MOVECO

CIRCULAR ECONOMY INNOVATION TOOLS

New Material Pathways

Qualification Programme Handbook

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2. INTRODUCTION

2.1. INTRODUCTION TO THE NEW MATERIAL PATHWAYS SECTION OF THE MOVECO TOOLBOX

This handbook is part of the **circular economy toolbox** of the **MOVECO project**. Its main goal is to initiate a different way of thinking about material use when products are designed, manufactured, used and end their life cycle.[1]

> The meaning of 'new material pathways' in this context is twofold – both finding new pathways for the same material as well as introducing new material into existing 'pathways' (= processes).

This document can either be used as background material for trainers and participants in a **workshop** or also by individual readers (**self-study** or within a self-formed study-group). For both cases, there are notes provided that guide through the material.

Indicative questions encourage you to reflect what you have just read.

In addition, throughout the text, you will find some indicative questions framed and marked by "?" that encourage to reflect what you have just read.

Cross-references to the case studies and further MOVECO materials help to deepen your knowledge about circular economy.

Moreover, there are cross- references to the case studies or other MOVECO material (such as the fact sheets) marked by "💡".

Practical exercises are pointed out for trainer-led workshops or self-study by individual readers or a self-formed study group

Further, the pencil sign points out practical exercises that can be done as part of a trainer-led workshop or in self-study by individual readers or a self-formed study group.

[1] Since material use is predominant when creating products, this section very much focuses on products. However, the basic ideas behind the exercises and the intention to find alternatives could also be applied for services by finding more environmentally-friendly alternatives to supporting materials used (examples would be e.g. cleaning service uses plant-based cleaning products, workshop provider uses double-sided printing on eco-friendly paper (if print-outs are needed at all), dry cleaning service reuses the water and the heat that are generated)

For the **practical** work, there are several **case studies** that invite discussion or reflection – paired with empty templates for worksheets that encourage looking at a self-chosen practical product example. In the end, there is a short quiz to test the knowledge gained in this section of the toolbox. You will find any specific terminology explained in the **glossary**. If you use this section as part of a workshop, there is an **evaluation form** at the very end that can be used to collect feedback at the end of the workshop.

2.2. LINEAR AND CIRCULAR ECONOMY AND MATERIAL USE

In a linear economy, resources and materials are used and will eventually leave the system in the process. They will finally end up in an incineration site or in the worst case in a landfill. In a circular economy, the aim is to use resources and materials in loops (=cycles), and keep them in the system as long as possible. In that way, there is not only an environmental benefit by the use of less resources and energy (as well as a more efficient, circular-oriented resource use), but also an economic advantage by cost reduction.

This section of the toolbox looks at the ways different materials are currently used in a linear economy and examines how this could transition into a circular economy. It invites to think about new material pathways - this includes finding new ways of using the same material in the same process, as well as moving it to another process or also shifting to another material by replacing the old one. For currently used materials, awareness of the advantages and disadvantages of their use are examined. Alternative materials are introduced and also looked at by examining the pros and cons for their use. The most important fact to be learned in this section is to learn that there is no single solution of "A replaces B", but that the whole process from the product design phase, manufacturing phase, use-phase to end-of-life phase needs to be looked at to make a decision on material use. The aim should be to move away from a linear process to a circular process or either leads into another circle or incorporates many circles. To achieve this, it is important to think outside the box and get creative by thinking about new material pathways – case studies will help to do so and hopefully enable to transfer the idea of new material pathways into the own reality of the workshop participants. We chose case studies from the Danube region (and in some cases, neighbouring regions) because they illustrate one or several principles of the circular economy very well.

2.3. MATERIAL CHOICE – NO "BLACK-AND-WHITE" DECISIONS

The following examples of general, well-known and frequently used materials were chosen to illustrate some of the advantages and drawbacks of the respective material. This is included at the beginning to show the general idea behind the considerations for material choice: there needs to be a decision made in respect to material use depending on each individual case. By choosing materials that are well known, the basic exercise becomes easier: examining possible alternatives to a certain material choice while at the same time being aware that the same material may be "good" for one application while "bad" for another. Also, there might be additional considerations to make such as e.g. water and energy consumption for resource extraction, transport distances, reusability or recycling potential, as well as standards and regulations of a particular industry (e.g. packaging for food has special requirements) to name just a few.

The following **section contains** some **basic features** that are **a starting point to judge the materials** and weigh possible use and benefits against possible drawbacks.[2] It is important to note that **there are no clear-cut decisions:** the advantages and disadvantages of the different materials have to be weighed against each other and decisions have to be made on the individual cases.

GLASS For example, when looking at packaging on the one hand, **glass** is resistant to loads, high temperature and chemical products, provides a barrier to gases and liquids and protects the content from light and degradation (brown or green glass) and has a high recycling potential. On the other hand, it weighs more than other material (e.g. five times more when compared to plastic) and has a higher energy expenditure when looking at logistics due to the weight and is more susceptible to breaking than other materials.

METALS There is a high energy use in the manufacturing of metals, but they are also quite durable, highly resistant and protective and also have a high recycling potential with high-quality secondary products.

PAPER AND CARDBOARD While **paper and cardboard** originate from plant-based, renewable raw material and can be light in weight (thin layer) with a high recycling potential, there is also a high energy use in recycling (also concerning collection and transport) and they are susceptible to humidity (if uncoated; if coated: compound and more difficult to recycle).

WOOD Wood is also a plant-based, renewable raw material with good stability and thermal-acoustic insulation. As material, one of its advantages is the fact that it can be used in cascades (a good step towards circularity, but eventually phases out) – it can have multiple uses for multiple products before it is eventually phased out. However, the cascading use can be complicated difficult when the wood surface is treated to improve durability or wood is used as one material in compounds – this has to be put into consideration when examined for circular uses.

