

Theoretical Background of Circular Economy

BOOKLET

by Dr. Csaba Fogarassy

2021

Theoretical Background of Circular Economy



Theoretical Background of Circular Economy

BOOKLET

Additional curriculum for the

TWO DAYS ONLINE TRAINING COURSE PROGRAM

The Theoretical Background of Circular Economy

© 2021 by Csaba Fogarassy & BIOEST Program

All right reserved

Table of content

1. CONCEPT OF THE CIRCULAR ECONOMY 7
1.1. Linear vs. circular economy 8
1.2. Circular economic models and solutions 9
1.3. Basics of circular economy 11
Principle of Inputs 12
Principle of Sustaining Cycles 12
Principle of Outputs 12
1.4. Main branches of circular economy (basic mechanisms) 12
Circular product planning and manufacture 13
Introduction of new, innovative business models 13
Redirecting cycles and cascades 14
Cross-sector cooperation 14
1.5. Priority levels for circular solutions 14
Refuse 17
Reduce 19
Reuse 21
Repair, Refurbish and Remanufacture 22
Refurbishing 23
Remanufacturing 23
Up-cycling 24
Recycling 25
Recovery 26
Linear solutions 27
References 29

1. CONCEPT OF THE CIRCULAR ECONOMY

In recent years, we have seen an increase in economic concepts which defined various concepts for the European Union to quickly leave the economic depression behind itself. Out of these, the bio-economic and low-carbon systems' strategy published in 2012 became a significant milestone. The reason was that these offered well-defined advice for both European scientists and economic actors - most notably from the British expert teams that created the German 'Bio-economy Council', or the framework of the EU's trade system. However, the defined development routes were often interpreted with insufficient economic and social background research, which made them hard to understand. This, in turn, made their effects hard to comprehend too. The first 'era' of bio-economy focused on the economic advantages of bio-technology. After this, due to the suggestion of OECD (Organisation for Economic Co-operation and Development), further topics of interest were added: agriculture, health, and industrial systems were followed by energy production and nanotechnology. By using renewable energy resources, and due to differences in professional opinion and arguments about climate change, the advancement of concepts slowed down significantly.
The drastic material- and energy usage decrease due to the economic depression that began in 2008, and lasted a long while caused the concepts aiding low carbon emission systems to lose their leading role. The EU Emission Trading System, in other words, the key facility of emission trading basically became incapable of operating already.

At the beginning of 2015, the 'circular economy' concept made its debut in European politics with a bang. It suggests creating a holistic system planning approach for the EU developments, which is a new idea for system solutions as of now (EC, 2015). The concept may offer a development route which spans across systems for all sectors, by exchanging the endlessly persecuted linear economic solutions for closed circles, in other words, solutions based on the theoretical basics of self-sufficient (closed material cycle) production structures. The popularity of the circular economy concept, and the belief in its success are unlike any other in the politics of the European Union, which is why there is worth in handling it as a special case.

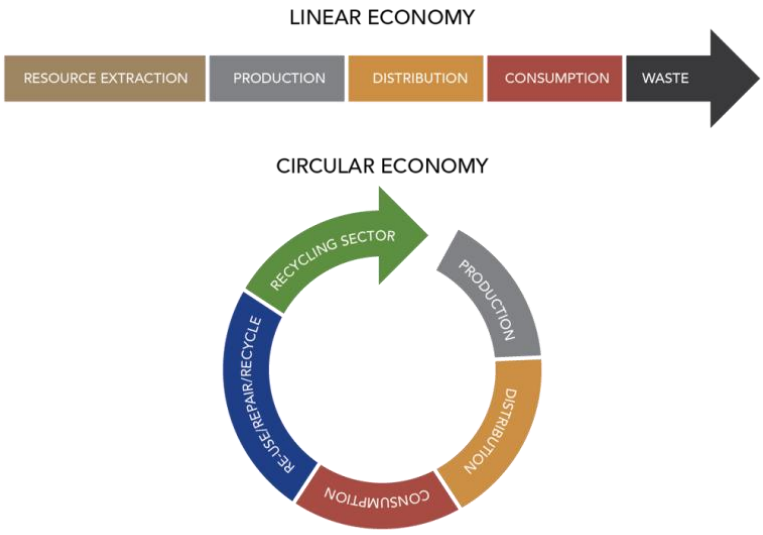
The circular economic model is basically an industrial/service system, which substitutes for the "end-of-life" concept by offering the option of reconstruction, assisting the usage of renewable energy resources, and aims to get rid of waste by the primary planning of materials, products and systems - and most of all, business models (Tukker, 2015). Regarding the description of circular economy system models, an important detail is that it further develops the usable indicators of the two previously introduced solutions - bio-economy and low-carbon economy - for the description of biological and technological cycles. Also, it

stresses the importance of working out scientific basics and connections. Currently, the Ellen MacArthur Foundation Team is the gathering of researchers having the highest amount of publications related to the topic in Europe, but most of the university research groups and scientific research institutions are dealing with some circular-related topic of interest.

1.1. Linear vs. circular economy

The economic structures currently in operation mainly follow the linear approach, which is based on the concept of "extract-produce-consume-discard", shortened to "extract-produce-throw out". This does not support the criteria system of resource management sustainability (Figure 1), or the operations of the material circulation (Ellen MacArthur, 2015). Therefore, linear economy is based on the one-way processes which prefer a high volume of production and low production costs, and is mainly based on the low-cost acquisition of necessary resources (mainly synthetic materials) for a relatively low cost (Webster, 2015).

Figure 1: Basic structure of linear and circular economic structures



Source: Ellen MacArthur Foundation Team, 2014

Circular economy recycles the products at the end of their life cycle, with a minimal to zero waste production and resource usage. The main processes of circular systems are the total decrease of produced waste, their re-usage, recycling, reproduction and repairing (EC, 2015). Another aspect appears in circular systems, gaining a huge advantage - which is prevention. This had its role diminished in western production systems in the latter half of the XX. century, but is on the way to regaining it.

The logic of the new circular approach acknowledges that though circulating waste within the system is indispensable, it only offers a stop-gap solution for the root of the problem. This means none other than basically producing waste. In the latter half of the 1900's, a new branch of the linear economy approach spread - which was the production of shortened

lifecycle goods. This basically meant that they artificially shortened the effective lifetime of goods during the production process (Agrawal et al., 2015). The "planned obsolescence" idea was conceptualised in the beginning of the 1930's. At this time, an American economist suggested its usage, in order to negate the effects of the economic depression. Though it was not widespread at the time, it was a routine part of production 20 years later (Bulow, 1986). This perspective still helps in sustaining the consumer economy based on over-production.

However, even decision makers managed to understand how the management of waste resulting from these processes cause an increased deadweight, which is more than their gains extracted from the economic growth, which happens due to said processes (Fogarassy et al, 2016). Therefore, the circular economy tries not only spreading the approach of reusing waste as a new form of capital, but also takes measures to lengthen the life cycle at the beginning of the process (Kraaijenhagen et al., 2016). This may be solved by modifying the warranty systems in a way that is applicable to a thought process tailored for long life cycle products. It further promotes designing business models (*sharing economy, refurbishing, re-manufacturing, upcycling, reverse logistics, etc.*) which push actors taking part in manufacturing or distribution to make and promote products with as long lifespan as possible. Circular economic models, unlike linear ones, can handle environmental, economic and social externalities, regardless of them being positive or negative.

