can make the transition to a circular economy, the benefits will be great. From 2030 onwards, €600 billion could be saved annually on primary material costs, €500 billion through lower costs for negative side-effects and €700 billion through other cost savings. These cost savings and new business models will increase gross national product by 11% by 2030 compared to the increase in following current practices (Ellen MacArthur Foundation, 2015b).

9.2. Reduced environmental footprint

In addition to these economic benefits, the European Union also gains a great deal in terms of the environment. Applying the principles of the circular economy to the construction, food and mobility sectors could lead to a 48% reduction in CO_2 emissions by 2030 and as much as 83% by 2050, compared to the CO_2 emissions in those years if the current model is adopted. The application of circularity to the economy also reduces the use of metals and concrete for means of transport and construction, fossil fuels, land, fertilizers, water and pesticides. By optimising the construction, food and mobility sectors, space for infrastructure can be replaced by green areas and housing, thereby increasing the quality of life in cities and improving air quality (Ellen MacArthur Foundation, 2015b).

9.3. The future

The European Commission itself states on the follow-up to the Circular Economy Action Plan that if the European Union wants to maintain its leadership role in the design and production of circular products and services, circularity must become the backbone of the industrial strategy. For example, circularity must be introduced in new areas and sectors, life cycle assessments of products must become the norm and the framework for eco-design must be broadened as much as possible (European Commission, 2019). Eco-design looks at the whole life cycle of a product or process and addresses the highest environmental impacts first.

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