CELLULOSE In the case of (corrugated) **cellulose** materials or films from cellulose that are used as alternatives, there are many positive aspects. For example, they are flame retardant, offer thermal insulation, can be made to be soundproof (panels) or transparent (e.g. as a film used for wrapping or coating), anti-static and electrical insulating while they are bio-based and (if uncoated) are biodegradable at the same time and can come with a light weight. On the other hand, the production processes require high amounts of energy and water. The decomposition needs a certain temperature level and in the case of films, the material is extremely thin so that there is more tear or discards which can lead to more pollution.

POLYMERS/PLASTICS They are lightweight but the recycling potential depends on the purity of the fractions collected and the traditional polymers are fossil-based and hardly to disintegrate and thus difficult to recycle which proves a huge burden to the environment.

BIOPOLYMERS There is also the possibility to use **biopolymers**, but attention has to be paid to the fact that not all biopolymers are actually made from bio-based materials (some are still fossil-based) and/or not all will actually disintegrate and close the loop. While there are biopolymers that are compostable/biodegradable, certain temperatures and times to rot are necessary for the material to perform this and often recycling/bio-waste/compost facilities do not offer these possibilities. In addition, biopolymers are still more expensive than plastic to produce and for the reasons mentioned also more expensive to recycle because up until now, they have to be removed from the recycling/bio-waste/compost facilities and most often need to be incinerated since they can be neither recycled with the other plastic nor composted. In addition, some biopolymers use resources that compete with land for food production, which can be another drawback by affecting another (agricultural and social) cycle (competition for land).

[2] This overview was compiled by using documents that were prepared by the EU-funded project IMAGEEN, where some of the MOVECO project partners were also partners before. The documents can be found at https://www.bayfor.org/de/eu-projekte/pr/tools.php

There are also fibres and fabrics derived from other sources such as corn. Depending on their production process, they have different properties such as biodegradable, recyclable and compostable while at the same time possibly being UV-resistant, stain resistant, breathable and elastic. Again, there is a certain temperature needed for them to decompose and the process to produce them requires high amounts of energy and water. In addition, the resources used are grown on areas that would be used for food production or are resources that can be used as food as well.

This shows that there are no easy decisions when it comes to material choice and use. A thorough analysis can help – e.g. by doing a life-cycle assessment of the product and looking at all product phases to see which material properties are required for the product in its original use and which material properties are required for a recycling or up-/downcycling potential.

EXERCISE 1

Can you think of cases where a traditional material was replaced by a new or even more traditional material?

Here are some examples from the case studies to help you get started:

- Plastic can be replaced by biopolymers, e.g. by the milk protein casein (as in the case study Qnature (DE), see p. 33) to provide a biodegradable alternative
- Styrofoam can be replaced by straw for packaging (as in the case study Landpack (DE), see p. 17) to provide a biodegradable alternative
- Straw can be used as bio-based resource to produce eco construction boards (as in the case study Ecopanely (CZ)), see p. 27)
- Insulation made from textiles can replace insulation materials like glass wool (as in the case study SK-Tex/HMCon (SK), see p. 28)

Exercise 1: Curious to find out more? Look closely at these examples as part of your workshop or your self-study/study-group.

EXERCISE 2

Can you think of cases where one material was used for another purpose than the original one or for multiple purposes?

Here are some examples from the case studies to help you get started:

- Recycled textile waste or insulation made from industrial (automotive) textile waste can be turned into cloths for cleaning or insulation material for a (dry construction system as in the case study SK-Tex & HMCon (SK), see p. 28)
- Even if there is just one material to begin with, it can turn into many products completely, using the material up (as in the case study Brocker Möhren (DE), see p. 29).

Exercise 2: Curious to find out more? Look closely at these examples as part of your workshop or your self-study/study-group.

2.4. PRODUCT DESIGN PHASE

It is important to start at the design phase of a product when examining the use of material and thinking about possible alternatives and/or new material pathways. The material used and the way the product is designed has a huge impact on the later phases of the product life cycle. There is a decision made for the materials to be used, impacting the resource use and their possible depletion. The location where resources are extracted and products are produced can have an impact on social and working conditions in other countries and will affect transport distances and packaging. The way they are constructed affects the use of the product, the possibility to repair it, any options to use it for another purpose than originally implied, as well as the possibility to recycle it. An approach that starts with life cycle thinking and/or includes a life cycle assessment is a good starting point, ideally aiming at a Cradle to Cradle® implementation that finally closes the loop(s) completely.

Important questions to ask at the product design phase are:

- How do you select your materials?
- Which materials do you intend to use and what are their advantages and disadvantages?
- Is the material selected biodegradable? Can it be repaired and recycled (and under which conditions)? What will happen at the end of the product life – can it be used for another purpose, be upcycled or downcycled?
- Do you consider primary materials only or also secondary materials (recycled) or refurbished parts?

- Is the material from renewable sources?
- Can you minimize the amount of material used?
- Will the material consist of compounds and/or non-frequent material?
- Did you conduct a life-cycle assessment for the future product?
- Would it be possible to sell a service instead of a product?
- In general, can you use an eco-design approach and/or include eco-efficiency principles at that stage?[3]

EXERCISE 3

Can you think of cases where a change at the design phase made a difference?

Here are some examples from the case studies to help you get started:

- Fairphone wanted to create a phone that can be disassembled and repaired, while at the same time trying to reduce resources from problematic origins and recycling scarce resources (as in the case study Fairphone (NL), see p.21)
- Rowenta wanted their products to be more easy to repair – and designed them in a way that they can be disassembled easily (as in the case study Rowenta Tefal, see p. 21)
- By chosing standard sizes for their packaging, Werner & Mertz was able to significantly reduce production waste for their Frosch products – and by chosing only one basic material for the packaging, it can be recycled more easily and also be used as a secondary raw material and thus be re-integrated in the production process (see p.18 for the Frosch case study)

Exercise 3: Look at the product design phase in the workshop/your self-study with the worksheet provided in chapter 5.1. The case studies show examples for changes made at the design phase – you are invited to discuss/reflect whether these changes took the change far enough and how they affected the whole product.