1.2. Circular economic models and solutions

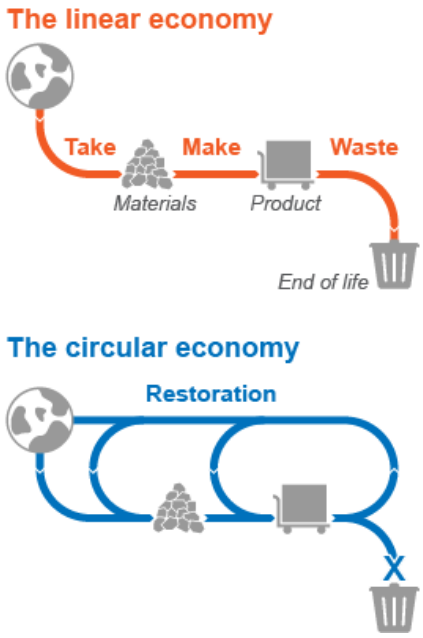
Circular economy describes an economic model, which separates growth and development from each other as the so-called global model, while also taking the finite resources of consumption systems into consideration. By using a refurbishing planning process, it keeps the product and its elements on the highest possible usage level and value. It offers not only an exceptional opportunity for introducing new products and services for enterprises, but also decreases the risks of procurement and cost fluctuations related to resources (Webster, 2015).

Linear economic models help fight against the need for economic growth resulting from the lack of valuables and foodstuffs, as it quickly produces a high amount of wares (f. e. the world economy was in such a state after the war). However, linear economic solutions cause an even greater instability on saturated markets, which cannot assure that resources will be preserved in a local state, and will be sustained. Reaching resources safely has become a fundamental topic to argue about at political debates and separate trade deals. These situations require us to define circular (closed material cycle) economic models (Figure 2).

The circular economic solutions have the specific attribute of being able to create a synergy between economic goal systems even if there are differences in level of development between them. This may become a very important policy for the development of the

European Union's member states, as the economic policy developments of recent years clearly showed how f. e. in the case of the ex-socialist countries, sufficiently applying the indicators developed for the EU's climate goals, or economic regulation tools is basically impossible. The usage of the circular economic models, and the characteristics of the various element blocks will be different for the well-developed countries and the countries currently in development. A very simple example is the base element of circular economic systems, 'Refuse', when consumers refuse to purchase (Dustin et al., 2016).

Figure 2: Open and closed material cycle systems



Source: Lisa Vanlint, 2017

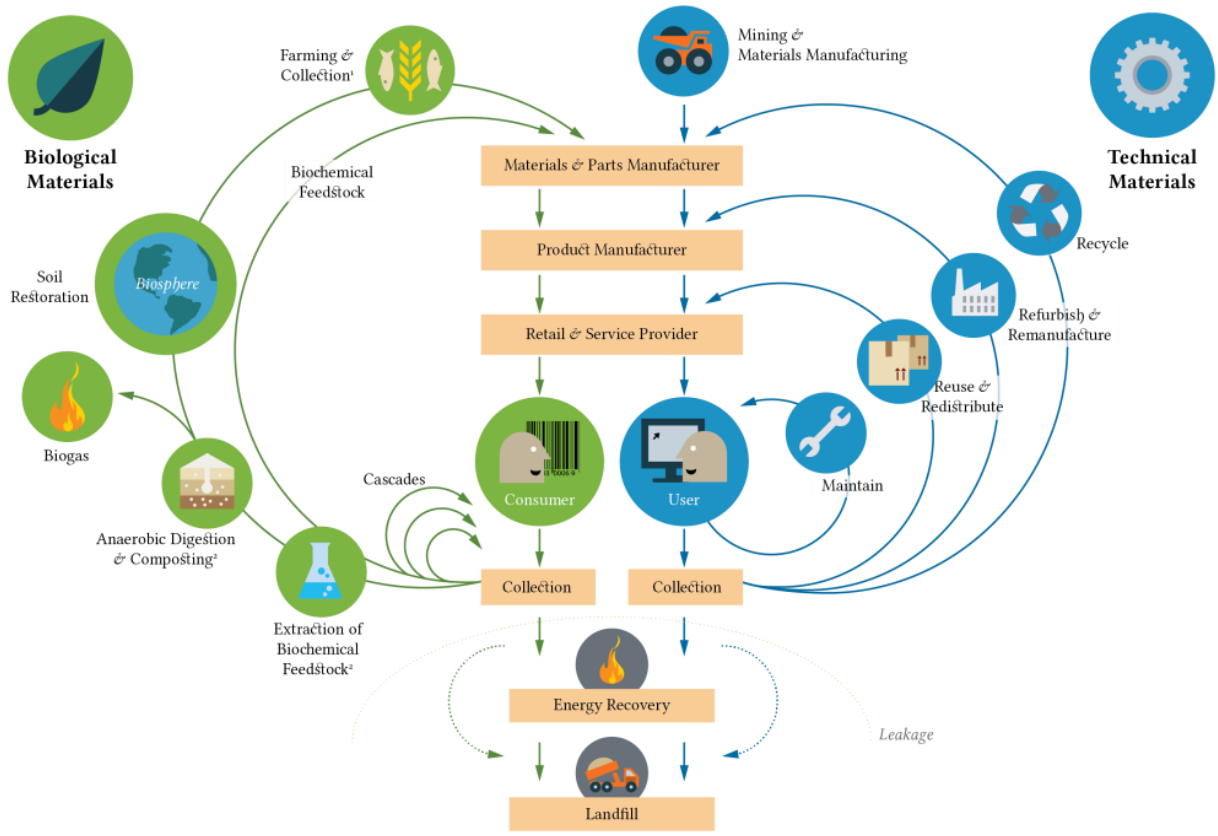
One of the most important policies of circular economy can immediately be caught red-handed in this case, as exchanging 'consumer' for 'user' is a fundamental requirement. In the case of the ex-socialist countries - most notably due to the difference in development levels - this is currently impossible. We can see multiple examples in the economic approach based on services which spread in recent years ('sharing economy' / shared usage of flats or cars), which offers services in the most developed member states in the European Union, whereas in others (e. g. UBER in Hungary), they cause economic and political conflicts en masse. The other representative model of circular economy is the 'Repair, Refurbish, Remanufacture' approach, which is completely in opposition to one of the most notable mottos of the XXI. century's consumer society: "I recommend to buy new, it is cheaper than the repair costs". This perspective was, in the beginning, used for the technological products which appeared with the digital age. This was when society began to realise the intent behind the phenomenon, as the motto was implemented even for wares which were easy to repair before (Szaky, 2014). This can be said to be the extension mechanism of planned obsolescence, where not only the actual lifetime of the product becomes shortened during production, but we even

prevent the consumer from lengthening it. To combat this, circular economy created the definition of 'circular design'. Its essence is for manufacturers to not only make sure of the long lifetime introduced before, but also to aid consumers to assure it as well.