[3] Read more in the MOVECO fact sheet »FACT SHEET CIRCULAR ECONOMY: TERMS & DEFINITIONS«

MOVECO cross-references: Please also have a look at following the MOVECO materials on our website: www.interreg-danube.eu/moveco:

- » CHECKLIST TO SUPPORT SMEs « in the section "product design & labelling"
- » FACT SHEET CIRCULAR ECONOMY: TERMNS AND DEFINITIONS « in the design section
- Section on the Circular Design Guide and assessment and certification schemes in the MOVECO fact sheet » FACT SHEET SUPPORTING TOOLS FOR A CIRCULAR ECONOMY «.

2.5. SOURCING, MANUFACTURING, DISTRIBUTION PHASE

The manufacturing process is also interconnected. There, the focus needs to shift away from the product production only, but consider also the process for sourcing processes (resource extraction, raw material production), as well as the distribution of the final product (consisting of packaging and transport requirements).

RAW MATERIAL EXTRACTION It is important to examine in a first step, where the resources and raw materials will come from. This includes examining whether they are limited and/or scarce and/or from countries with poor working conditions and social standards, as well as difficult political conditions. Also, there is the energy needed to extract the resources and produce the raw materials needs, which needs to be considered, as well as how the environmental impact looks like – for example when chemicals used for the extraction process.

PRODUCTION AND MANUFACTURING In a second step, the production site itself needs to be examined, including the production process and the waste that is generated there. When looking at the production site, topics like energy efficiency, heat and water reuse, emission reduction, material flows and waste management are important. For the latter, there needs to be an examination whether waste created by the production process can be avoided or minimized, if the by-products can be re-integrated into the same production process or used as secondary resources for another process, or if the waste can be recycled and then used as secondary resource.

DISTRIBUTION In a third step, the distribution also needs to come into focus to determine how long the transport distance will be, whether there are any special requirements to the packaging and which way of transport will be chosen (e.g. land, sea, rail, air).

Important questions to ask at the phase of sourcing, manufacturing and distribution phase are:

- Will the production be dependent on imported (scarce) resources or raw materials?
- Is the product intended to be a mass product or only with a limited number? Is "production on demand" an option?
- Will the production require the use of hazardous substances, e.g. by sealing the surface of the product?
- Will the way the product is produced affect the amount of waste that is generated, e.g. by only a small part being cut-off from a big block of a material?
- Can the production waste be reduced or minimized (or avoided altogether) and/or used as secondary material (within the production itself, but also by other companies)? Especially for scarce materials, this can take pressure of the natural resources – reusing waste or its components as secondary material avoids new extraction of virgin materials.

EXERCISE 4

Can you think of cases where a change at the sourcing, manufacturing and distribution phase made a difference?

Here are some examples from the case studies to help you get started:

- Frosch products consist of regionally grown natural resources that are harvested and transported to the production site regionally (see case study Frosch – Werner & Mertz (DE), p. 18).
- Instead of producing new laptops, Zebra is refurbishing used ones – replacing broken parts and checking them thoroughly before selling them again (see case study Zebra (SK), p. 23).
- By optimizing their packaging, Iskraemeco was able to optimize their distribution. They also integrate recycled plastics into their production process instead of new plastics (see case study Iskraemeco (SL), p. 24).

Exercise 4: Look at the manufacturing phase in the workshop/self-study with the worksheet provided in chapter 5.2. The case studies show examples for changes made at the manufacturing phase – you are invited to discuss whether these changes took the change far enough and how they affected the whole product.

MOVECO cross-references: Please also have a look at the MOVECO "Checklist to support SMEs" in the section "manufacturing & supply chain", available at www.interreg-danube.eu/moveco

2.6. PRODUCT USE PHASE

When dealing with the product use phase, it is important not only to look at the intended use of the product. It is necessary to examine whether it is likely that its users will use it in another way and/or for another purpose. In a linear economy, there is an incentive to use products in rapid succession, quickly replacing them with newer models. In a circular economy, the time span for the use of a product is extended (theoretically, to indefinite). This can be done by creating multiple-use products or products that can be down- or upcycled easily. In addition, products in a circular economy can be repaired and/or shared easily. As an interlink to the next phase end-of-life, it is also important to look at the options users have to recycle the product – in regard to access to recycling facilities, how easy it is to understand how and where it can be recycled.

Important questions to ask at the product use phase are:

- How can the lifetime of the product be extended? How can the warranty/maintenance be extended?
- Can the product be shared with others (sharing potential) or turned into a service?
- Can the product be used in any other way than intended, can it be down- or upcycled?
- Can the use of the product be adapted?
- Can the product be repaired (easily)?
- Is there a take-back or return system in place?
- Can the product be refurbished or remanufactured?

EXERCISE 5

Can you think of cases where a change at the product use phase made a difference?

Here are some examples from the case studies to help you get started:

- Zebra Computers renovates old electrical devices by cleaning, running stress tests and, if necessary, changing battery or hardware. The result is 100% technical condition of the old device which is ready for the next use (see case study Zebra (SK), p. 23).
- To extend the use time of their product and enable customers to repair and update parts, Fairphone has designed the first modular smart phone and supplies parts individually (see case study Fairphone, p. 21).
- Instead of owning their routers, Telekom customers lease them and return them for free for recycling when they no longer need them – Telekom thus has replaced a product with a service (see case study Telekom (DE), p. 19).

Exercise 5: Look at the product use phase in the workshop/self-study with the worksheet provided in chapter 5.3. The case studies show examples for changes made at the product use phase – you are invited to discuss whether these changes took the change far enough and how they affected the whole product. Have a look at the best practices to see some examples for implementation.

MOVECO cross-references: Please also have a look at the MOVECO "checklist to support SMEs" in the section "product properties & usage & end of life", available at www.interreg-danube.eu/moveco

2.7. END-OF-LIFE PHASE

In the traditional, linear economy, the end-of-life phase is the last phase of a product. After this phase, the product is disposed of in the linear economy. In contrast, the circular economy aims at closing the loop by bringing the product or its components (or part of the components) back into the cycle. This can be the case by **re-integrating it in the original loop** (same product) or by **integrating it into another loop** (other product or process). In the circular economy, the end-of-life phase is not considered the end phase, but as the beginning of a new cycle. Not all materials can be recycled to an indefinite extent and kept in the loop forever – **for those** that **phase out of the cycle(s),** circular economy aims at avoiding the final disposal at all if possible, since landfilling creates huge problems to environment and society. If the materials are incinerated, it is important to employ energy and heat recovery schemes (and of course, proper air filtration as well as safe deposits of the bed ashes). Moreover, here is another **link back to the product design phase** and the **production process**: we should avoid creating products that partially or entirely will end up in landfills by choosing other materials or production processes (e.g. avoiding compounds that cannot be recycled). If possible, materials that phase out should be recycled or recovered. If this is not possible, they should be incinerated with energy and heat recovery, so that the energy and heat generated can be used for other processes.

Important questions to ask at the end-of-life phase are:

- What is the reuse potential of the product? Can it be reused in a similar way or another way (up- or downcycling)?
- How does the recycling potential of the product and its individual components look like?
- Can the material or components of the product be re-integrated into the production process (same product) or integrated into another production process (new product) e.g. as secondary material?
- If the products or materials need to phase out: can they be incinerated with energy use and heat recovery? Can landfilling be avoided? If they need to be landfilled, are they stable and can be landfilled in a safe landfill according to current legislation?

EXERCISE 6

?

Can you think of cases where a change at the end-of-life made a difference?

Here are some examples from the case studies to help you get started:

- Trigema chose the Cradle to Cradle® approach for their CHANGE® collection. It is closely modelled on the natural systems with closed material cycles. The organic garments including all materials used for the production are recyclable and 100% compostable in an ecologically

safe way. Thus the end-of-life is not the end, but actually a new beginning (see case study TRIGEMA, p. 31).

- Established return schemes make it easier for the customer to return the product at the end of its life – for refurbishment and/or proper recycling (see case studies Telekom, p. 19 and Fairphone, p. 21).

Exercise 6: Look at the end-of-life phase in the workshop/self-study with the worksheet provided in chapter 5.4. The case studies show examples for changes made at the end-of-life phase – you are invited to discuss whether these changes took the change far enough and how they influenced the whole product. Have a look at the best practices to see some examples for implementation.

MOVECO cross-references: Please also have a look at the MOVECO "checklist to support SMEs" in the section "product properties & usage & end of life" and at the MOVECO » FACT SHEET CIRCULAR ECONOMY: TERMNS AND DEFINITIONS « in the section on waste management & recycling" for more information at www.interreg-danube.eu/moveco

2.8. CONCLUSION / TAKE-HOME-MESSAGES

The section new material pathways of the MOVECO toolbox has shown that it is important to examine all aspects of a product's life-cycle(s) to find out where improvements and changes can be made. It has become clear that there are huge interdependencies at all phases, where already a small adaptation can result in a big change. It has become clear that there are no clear-cut black and white decisions, but that individual decisions have to be made. By looking at examples and getting creative, new material pathways can be found – using the same or different materials. Even though it will not be possible to do a complete shift from linear to circular with existing products, it will be possible to close some of the loops and find connections where there were none before, to keep materials in circulation for a longer time.

3. NOTES

3.1. FOR TRAINERS: HOW TO WORK WITH THIS SECTION IN THE WORKSHOP

The material of the new material pathways section of the MOVECO toolbox is designed in a modular way, so that you can tailor the workshop to the SMEs in the audience and the time available. Here is how:

1) Go through the **PowerPoint** presentation and choose the examples you would like to include and remove the others from the presentation. Make sure you also read the "notes for trainers" notes that are included in the notes of the presentation (below the slides in the notes view) to prepare your session.

2) Select the matching **case studies** from the handbook to work with in the workshop.

3) Prepare your **introductory lecture**; you can use the information from the notes in the presentation as well as from the handbook. In addition, there are links and reading recommendations that can help you. You may choose to direct your participants/readers to those for further reading at the end of the workshop as well.

4) Prepare the **basic outline for the discussion** of the case studies (starting questions, time frame, etc.) and start the discussion with the participants. Then make sure to step back a little and encourage the discussion among the participants. You may choose to take notes yourself for a concluding summary or assign the task to the group members.

5) Direct the participants to their own **analysis with the empty worksheet templates**, encouraging them to get creative and think outside the box. Make sure you stress that there are no "wrong" answers, but that this is an exercise for coming up with new ideas and possibilities – which naturally do not all lead to success eventually. Be ready to assist and answer questions. Depending on the background of the participant, this can be done in individual work time or as group work – decide.

6) Give the participants enough time to **sum up** their own analysis and then encourage them to **present** it to the group. Make sure the group respects the individual ideas by stressing again that this is about creative ideas and not "right" or "wrong", invite them to add comments or suggestions to the individual contributions.

7) Finish the session with the **quiz**, point to **additional reading** and take up **comments and suggestions** (also to improve further editions of the workshop)

8) Do not forget to ask the participants for an **evaluation** with the evaluation form.