1.3. Basics of circular economy

The main advantage of circular economic models is that they prefer a holistic approach to development branches, where the cooperation between market actors, the stable and long-term operation of local systems and markets based on local resources, and the innovative mobilisation of the labour market are the primary points. When designing models, scientific adequacy, and interdisciplinary approach are necessary. The bio-economy and low-carbon economy mentioned in the introduction are partially joined as one for circular economic systems, via the indicator systems. Circular economic systems close material flows in two great cycles - one is determined by the cycle processes of biological cycles, whereas in the other, the closed systems of technological cycle processes are the sustainable system solutions (Figure 3).

Figure 3: Biological and technological cycles of circular economy



Source: Ellen MacArthur Foundation, 2014

Based on the professional base theses created by the Ellen MacArthur Foundation in 2012, we should define three important basic policies for the optimal design of circular economic systems:

Principle of Inputs

In the first step, the circular economy concept preserves and increases the natural resource systems by continuously keeping resource reserves under control, and balancing the material flows of renewable energy resources. In the case of inputs, the system is basically predestined for sustaining the flow of renewable energy resources, named 'flow management', and during servicing technological processes, it aims to perpetually circulate reserves instead of hoarding them, named 'stock management'. Therefore, management processes concentrate on always making sure renewable materials and non-renewable stock are always at hand, all done on the input side of the circular system perspective (examples are the regeneration of soil, or securing secondary base materials). They mainly achieve this by sustaining the material flow, most notably via increasing the share of services.

Principle of Sustaining Cycles

The previously mentioned biological and technological cycles or cycle processes close system processes via the different-length loops. As the operations of the economy, but most notably its growth is dependent on the quantity of resources at hand, these cycle processes are able to assure that the operations of the production systems are sustained properly. In the linear systems, if the resources (base materials) indispensable for production cannot be procured, the economy will be incapable of either growth or development. Circular economic solutions offer development branches in a way that they assure these resources are always at hand through the material cycles (biological base materials and raw materials), on the highest possible level (Ellen MacArthur Foundation, 2012). It aims to return the base materials of biological cycle processes into the environment (f. e. the circulation of soil nutrients, water circulation) via the shortest possible cycles, so-called cascades. The new product cycles of circular economic models are mainly generated within the technological cycles, by reacquisition of resources, or modernisation, repair of technological systems.

Principle of Outputs

Increasing the efficiency of the system must be done by identifying and planning the processes, by which we avoid the negative and positive externalities. This includes planned soil usage, avoiding water- and noise pollution, preserving good health, avoiding the usage and generation of toxic materials, avoiding incorrect business solutions, and completing all the procedures listed by using the systems of local resource usage.

1.4. Main branches of circular economy (basic mechanisms)

The circular economy concept is highly popular for government strategies and entrepreneurships as well, since it tries to exchange the traditional linear economic thought process with an alternative, logical economic perspective which turns towards the future. The

most enticing side of the circular economy concept is that it separates economic growth from the increasing input requirement, by which it can stimulate innovation, and may continuously generate new jobs. The new economic building blocks (f. e. sharing platforms) may cause changes in the interpretation of business processes if they are introduced. The current hope is that these building blocks can lead to system-level changes soon.

The Ellen MacArthur Foundation determined four main points, or basic mechanisms in 2012, which are required for constructing or redesigning the circular economic systems. These are:

- Circular product planning and manufacture
- Introduction of new, innovative business models
- Redirecting cycles and cascades
- Cross-sector cooperation

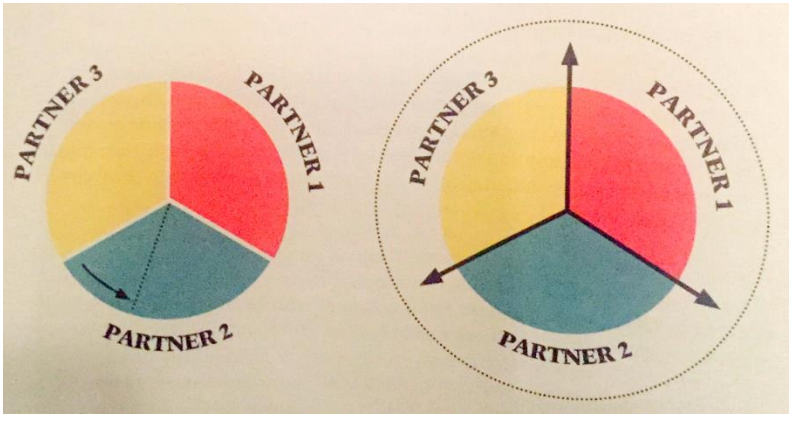
Circular product planning and manufacture

A key element of circular economy is the refurbishing and regenerative planning process. The capability to reacquire materials must influence not only the end of the life cycle, but also offer fundamental competences for the entrepreneurship on circular planning, re-usage and recycling. Information should be amassed related to the circular products and planning in a quantity as rich as possible, and competent methodologies have to be designed for it as well. In the case of planning and final consumption, feedbacks must be collected, in order to raise the efficiency of system operations.

Introduction of new, innovative business models

The business models preferred by the circular economy concept are not oriented towards the possession of tools, but their usage instead. Opposed to the classic stock, in other words, the economic perspective focusing on stocking, the flow, in other words, the economic solutions focusing on flowing or service-based economic solutions are preferred.

Figure 4. The goal is not to achieve the biggest slice of the 'pie' possible



Source: Kraaijenhagen et al., 2016

In the new business solutions, entrepreneurships search for partners they can also connect to vertically in the linear system. However, they can also increase their business opportunities via other cooperative business connections, and mutual, inter-sector cooperation as well. In the case of circular solutions, the goal is not to achieve the biggest slice of the 'pie' possible, but to make the entire pie as big as possible (Figure4). In the case of circular business solutions, new business models will be successful if as many people as possible join their management.

Redirecting cycles and cascades

The circular economic model concentrates on two fundamental areas, one of which is the area of biological cycles, or cycle processes, and their sustaining, in which material flows have to be kept in motion as the primary preference. During the material traffic, waste is not generated (or only in small quantities), since in all phases, the system assigns waste a value (via so-called cascades). The main goal of circular economy is to completely recycle organic materials into the primary resources (soil, water, nutrients). In this way, it can continuously supply resources to any area from foodstuff production to resource material production.

The circularity of technological systems is maintained via similar cycles. The system tries to avoid generating waste as much as possible, by lengthening life cycles (repair, remanufacture, refurbish), thereby increasing the level of circulation, and indirectly, the usage life cycle of products or their components.

Cross-sector cooperation

In the case of circular economic solutions, making connections, cooperation forms which span through the product chain or sectors is a general practice, which means things like joint resource material acquisition, sharing information, or joint educational training programme, or marketing cooperation agreements. In the case of circular economic models, we can often experience how the old, well-known economic framework is not capable of sustaining circular solutions. The development of the system can often be inhibited by actual regulatory mechanisms, tax practice, economic limitations, etc. Political decision makers often must be persuaded that circular systems mean a more efficient development branch, and that they have to be assisted by governmental decrees as well. Circular economic models come with much less risky operational conditions, as entrepreneurships are not threatened by fluctuations in the acquisition costs of resources, or the consequences of market instabilities related to selling products or services.