3.2. FOR WORKSHOP PARTICIPANTS AND SELF-STUDY READERS: HOW TO WORK WITH THIS SECTION IN THE WORKSHOP OR ON THEIR OWN

There are **two ways** that you can work with this section of the MOVECO toolbox. Here is how:

In a workshop

The material of the new material pathways section of the MOVECO toolbox is designed in a modular way, so that the trainer will put together a workshop that is tailored to the audience and guide you through it. This section of the toolbox is hands-on, which means that will be plenty of room for **discussions** and **bringing in your own ideas**. The focus is on the creative process to come up with new ideas and creative solutions – there are no "right" or "wrong" answers, so please **contribute lively** with your own ideas and suggestions. We encourage you to **take notes** in case you want to come back to the material later. The handbook in the end will serve as your repository, where you can look up information and find suggestions for **further reading**.

Self-study

If you do not have the possibility to attend a workshop, you can nevertheless use the materials provided for self-study and find out all about material pathways for yourself. It is suggested that you proceed in the following order and take notes as you go along.

1) Read the **introduction** in the handbook
2) Look at the **presentation** with all the examples
3) Go back to the handbook and read the background information provided for each **case study** (or a selection, as you with).
4) Take an empty **worksheet template** to look at your product or production process (or, if you do not have an own example, choose one that you are somewhat familiar with). Read through the section of the handbook that explains the individual phases in chapter 2 and follow the guiding questions set there in the exercises and on the worksheet templates. The aim here is to get creative and think outside the box – just go ahead!
5) Look at the **further readings** section and the links to dig deeper into the topic

It would be a good idea to find somebody to team up with and discuss your findings – either via skype or in person. You can also try to set up your own mini-workshop by using the notes for the trainers above to guide you.

4. CASE STUDIES

In the following, there are several case studies for selection to work with in the workshop to foster discussion or in individual study to learn more. The examples chosen are from six categories and several countries of the Danube region (and in one case, a neighbouring country).

4.1. PACKAGING

- Landpack (DE)
- Frosch (DE)

4.2. ELECTRONICS

- Telekom (DE)
- Fairphone (NL)
- Zebra (SK)
- ROWENTA (SK)
- Iskraemeco (SI)

4.3. AGRICULTURE

- Brocker Möhren (DE)

4.4. CONSTRUCTION

- Ecopanely (CZ)
- HMCon / SK-Tex (SK)

4.5. TEXTILES

- Trigema (DE)
- Qnature (DE)

4.1. PACKAGING

PACKAGING – LANDPACK (DE)

LANDPACK GMBH, PUCHHEIM, GERMANY – WWW.LANDPACK.DE

Landpack has an established solution for replacing styrofoam by their straw products which are made of 100 % renewable resources.

Furthermore, Landpack has an eye on the amount of straw taken out of the agriculture so that no ecological disadvantages can occur.

Adaptations made at the product design phase by developer/engineer

- Insulation
- Shock absorption
- Moisture-regulating
- Comparable thermal conductivity values as styrofoam – but less expensive and more environmentally friendly
- 100% renewable resources
- 100% natural product, no additives
- Disposal in organic waste

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- Straw as a side product from regional farmers
- No competition with food production
- Minimal primary energy consumption
- Climate-neutral production
- Negligible water consumption
- 70% less shipping and storage volume

Adaptations made at the use phase, including adaptations by consumers

- Insulation material from straw
- Upcycling straw for pets, in the garden, for seat cushion etc.

Adaptations made at the end-of-life phase, including waste collection/recycling

- Biodegradable (DIN EN 13432)
- Disposal in organic waste/garden → closing the humus loop
- Good heating value if disposed in the residual waste

PACKAGING – FROSCH (DE)

FROSCH – WERNER & MERTZ GMBH, MAINZ, GERMANY – WWW.FROSCH.DE

Frosch cleaning products follow the Cradle to Cradle® principle by closing the loop from resource origin to the recycling of the packages

Adaptations made at the product design phase by developer/engineer

- Product recipes are as environmentally friendly as possible by using natural, regionally grown ingredients
- Product recipes contain no microplastic
- The PET packaging is 100% recycled plastic, 20% of which is from the "Recyclate-Initiative" Yellow Sack source (initiative for using recycled materials as secondary resource)
- Standard sizes of product packaging minimizes producton waste and material use
- Three basic materials used: PET, cardboard, glass

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- Water treatment and –reuse
- Sewage water treatment
- Energy saving in production process and use of renewable energy
- Environmental management system (DIN ISO 10001, EMAS)
- Renewable, plant based raw materials (grown in the region with biodiversity concept)
- Raw material use is continually optimized for product recipes
- Rezyklat Initiative: recycled PET material is used as secondary resource to produce new PET packaging (no crude oil), using post consumer recyclat

Adaptations made at the product use phase, including adaptations by consumers

- Refill packaging
- Dialogue with consumers / blog with tipps for correct product use (less product waste) and tipps for upcycling (DIY)
- Consumer awareness: no harsh chemicals needed for cleaning and care – natural ingredients do the job as well
- Standardized sizes but larger quantities available upon request

Adaptations made at the end-of-life phase, including waste collection/recycling

- Rezyklat Initiative closes the loop, PET becomes secondary resource instead of secondary fuel for incineration plants
- Under development: product labels that are fit for the circular-economy (close a loop)
- Three basic materials used mean that they can be collected and recycled in pure fractions: higher recycling rate
- Reuse possible (re-fill)

4.2. ELECTRONICS

ELECTRONICS – TELEKOM (DE)

TELEKOM DEUTSCHLAND GMBH, BONN, GERMANY, WWW.TELEKOM.DE

The examples by Telekom show how business models change when circular economy principles are put into consideration – service models can replace ownership, product repair services help to prolong product life.