1.5. Priority levels for circular solutions

The approach which gained fame as '3R' has been in the curriculum of public education since 1818, and means the three basic capabilities (Reading, wRiting, aRithmetic), promoting their importance. After a while, environment conservation activists also created their own 3R -

to symbolise their priorities - which means Reducing the quantity of waste which was on the rise rapidly during the second half of the XX. Century, Recycling it, or completely preventing its creation by Reusing products.

These 200 years' worth of pillars are the basis of the alternative economic perspective named circular economy, which gains more and more ground nowadays. The concept was designed as an answer for the linear economic perspective which reigned until the beginning of the XXI. century, and advertises production based on new resources, and throwing products away after their effective life cycle is used up (End of Life). In the circulation of natural ecosystems, the waste of one life form is always the nutrient for yet another life form. It is impossible to imagine that any life form in nature would produce an 'output' which will not become an 'input' for another one (Szaky, 2014).

Another important aspect of the natural ecosystem, apart from not producing any waste, is that the phenomenon of overconsumption is also unknown. Humanity had to progress in the initial stages of history in a fashion similar to animals - hunting, foraging, and finally, producing for its own consumption were the stages to gain food for humanity. However, nowadays, these processes became obsolete, due to artificial supply systems. Therefore, foodstuffs which became more and more cheap, and easy to acquire, induced the limitless consumption we can see today (Szaky, 2014). In the last half-century, our economy also began to advertise the advantages of exploiting man's proneness to over-consume in other areas of life. The camp of alternative economy branches' activists summarised three main pillars which they believe support today's consumer society.

One of these is the previously mentioned planned obsolescence. The other is the question of using loans. Though this tool was always meant to induce economy, at first, it was used for the goal of making the one requesting the loan invest the money collected for later profit acquisition. However, it became a tool for sustaining the continuous need for consumption active. Finally, another pillar of consumer society surfaced in the form of marketing, which is one of the most efficient method of influencing consumers to further enhance consumption.

The processes concluding in nature must be stressed because they also have an influence on creating a correct interpretation of the circular economy perspective. The reason is that the name referring to circulation, based on earlier experiences, often births a completely incorrect interpretation. And this may become fatal, as the establishment of a scientific and practical basis is only in progress currently. Based on what we have seen so far, the name 'circular' incited researchers to look towards recycling on multiple occasions before. Meaning, most researchers started from the question of how the huge mass of waste, which was produced by humanity, could be recycled into the production systems. And this is an incorrect interpretation, no matter how we see it. Circulation refers to the natural circulation, which was detailed above. According to the idea, economy must copy the operations of

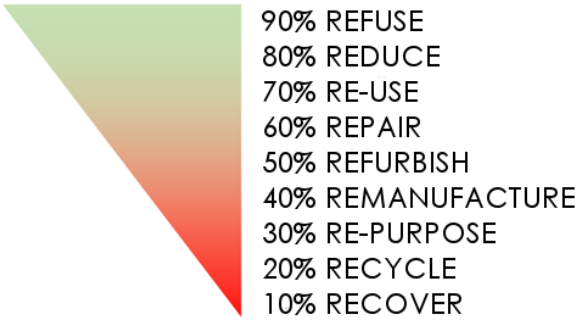
natural ecosystems, where the logic, by which systems living in symbiosis with each other operate, fundamentally prevents the appearance of waste (EMF, 2015). Furthermore, in this cycle, no over-consumption exists either.

The theory itself cannot be said to be completely new, since alternative perspectives appeared one after the other from the 1970's (f. e. bio-mimicry, industrial ecology, natural capitalism, from cradle to cradle theory, blue economy), which placed production systems on a natural basis. The circular economy theory considers all these theories its predecessors, and adopts the 'Solve the problem at its roots' motto as its main policy. This also stresses that instead of searching for waste treatment solutions, we should work on preventing waste from appearing altogether (Benton et al., 2016). A much older connection can be said to be the source of this, which is the Jevons paradox - a basic part of environmental economy. William Stanley Jevons described the long-term negative mechanism in his 1865 book "Coal question". The problem is that technological developments aim to increase the efficiency of currently used systems. In his example, even though developing the efficiency of coal-based production resulted in decreasing industrial air pollution in the short term, the result was that the more economically sound processes caused an increase in technology usage, which, in turn, increased overall carbon-dioxide emission (Alcott, 2005). Based on this, it is easy to imagine what would happen if circular solutions would only concentrate on returning material flows into production.

The 3R policy is also based on a similar logic, as only a single one of the three keywords focus on recycling, the other two suggest that consumption has to be limited, and already purchased wares should be used for as long as possible. Tom Szaky, CEO of the waste treatment company known across the world, Terracycle, also uses this as a basis. He believes that before designating a product as waste, three things must be concentrated on. The first is the function, that it fulfilled. If we deem it to be not used to the level of being incapable of fulfilling its original purpose, we should continue its usage. In case our needs cannot be satisfied by it, we should offer it to second hand shops, where others can still decide if they are willing to use it in its current form. The second important aspect is the product's shape. In our current world, we are used to the phenomenon that production systems give different products to any function, in order to increase consumption. Therefore, we often do not even think how many uses a product could have, if we were to only be creative. For example, instead of buying a new flowerpot, we can also place our plants into sour cream boxes as well. The line of examples would be long, as so-called 'further usage' created multiple business models nowadays. Returning to Szaky's thoughts, the material of the used product is the last for him as well. If we determined that a product is incapable of serving its original function for neither us nor others, and cannot be used for other purposes either, is when we can think of recycling (Szaky, 2014).

During the design of circular theses, researchers base on the previously introduced, 'R-signed' methods, and follow a philosophy similar to that of Tom Szaky. The toolset of waste treatment and prevention was expanded until 9R nowadays, which are called the priority levels of circulation (Figure 5).

Figure 5: Priority levels of circulation



Source: Fogarassy et al., 2017

Though the concept seen on Figure 5 is from a different source, we changed a bit on its hierarchy based on our own researcher's decision, and domestic experiences. Similarly, to the Szaky logic, in our case, we designated two aspects by which we redefined the order of methods. The first one is the 'function before the material' policy, which aims to lengthen the usage of the product for its intended purpose for as long as possible. This is how we can assure that the preferred process is completed with as low material usage as possible. The second priority is to minimise the energy used. In other words, after the effective life cycle is finished, the product should be changed to suit other purposes with the lowest possible energy requirement. The various methods were ranked on Figure 5 - this ranking will also designate the strength of their role in the various circular base mechanisms. The policies listed serve as a basis for a detailed introduction of the methods later, where their ranking in the hierarchy will also be explained.

Refuse

The method above is also one of the most effective interpretations for circularity. In this case, we do not have to produce a new product at all, since consumers refuse to purchase said product. In general, this is the point which cause hardships to most people who attempt to understand it, and also means the most critical point of circular economy. Many do not understand how we can talk about circularity, if the material flow is not even created. Continuing on this road, others believe that increasing production is indispensable for sustaining economic growth, whereas circularity only has to integrate into the system via recycling. However, critics advertising these requirements fail to take two fundamental aspects into consideration. One is the creation of the many externalities, which may cause the economy's current tendency to be increasing, due to their indirect nature (Kallis, 2011). If

we could arrange a value to all these effects, and keep them listed, economic processes would display an entirely different picture (Kallis, 2011). The other aspect is the materialist policy, which constricts most critics into the theoretic framework of the linear economy.