Adaptations made at the product design phase by developer/engineer

- Modular, easy to disassemble, repair and re-manufacture phones were taken into the program (e.g. Fairphone)
- Construction of routers with sturdier material and switch to lease instead of ownership model (service instead of product)

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- Use of recycled materials if possible
- Use of conflict-free resources

Adaptations made at the product use phase, including adaptations by consumers

- Facilitation of legitimate second-hand markets for used phones (includes proper data removal), example: second hand phones by Telekom/Congstar
- Campaigns for increasing the resource efficiency awareness in consumers and businesses
- User-friendly collection systems and increased communication efforts: returns must be made easier and more attractive, will then lead to higher recycling quotas for small IT / ICT devices and better recycling
- Easier repair: partnership with Reparando, who offer a service to come to the home (or business) of the user to repair the phone at the spot → repair becomes easy and convenient
- Routers: lease instead of ownership, free take-back or exchange to newer model (mail envelope/code provided)
- Currently only German ICT company awarded with the official sign "Blauer Engel" ("blue angel") of Germany that certifies environmentally friendly products – makes it possible for consumers to easily recognize and decide for an environmentally friendly alternative

Adaptations made at the end-of-life phase, including waste collection/recycling

- One of the leading companies in take-back schemes for smart phones that were bought at Telekom: since 2003, more than 2.6 million devices were collected (the most successful take-back scheme in Germany)
- Collected devices were either reused or properly recycled
- "Handysammelcenter" online platform for free collection and proper recycling of other smart phones, joint initiative with other cooperation partners, donations from the sale of refurbished phones (or recycling) to NGOs and charitable organizations

ELECTRONICS – FAIRPHONE (NL)

FAIRPHONE B. V, AMSTERDAM, THE NETHERLANDS4, WWW.FAIRPHONE.COM

For their mobile smart phones, Fairphone follows a modular approach that allows easy disassembly and repair and prolongs the life-time of the phone. In addition, Fairphone aims at minimizing conflicts at resource extraction (mines in jurisdiction of government apply environmental standards) and manufacturing while at the same time trying to improve the labour conditions of the workers.

Adaptations made at the product design phase by developer/engineer

- Durable materials to extend the life-time of the phone
- Modular product design: parts can be exchanged, replaced, upgraded and customized easily by user to also extend the life-time of the phone
- Affordable spare parts makes it easy to decide for replacement of individual parts and self-repair instead of switching to a completely new phone if only a component is not working any more

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- Use of fair source materials from conflict-free mineral supply chains
- Establishment of initiatives for conflict-free supply chains e.g. Conflict-Free Tin Initiative (has involved into a full traceability program that is now accessible for the whole electronics industry) or joining of initiatives for responsible sourcing from conflict-free mines (e.g. Solutions for Hope for tantalum or joint initiative with Wolfram Bergbau and Hütten AG for tungsten, as well as Fair Trade for gold)
- Supply chain transparency combined with initiatives to improve good working conditions (safe working environment, fair wages, working hours, representation of workers) and assessments rather than audits to make joint improvements with suppliers and overcome challenges

Adaptations made at the product use phase, including adaptations by consumers

- Modular product design means that users have more control over their smart phone – it can be opened easily and most parts can be repaired and/or exchanged
- The durable case and modular product design mean that the users can use their phone longer without compromising the technical updates – for example the phone can be upgraded with a new and better camera (only the camera module needs to be exchanged, not the whole phone is replaced)

Adaptations made at the end-of-life phase, including waste collection/recycling

[4] Fairphone is not from a country adjacent to the Danube region but it was the first and best example for a modular phone design

- Reuse is encouraged: spare parts are sold and repair tutorials are offered to enable remanufacture and re-sale of the phones
- Take-back program ensures the proper recycling of the phones (including monitoring of the environmental impact and working conditions at the recycling sites)
- Modular product design also means modular disassembly: parts can be recycled better since they can be separated into the original components more easily than in conventional phones
- Partnerships with local partners to make improvements to local collections and helping countries that lack formal and safe recycling options (Responsible E-waste Recycling, Closing the Loop in Rwanda and Uganda, Recell Ghana in Ghana for collection, proper recycling in Belgium)
- European Phone Recycling Program with Teqcycle to encourage donations of old phones to be safely recycled or reused
- Recycled materials re-enter into the world market as recycled materials
- New business models are explored for the service and ownership of the phones

ELECTRONICS – ZEBRA (SK)

ZEBRACOMP NLC, S.R.O., STARÉ HORY, SLOVAKIA– WWW.ZEBRACOMP.SK

Zebra Computers provides products such as laptops or PCs that are bought from corporate companies mostly from Western Europe and undergo the process of renovation. The resulting product has even better performance than a new product with similar price. At the same time, it saves energy for the production of a new device.

Adaptations made at the product design phase by developer/engineer

- Renovation of old electronic devices
- Only the best-quality brand models are refurbished
- Products imported from Western Europe have been used by multinational companies or by one user only, which ensures quality before the next phase

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- Stress tests of the device´s performance
- Cleaning
- 100% technical condition
- Battery or other compomnents change/hardware update in case of bad condition
- Adjustment of the keyboard to local (Slovak) conditions
- Classification of products within 3 categories according to device´s look condition

Adaptations made at the product use phase, including adaptations by consumers

- Transparency in providing information about the condition of the devices
- New 24 months guaranty with the possibility to extend it up to 4 years
- Low price compared to a new device with similar performance
- Other partner distributors in Slovakia
- Fast warranty service
- Environmental awareness raising and other CSR activities

Adaptations made at the end-of-life phase, including waste collection/recycling

- “Old” devices get a “new life” with a new 24 months guaranty (= used again instead of recycled right away or thrown away)
- Standard performance of the obligations within the EPR schemes for WEEE

ELECTRONICS – ROWENTA (SK)

ROWENTA TEFAL (GROUPE SEB), ECULLY, SLOVAKIA –WWW.GROUPESEB.COM

Groupe SEB has been working for over ten years to develop eco-intelligent products. In this ecodesign approach, Rowenta analyzes the life cycle of its products, continuously searching for possible environmental optimizations at each phase.