In the recent decades, many theories aiming to move the current stock economy towards the flow economy, which is based on a service thought process, were born (Tukker, 2015). In theory, we have known the performance economy concept designed by Walter Stahel Swiss architect for a long time (Stahel, 2006), and could see multiple examples of the sharing economy nowadays, which has been taking ground steadily (Belk, 2014). Though the theoretic background, or the practical implementation make names differ, the idea behind them stresses the same interpretation. That is: we require business models which help members of society, so that they do not need to own the product to gain their services (Webster, 2015). The simplest example is the public washing machines in the United States, which are well-liked among people (Figure 6). In these facilities, customers can pay to use washing machines instead of buying them.

Figure 6. How to use public washing maschine



Source: quora.com

Furthermore, the business model made by Hilti also shows that philosophy does not merely stand its ground on the competitive market, but may even generate explicit competitive edge. The most notable consumers of construction tools are construction firms, who should calculate with a high cost in order to purchase and store equipment. Furthermore, these firms work on a commission basis, which means a situation where they do not use tools required for a certain commission until they get a similar commission. Hilti, which sells construction machines, realised these needs, and began to lease its most pricey wares as well. This also meant that since they manufactured less products, which decreased the stock, which in turn decreased their production costs, meanwhile, their consumer circle expanded. Many people began to search for their products on the market due to how they were easy to rent instead of purchasing them.

Figure 7. Home depot tool rental center



Source: Hilti, 2012

Hilti company offers a prime example of how reducing production secures an extra source of income, and may cause economic growth (Johnson et al., 2008). Therefore, one important pillar of circular economy is to change the 'consumer' into a 'user' (Kraaijenhagen, 2016).

Reduce

In this case, it refers to reducing both ends of the product chain. On the one hand, we use less resources to produce less products in the beginning of the process. The question remains - which end of the market does the circulation start, from the consumer, or from the producer? Though early, classic economic theories were born on markets where a low amount of products had to deal with over-demand, these things did change with time. Nowadays, the demand for products determines the supply, and has done so for the last century. Moreover, supply often goes beyond the demand these days. Therefore, tools to artificially stimulate

demand became 'popular', such as the previously mentioned marketing, loan, or planned obsolescence. These methods induce, create opportunities, or force us to increase our consumption, which in turn increases the waste we produce. Therefore, the answer to this question is obviously on the side of the consumer. We ourselves are responsible for the amount of products currently on the market. If we decide to decrease our consumption, we can force producers to stop creating so many unnecessary products (Szaky, 2014). However, interpreting the method to decrease is not so simple.

No questions asked, we can talk about a direct side, where we become aware consumers, in which case, we do not allow the various marketing methods and tools to seduce us (f. e. the pay for 2, take 3 home discounts), and do not buy products which we do not even need. One of these cases is when we consciously try to purchase long-lasting products (Bakker et al., 2014). Looking at the life cycle of products, an important thing to note is that the price of a product is usually calculated from the first half of this cycle (which means until it gets to the consumer). Naturally, as its fate after this is not exactly known, it would not be fair to include the end of the life cycle (treatment after life cycle ends). Regardless, if even this would happen, some products would be cost a lot more than what we should pay for it on the market. A good example of integrating externalities into product prices is the gradual increase of tobacco products, based on what amount the State spends for healing the respiratory problems caused by smoking. A similar situation affects short life cycle, usually worse quality products as well. The amount of waste resulting from these increases each year, and forces an increasing amount of costs on the organisations maintaining waste treatment facilities. However, even beyond social costs, if the consumer would be willing to calculate a bit, they would be capable of understanding that buying and replacing cheaper products over and over generates a higher cost even on a basis of units, instead of purchasing a more expensive product which lass a lot longer. This is where the saying 'the cheapest stuff is the most expensive, and those buying them splurge the most' comes from.

Another indirect method to decrease consumption is to purchase local products (Fogarassy et al., 2016). This is another aspect which was defined by multiple theories before the circular thought process was spread. Many concepts stress the economic and environmental importance of strengthening local markets. This is how national riches can be kept within national borders most efficiently (Hildreth, 2011), and transporting international products does not cause such a strong load on the environment either. In case we purchase local products instead of those from abroad, the volume of decrease in the material flow is multiplied as well, since not only the product can be manufactured in the country instead of abroad, but the distribution systems do not have to be constructed either. Furthermore, in case local markets gain more control, not only the money will be kept in place, but resources as well,

which are becoming more and more important due to their nature of being limited in quantity (de Jong et al., 2016).

Reuse

This method has very simple characteristics. According to the mechanism introduced before, we list processes when someone wants to be rid of a product they own, which can still fulfil its function, here. Therefore, they do not discard the product, but take it to a second-hand shop instead. The action of reuse is a well-known method to decrease the robust amount of waste generated by mankind. It mainly refers to second hand activities which makes it possible for people to hand in their used goods. This way they can save them from turning into garbage. On the other hand, the ones in need are able to buy a product of which they could not afford an original piece. So the definition is easy and second hand stores are widely anticipated throughout Europe and the world. Nevertheless, the function of these businesses still differs from each other depending on which side of the continent they take place. While in case of the UK or the Netherlands similar stores follow the described protocol, the Hungarian practice is a bit different. In Hungary, these shops mostly run under the name of 'British' or 'American' second hand. It means that they acquire their supplies from the labelled countries (Figure 8).

Figure 8. Advertisment of British used cloths in Hungary (from the distributor)



Soure: eladoruha.hu

This phenomenon would not be a problem in the first place, if these products are entirely second hand. The reality is that most of them have never been used and they were transported to other countries because there was no sufficient demand for them in the origin country. It might also happen that the original owners bought them in a discount (which

offered multiple goods in the same type) and they decided to turn some into second-hand without usage. The Hungarian chain store called 'Háda' is specialized in this field of business. Based on the description of the distinct second hand routines, there is a major different between them in terms of circularity. While the Western-European practice truly stands for a reusing activity which extends the life cycle of products, the Hungarian application remains linear. By offering non-used goods the similar stores only function as businesses distributing simple export products.

The following, and preceding methods can be considered the most efficient solutions, as these make us capable of preventing the creation of waste.

Repair, Refurbish and Remanufacture

One of the most notable mottos of the XXI. century's consumer society: "I recommend buying new, it is cheaper than the repair costs". This perspective was, in the beginning, used for the technological products which appeared with the digital age. This was when society began to realise the intent behind the phenomenon, as the motto was implemented even for wares which were easy to repair before (Figure 9). This can be said to be the extension mechanism of planned obsolescence, where not only the actual lifetime of the product becomes shortened during production, but we even prevent the consumer from lengthening it. To combat this, circular economy created the definition of 'circular design' (EMF, 2015).

Figure 9. Repair service (if the product is open to improvement)



Source: http://www.appliancerepairsmaldon.co.uk/

Its essence is for manufacturers to not only make sure of the long lifetime introduced before, but also to aid consumers to assure it as well. The first variant of this is when after the product malfunctions, it can simply be repaired. Looking at priorities, out of the three processes, this one is the most efficient, since this process can be concluded with minimal energy usage and waste remaining.

Refurbishing

Refurbishing is different from this, as we look at the compatibility attributes of the product for this. Nowadays, we often find ourselves incapable of having a product repaired, as the malfunction of one of its elements causes us to have to throw away the entire product, since there is no way to change said element. Therefore, circular planning prefers the creation of products that are easy to disassemble, to make the various elements, parts easy to exchange with new ones. Maybe the most notable complication can be seen in this area, as one of the most widespread business model of our time is the so-called 'lock-in effect'. The concept is based on the companies locking their customers to themselves after they have purchased a product (Amit, Zott, 2012). This strategy is used by f. e. Nespresso or Apple.

Figure 10. Nespesso service shop (professional lock-in effect)



Source: Guido Krzikowski / Bloomberg / Getty Images, 2011

As for the former, after the customer buys the coffee machine, they can only use the company's capsules in it to make coffee. As for the latter, Apple made a firm structure, in which everything is against the basics of circular economy. Their many varied technological hardware and software creations are only compatible with the company's other products explicitly. The first, and maybe most notable scandal related to planned obsolescence is also related to them. When they released one of the iPhone series, they deliberately used a short life battery, and refused to exchange it. Instead, they urged their consumers to buy new products. Said companies are a good example for how circular economy's spread requires not only social support, but serious aid from business actors as well.

Remanufacturing

Finally, in the case of remanufacturing, recycling and the previously introduced refurbishing are blended together. This is due to us aiming to make a new product from the elements of used products. An excellent example is when two laptops malfunction at the same time, one has a screen error, and the other a frame error. In these cases, the company suggests buying

new, but if they were to combine the usable elements of the two, only one would become waste (Figure 10). Unlike repair, refurbish and remanufacture both generate waste from used or malfunctioning components.

Figure 10. Used products are waiting for selection and remanufacturing



Source: circulatenews.org, 2017

However, these methods consume much less resources and energy, when compared to manufacturing brand new products. And the most important is that this way, we are also capable of preserving the function that was fulfilled before as well.

Up-cycling

This is the first method which shows some similarity with current trends to some extent. This is caused due to the so-called 'retro' perspective being a fad all around the year, which supports the various methods of reusing already used products. (As for the question 'Are consumers willing to pay for newly made, artificially worn-out retro clothes, which naturally does not have a place in circularity's ideology?', remains to be known.) Thanks to this, this branch managed to take considerable advantage during the last two decades, and multiple companies happily use it during their CSR projects (Spitzeck, 2011). Its essence is that we find alternative methods of usage for products which lost their original function (EMF, 2015). One example would be the wallet made of used wrapping paper, or the wall clock made of an old black vinyl record (Figure 11.).

From certain perspectives, this process is much more efficient than the repair or refurbish. It is enough to imagine that the smart solutions under this category are usually independent of many inputs, like product manufacturing from used parts. Furthermore, often no waste is produced either, contrary to used parts. However, circularity's ideals prefer to preserve the original role, which, in this case, is lost by the product. From here on, the only useful solution is

to find it some other function, and to prevent it from becoming waste. However, the original function will be needed as well, since it must be replaced with a new product.

Figure 11. Clock made of an old black vinyl record



Source: etsy.com, 2017

Based on this logic, the structure of a circular economy became much clearer too. At first, it notes that we should think about a product before buying it, and decide if we have any need for it in the first place. After that, if we answer yes - and the function we need requires both a usage of material, and the creation of a new product - we should aim to have the procured product fulfil its function for as long as possible.

Recycling

Its definition was always surrounded by the mysticism banded around its usefulness. Regarding the concept of circular economies, this mechanism is the first to come up in people's minds. However, our "Dear Reader surely understood by now", that the idea based on circulation is no more than simply returning material into the process. During recycling, circularity policies are only implemented in a faded manner, since we cannot speak of sustaining the product function, or creating a new function. In these cases, we concentrate on the material composition of the objects, which can be used in the production processes as secondary resource materials. And this requires another round of energy usage, even if it needs no new materials - or only a little amount of them. Most of the consumers are not aware how the selective garbage collection required for recycling works. They basically cannot be held responsible for this, since similarly to our previous example, the production side once again makes things difficult for them.

Looking at history, we do not need to go back into times where wares were made from one-two different base materials. However, nowadays, the materials used to manufacture products are extremely complex (Szaky, 2014). This is one of the reasons for the product returning facilities not working sufficiently even in countries like the Netherlands. There is no use for the highly sophisticated recycling capacity the country created in recent years (de Jong, 2016). And in other countries, simply the activity or number of members of society is insufficient for reaching the critical mass required for maintaining the system in an economically sound manner. If we need a positive example, we can look at the aluminium sector. In our case, the manufacturers already realised that using secondary resources can significantly decrease energy usage, thereby decreasing production costs as well (Frischknecht, 2010). (This can also be attributed to how in the last 30 years, the aluminium sector could decrease its air pollution effects, even with increasing production.) Therefore, it is obvious the actors of the business side are motivated to make sure the facilities required for collecting the customers' returned products are there for society. This example clearly shows that while on higher levels of the circular priorities (Refuse, Reuse, Reduce), the attitude of consumers has a higher impact on processes, as we are heading towards the lower levels, the producing side gets more power by using circular product planning and income motivators.

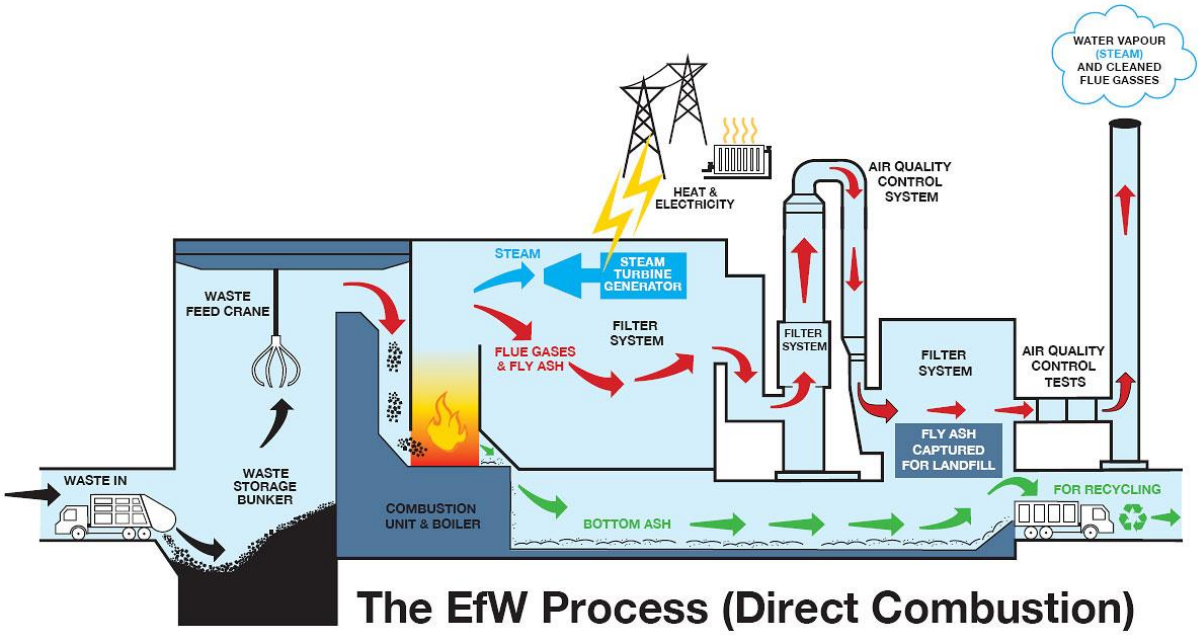
Recovery

Recovering energy from waste is basically one of the most primitive methods of waste treatment processes. People usually associate to energy produced in trash combustors when thinking about this method, which may have a significantly different efficiency due to differences in the actual facility (Grosso et al., 2010).