Adaptations made at the product design phase by developer/engineer

- Products are designed to be easily repaired, dismantled and reassembled
- Product design with a limited number of materials to facilitate the sorting ofwaste
- Large number of parts is stored separately in order to repair at the lowest cost (for 10 years on average after purchase)
- Modifications based on operational feedback to ensure that the new generation of products is even easier to repair
- Certification - "Repairable Product 10 years"

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- Vacuum cleaner Silence Force 4A – 92% rate of potential recyclability
- 100% of the new Rowenta vacuum cleaners meet new energy saving and efficiency standards and go beyond
- Silence Steam generator – made from recycled household appliances, containing up to 40% recycled material
- The case of steam generator irons is entirely made out of recycled material
- Optimalization of the flow of the recycled raw material supplied to the production plants

Adaptations made at the product use phase, including adaptations by consumers

- Commitment to repair electrical products for up to 10 years
- Reasonable costs of repairing
- 6,500 professional repaires around the world

Adaptations made at the end-of-life phase, including waste collection/recycling

- 79% of the products can be recycled
- Complete circular economy cycle implementation[5] in cooperation with R&D team from Veolia (France)

[5] https://www.eco-systemes.fr/en/all-about-eco-systemes

- Under a completely closed-loop circular economy, the waste electrical and electronic equipment (WEEE) collected by Éco-systèmes (an organization that represents household appliance manufacturers in France) is recovered as recycled raw materials by Veolia, which is then used by SEB to produce new appliances sold in stores. This tripartite approach has led to the closed-loop recycling of WEEE plastics, in particular through the sale of a range of Rowenta brand (SEB group) steam generator irons, which use approved recycled polypropylene.

ELECTRONICS – ISKRAEMECO (SI)

ISKRAEMECO, D.D., KRANJ, SLOVENIA – WWW.ISKRAEMECO.COM

Smart electricity meters digitalisation and modular product design for the circular economy!

Adaptations made at the product design phase by developer/engineer

- Modular design
- Exchanging hazardous chemicals with less hazaradous ones
- Systems approach through lifecycle assessment
    - Design for extended life span: 20 years
    - Lower self consumption of energy, the meter uses less energy for its own operation
    - Increased material efficiency, smaller lighter meters
    - Less conflict materials
- Latest project: Communication with plastic recycling facilities to adopt recycled plastics if material specifications can be met

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- Accountability, supplier benchmarking
- Resource traceability, transparent supply chain
- Material and energy effciency optimisation
- Lean production, continuous improvement over the last three years:
    - Water consumption ↓ 28%
    - Energy consumption ↓ 25%
    - CO_2 emissions ↓35%
    - Waste ↓24% as calculated per product unit
- Appr. 70% of the product mass is supplied by local suppliers
- New packaging solution resulting in appr. 25% increase of individual shipment load, packaging 100% recyclable – 50% less carton packaging
- Logistics: transport supplier must comply with EURO 6 standards

Adaptations made at the product use phase, including adaptations by consumers

- Increased durability
- Adaptabilty
- Interoperability
- Upgradeability
- Reversed flows – information/improved relationships with buyers

Adaptations made at the end-of-life stage, including waste collection/recycling

- Easy disassembly
- Recyclability
- Reversed flows – recycled materials

4.3. CONSTRUCTION

CONSTRUCTION – EKOPANELY (CZ)

EKOPANELY SERVIS S.R.O., PŘELOUČ, CZECH REPUBLIC - WWW.EKOPANELY.COM

100% ecological product from bio-based source (straw), fully recyclable (closed loop), while having better insulation properties than traditional products.

Adaptations made at the product design phase by developer/engineer

- 100% ecological product - ecological and vapour permeable construction boards – that has similar properties when compared to traditional insulation (e.g. glass wool): heat accumulation, acoustic absorption, high mechanical resistance, vapour permeable, insulation properties, thermal stability, energy savings, fire resistance

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- Sourcing: made from natural materials (straw coming from regional farmers) and recycled materials (recycled cardboard)
- Production without using hazardous substances: straw pressed at high temperatures and under high pressure to create a core of compressed straw using no bonding agents and enclosed using recycled cardboard
- Negative carbon footprint ensured by the low CO_2 emission production process

Adaptations made at the product use phase, including adaptations by consumers

- Eco boards cope better with fast changes in temperature and therefore save on heating costs
- Life-time of the product: dry straw pressed to form a panel can last for up to 100 years
- Can be used for internal partition walls, ceiling construction, cladding and also for all exterior work
- Easy to install - using the eco board systems reduces on-site construction time, which leads to significant savings in any construction projects

Adaptations made at the end-of-life phase, including waste collection/recycling

- Offcuts and scraps from the eco boards without surface treatment are recyclable and can be used to produce new eco boards
- Used eco boards can be returned back to the company for recycling
- Waste eco boards are compostable or used as natural heating fuel

CONSTRUCTION – SK-TEX & HMCON (SK)

SK-TEX S.R.O., BRATISLAVA, SLOVAKIA – WWW.SK-TEX.COM
HMCON SLOVAKIA, S.R.O., TRNAVA, SLOVAKIA – WWW.HMCON-SLOVAKIA.SK

In an industrial symbiosis, SK-Tex and HMCon turn (industrial) textile waste into insulation for a dry construction system. Thus, the waste from one industry is turned into a resource for another in order to create insulated dry construction boards as new product (which is again recyclable).