These facilities often cause more negative externalities to emerge during their operations - f. e. air pollution - when compared to the positive benefit at the end of the process (Figure 12). Nothing is better proof of this than the fact that in the world, there are currently no trash combustion facilities operating with a profit, not even in western countries. This is a perfect example of how the method is simply weak, instead of a difference between the development levels of countries, or the presence, or lack of a critical mass similarly to recycling, either of which inhibiting the process. Nowadays, however, other solutions spread quite far as well, which may be implemented in a circular methodology a bit better.

One example is the new electric car developed by Toyota, which uses wastewater as fuel, or the system converting bovine manure into biogas in the Netherlands, Friesland. However, on such low levels of circularity, developments must be handled with care, as they may lead towards a very bad direction, based on the Jevons paradox.

Figure 12. Energy from Waste (EfW)



Source: arc21.org.uk, 2017

Out of the examples mentioned, one of the aims of Toyota is to make use of the robust quantity of wastewater in the city, whereas the Dutch people want to decrease the negative externality content of agricultural load (Kraaijenhagen, 2016). However, basically neither properly represents the fundamental requirement of circularity, which states 'to treat the problem at its roots'. Since the biggest problem with bovine husbandry is that these animals have a significant environmental load, both from the perspective of the amount of water they consume, and the GHG emission they cause. Therefore, the Dutch province which exploits their manure may, when first seen, seem to be more efficient than other agricultural systems. However, their energy production concept based on this will favour increasing the husbandry's size, which will, in the long term, cause even more environmental problems, than the advantages gained by using their manure.

Linear solutions

Regarding the sector of waste treatment, linear methods currently dominate our systems in operation. This is where the method of trash combustion mentioned earlier is categorised, which, though has some level of energy production, should be refused from both an economic and an environmental perspective. The other widespread linear process is trash depositing, when they deposit the products which reached their end of life by area usage. These methods have the main problem of not upholding the main policy of circular economies, which states that waste is not a problem to solve, but capital to use (Table 1.).

Therefore, recent theories mostly elaborate on waste management, but resource management instead.

<table>
<tr><th></th><th>Business model</th><th>Consumer</th><th colspan="2"></th></tr>
<tr><td rowspan="5">Prevention of waste</td><td>Refuse of producing new products (prevent the use of resources)</td><td>Refuse of purchasing new products (Sharing Economy)</td><td rowspan="2">Prevention of production activity</td><td rowspan="10">Circular solutions</td></tr>
<tr><td>Re-use (second hand)</td><td>Purchase of second hand</td></tr>
<tr><td>Production of long lasting products (extended stewardship)</td><td>Purchase of long lasting products</td><td rowspan="3">Reduction of production activity</td></tr>
<tr><td>Reduce (resource usage)</td><td>Conscious consumer attitude</td></tr>
<tr><td rowspan="4">"Circular design"</td><td>Repair</td></tr>
<tr><td rowspan="6">Waste management</td><td>Refurbish (Change of obsolete components)</td><td rowspan="5">Re-utilization processes</td></tr>
<tr><td>Remanufacture (new product from second hand)</td></tr>
<tr><td colspan="2">Upcycling (Re-purpose)</td></tr>
<tr><td>Vast reduction of materials during production</td><td>Recycle/selective waste collection</td></tr>
<tr><td colspan="2">Recovery</td></tr>
<tr><td colspan="2">Incineration of waste</td><td colspan="2" rowspan="2">Linear solutions</td></tr>
<tr><td colspan="2">Landfill</td></tr>
</table>

Table 1. Business models and consumer attitudes in case of linear and circular solutions

Source: based on Cramer, 2014

References

1. Agrawal, V. V., Kavadias, S., Toktay, L. B., 2015. The limits of planned obsolescence for conspicuous durable goods. Manufacturing & Service Operations Management, 18 (2), 216-226, http://dx.doi.org/10.1287/msom.2015.0554

2. Alcott, B., 2005. Jevons' paradox. Ecological Economics, 54 (1), 9-21, http://dx.doi.org/10.1016/j.ecolecon.2005.03.020

3. Amit, R., Zott, C., 2012. Creating value through business model innovation. MIT Sloan Management Review, 53 (3), 41-49.

4. Bakker, C., Wang, F., Huisman, J., den Hollander, M., 2014. Products that go round: exploring product life extension through design. Journal of Cleaner Production, 69, 10-16, http://dx.doi.org/10.1016/j.jclepro.2014.01.028

5. Belk, R., 2014. You are what you can access: sharing and collaborative consumption online. Journal of Business Research, 67 (8), 1595-1600, http://dx.doi.org/10.1016/j.jbusres.2013.10.001

6. Benton, D., Hazell, J., Hill, J., 2016. The guide to the Circular Economy. Greenleaf Publishing Limited, UK, pp. 25-40.

7. Boon, F. P., Dieperink, C., 2014. Local civil society based renewable energy organisations in the Netherlands: Exploring the factors that stimulate their emergence and development. Energy Policy, 69, 297-307, http://dx.doi.org/10.1016/j.enpol.2014.01.046

8. Bulow, J., 1986. An economic theory of planned obsolescence. The Quarterly Journal of Economics, 101 (4), 729-749, https://doi.org/10.2307/1884176

9. Butler, J., Docherty, P., 2012. Securing the Benefits of Wind Power in Scotland: A new concept for community benefit provision. – Research Report. Vento Ludens Ltd&Docherty Consulting Ltd., Edinburgh. pp. 78, Link: http://www.all-energy.co.uk/__novadocuments/28619

10. Cramer, J., 2014. Moving towards a circular economy in the Netherlands: Challenges and directions. Utrecht University, pp. 1-9. Link: http://usi-urban.wp.hum.uu.nl/files/2015/04/Paper-HongKong-JC-april-2014.pdf

11. Darby, S., 2010. Smart metering: what potential for householder engagement? Building Research & Information. Special Issue: Housing occupancy feedback: linking behaviours and performance, 38 (5), 442-457, http://dx.doi.org/10.1080/09613218.2010.492660

12. de Jong, S., van der Gaast, M., Kraak, J., Bergema, R., Usanov, A., 2016. The Circular Economy and developing countries – a data analysis of the impact of a Circular Economy on resource-dependent developing nations. Centre of Expertise on Resources, The Hague, pp. 17-19, Link: http://hcss.nl/sites/default/files/files/reports/CEO_The%20Circular%20Economy.pdf

13. Dustin, B., Coats, E., 2016. The End of the Upgrade? How O2 is Adapting to a More Circular Mobile Market. Green Alliance, UK, pp. 12-26, Link: http://www.green-alliance.org.uk/resources/The_end_of_the_upgrade.pdf

14. Ellen MacArthur Foundation, 2012. Towards the Circular Economy: Economic and business rationale for an accelerated transition. Ellen MacArthur Foundation Publisher, UK, pp. 21-34. Link: https://www.ellenmacarthurfoundation.org/assets/downloads/publications/Ellen-MacArthur-Foundation-Towards-the-Circular-Economy-vol.1.pdf

15. Ellen MacArthur Foundation, 2015. Towards the Circular Economy. Business rationale for an accelerated transition. Ellen MacArthur Foundation Publisher, UK, pp. 5-9. Link: https://www.ellenmacarthurfoundation.org/assets/downloads/TCE_Ellen-MacArthur-Foundation_9-Dec-2015.pdf

16. European Commission (EC), 2015. Closing the loop - An EU action plan for the Circular Economy. Link: http://eur-lex.europa.eu/resource.html?uri=cellar:8a8ef5e8-99a0-11e5-b3b7-01aa75ed71a1.0012.02/DOC_1&format=PDF

17. Farhangi, H., 2010. The path of thes martgrid. IEEE Power and Energy Magazine, 8 (1), 18-28, http://dx.doi.rg/10.1109/MPE.2009.934876

18. Fogarassy, Cs., Orosz, Sz., Ozsvári, L., 2016. Evaluating system development options in circular economies for the milk sector – development options for production systems in the Netherlands and Hungary. Hungarian Agricultural Engineering, 30, 62-74, http://dx.doi.org/10.17676/HAE.2016.30.62

19. Frischknecht, R., 2010. LCI modelling approaches applied on recycling of materials in view of environmental sustainability, risk perception and eco-efficiency. The International Journal of Life Cycle Assessment, 15 (7), 666-671, http://dx.doi.org/10.1007/s11367-010-0201-6

20. Granström, P., Jackson, J. A.,Denda, R., Gomez, A., Perez, J. A. R., Baron, M., Micheli, G., Cagno, E., Mauri, G., Goni, A., 2014. Steering the implementation of smart metering solutions throughout Europe, MeterOn 7th Framework Programme of the European Commission project, Final report. Link: http://www.meter-on.eu/file/2014/10/Meter-ON%20Final%20report-%20Oct%202014.pdf

21. Grosso M., Motta A., Rigamonti L., 2010. Efficiency of energy recovery from waste incineration, in the light of the new Waste Framework Directive. Waste Management, 30 (7), 1238-1243. http://dx.doi.org/10.1016/j.wasman.2010.02.036

22. Hildreth, P., 2011. What is localism, and what implications do different models have for managing the local economy? Local Economy: The Journal of the Local Economy Policy Unit, 26 (8), 702-714, http://dx.doi.org/10.1177/0269094211422215

23. Huybrechts, B., Mertens, S., 2014. The relevance of the cooperative model in the field of renewable energy. Annals of Public and Cooperative Economics, 85 (2), 193-212, http://dx.doi.org/10.1111/apce.12038

24. Johnson, M., Christensen, C., Kagermann, H., 2008. Reinventing your business model. Harvard Business Review, 86 (12), 50-59.

25. Kallis G. (2011): In defence of degrowth. Ecological Economics, 70 (5), 873-880, http://dx.doi.org/10.1016/j.ecolecon.2010.12.007

26. Kraaijenhagen, C., van Open, C., Bocken, N., 2016. Circular Business – Collaborate and Circulate. Ecodrukkers, pp. 5-30.

27. Morris, C., Pehnt, M., 2012. Energy Transition – The German Energie wende. Heinrich Böll Stiftung. pp. 112. Link: https://book.energytransition.org/sites/default/files/downloads-2016/book/German-Energy-Transition_en.pdf

28. Pauli, G., 2010. 10 years 100 innovations 100 million jobs inspired by nature. The Club of Rome. pp. 7-13.

29. Rae, C., Bradley, F., 2012. Energy autonomy in sustainable communities - a review of key issues. Renewable and Sustainable Energy Reviews, 16 (9), 6497-6506, http://dx.doi.org/10.1016/j.rser.2012.08.002

30. Sáfián, F., Munkácsy, B., 2015. A decentralizált energiarendszer és a közösségi energiatermelés lehetőségei a településfejlesztésben Magyarországon. Földrajzi közlemények, 139 (4), 257-272, Link: http://www.foldrajzitarsasag.hu/downloads/foldrajzi_kozlemenyek_2015_139_evf_4_pp_257.pdf

31. Sarkar, A., Singh, J., 2010. Financing energy efficiency in developing countries—lessons learned and remaining challenges. Energy Policy, 38 (10), 5560-5571, http://dx.doi.org/10.1016/j.enpol.2010.05.001

32. Schaltegger, S., Hansen, E., Lüdeke-Freund, F., 2016. Business Models for Sustainability: Origins, Present Research, and Future Avenues. Organization & Environment, 29 (1), 3-10, http://dx.doi.org/10.1177/1086026615599806

33. Schaltegger, S., Lüdeke-Freund, F., Hansen, E., 2012. Business cases for sustainability: the role of business model innovation for corporate sustainability. International Journal of Innovation and Sustainable Development, 6 (2), 95-119, http://dx.doi.org/10.1504/IJISD.2012.046944

34. Spitzeck, H., 2011. TerraCycle – A business founded for societal benefit generation. Humanistic Management in Practice, Part of the series Humanism in Business, 266-276, http://dx.doi.org/10.1057/9780230306585_18

35. SolarPower Europe, 2016. Solar Market Report & Membership Directory. Publishing Events Ltd, UK, pp. 18-26. Link: http://www.solarpowereurope.org/fileadmin/user_upload/documents/2015_Market_Report/SPE16_Members_Directory_high_res.pdf

36. Stahel W. R. (2006): The Performance Economy. Palgrave Macmillan Publisher, pp. 349.

37. Szaky, T., 2014. Outsmart waste: the modern idea of garbage and how to think our way out of it. Berrett-Koehler Publishers, California, US, pp. 126-144.

38. Tukker, A., 2015. Product services for a resource-efficient and circular economy – a review. Journal of Cleaner Production, 97, 76-91. http://dx.doi.org/10.1016/j.jclepro.2013.11.049

39. Vadacchino, V., Denda, R., Fantini, G., 2013. First results in Endesa smart metering roll-out. Electricity Distribution (CIRED 2013), 22nd International Conference and Exhibition 10-13th of June, 2013, Stockholm, http://dx.doi.org/10.1049/cp.2013.0850

40. Webster, K., 2015. The circular economy – a wealth of flows. Ellen MacArthur Foundation Publishing, UK, pp. 104-110.