Adaptations made at the product design phase by developer/engineer

- Although different materials are used, the end product (insulated dry construction boards) is similar to traditional products by design and properties (thickness, high sound insulation, fire resistance; in addition: improved thermal-insulation when compared to traditional insulations such as glass wool)
- The (industrial) textile fibers are specially treated (mold-resistant and fire-retardant) and then combined with heavy acoustic rubber so that the new dry construction system has the same properties as comparable, traditional systems
- Designed in a way that it is easy to disassemble later on

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- Instead of traditional insulation for dry construction systems (such as mineral wool), the waste from another industry (industrial textiles) is recycled and turned into resources
- By using a secondary raw material, no primary raw materials have to be used (saving resources). Also, waste is avoided in the first industry/loop since it is integrated in a second industry/loop and turned into a new product
- Eco-friendly production techniques, no harsh chemicals
- The manufacturing process is more energy efficient when compared to traditional processing technologies of comparable, traditional products

Adaptations made at the product use phase, including adaptations by consumers

- Can be used like any other, traditional dry construction boards; life-time of product is determined by life-time of the building
- Easy to repair/replace components in case of damage

Adaptations made at the end-of-life phase, including waste collection/recycling

- Take-back-system: partition walls can be brought back to the company or established collection sites for recycling
- The recycled materials are then used again to produce the same product/components up to four times (closed loop)

4.4. AGRICULTURE

AGRICULTURE – BROCKER MÖHREN (DE)

BROCKER MÖHREN GMBH & CO.KG, WILLICH-SCHIEFBAHN, GERMANY – WWW.BROCKER-MOEHREN.DE

With its zero waste carrot production, Brocker Möhren shows how food wastes during harvesting can be successfully avoided and how 99% of the harvest can be marketed by diversified use of by-products with the help of improved harvesting and processing techniques.

Adaptations made at the product design phase by developer/engineer

- Diversification of product range
- Primary products: 90% for the food sector
    - Carrots
    - Cut carrots for salads
- Secondary products:
    - Special marketing for small carrots
    - Juice
    - Animal feed
- By-product: 1% of harvest goes to biogas plant

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- Environmentally-friendly carrots processing
    - Multiple water cycles and reprocessing of service water
    - Environmentally friendly cooling systems and coolants
    - Regular inspections of production facilities regarding energetic aspects
- Logistics
    - Photovoltaics on the buidlings of the logistics centre
    - Trainings for environmentally-friendly, low emission und anticipatory, economic driving
    - Special tyres of delivery trucks to reduce noise and friction of resistance
    - 80 – 90% space utilisation of the full truck load
- Sustainable agriculture
    - Demand-based fertilisation, rotation systems to avoid monoculture, soil protection (cross-compliance criteria)
    - Targeted application of plant protection products through GPS-based precision farming ("use only as much products as necessary, as little as possible")

Adaptations made at the product use phase, including adaptations by consumers

Brocker Möhren's policy can improve the visibilty of imperfect vegetables by selling small carrots. Apart from that, as it is a fresh product, Brocker Möhren has limited influence on the consumer's consumption patterns.

Adaptations made at the end-of-life phase, including waste collection/recycling

- Packaging
    - Unnecessary packaging is avoided
    - Use of lightweight packaging
    - Reuse and maintenance of wood storage boxes and other reusable systems for storage and transport
- Avoiding food waste at producer side
- 100% processing of planted carrots: 99% goes to food, juice, salad or animal feed industry, 1% is processed in a biogas plant

4.5. TEXTILES

TEXTILES – TRIGEMA (DE)

TRIGEMA INH. W. GRUPP E.K., BURLADINGEN, GERMANY – WWW.TRIGEMA.DE

The Trigema CHANGE® collection is closely modelled on the natural systems with closed material cycles. The organic garments including all materials used for the production are recyclable and 100% compostable in an ecologically safe way.

Adaptations made at the design phase by developer/engineer

- Design of CHANGE® collection based on the Cradle to Cradle® concept
- Material health: no use of harmful (toxic) substances/colorants; scientific research to find suitable "positive", biocompatible substances to use for coloring and manufacturing processes
- Material reutilisation: shirt incl. biodegradable yarn is fully recyclable, compostable
- Renewable energy and carbon management

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- The organic cotton's journey for the CHANGE® collection:
  - Growing and harvesting in Turkey;
  - Ginning, purification, combing and spinning takes place in Greece
  - Knitting and manufacturing 100% in Germany.
- Preservation of natural resources by organic cotton production in Turkey (environmental sustainability)
  - Soil fertility (bovine dung, crop rotation, mixed cultivations, lower yields)
  - Water stewardship for drinking water: Reduction of water consumption, taking the climatic conditions into account, natural precipitation, if necessary drip irrigation
  - Waste water treatment in the manufacturing companies
  - Avoid textile waste/offcuts thanks to a specialised IT-programme to optimize fabric use
- Code of Conduct (social sustainability)
  - Fair working conditions and labour rights
  - Financial security and higher profitability for farmers
- Low production costs (economic sustainability)
  - No expenses for mineral fertilizer, plant protection products
  - Higher sales prices for organic quality
- Long-term supply contracts (stable prices and volumes)

Adaptations made at the product use phase, including adaptations by consumers

- Consumer health aspects:
    - Organic cotton without any harmful substances
    - No uptake of harmful (toxic) substances from clothing through physical contact
- Buying fair and locally manufacture clothing helps
    - Safeguarding European jobs
    - Minimizing negative environmental impacts
- Showing alternatives to the fast fashion industry

Adaptations made at the end-of-life phase, including waste collection/recycling

The resources used for the production of the organic shirts can be reinserted in the natural nutrient cycles after the end of the product life.

TEXTILES – TRIGEMA (DE)

QNATURE UG, HEMMINGEN, GERMANY – WWW.QMILKFIBER.EU

Biopolymer granulate/film, fibres and cosmetics based on non-food milk (polymer milk protein casein): Qmilk is a very good example for thinking outside the box in order to substitute conventional raw materials with renewable raw materials and waste.

Adaptations made at the product design phase by developer/engineer

- New/different resource
- Waste as a resource
- Renewable raw materials
- Free of solvents, plasticizer and adimids
- Flame retardant fibres (fire protection class B2 according to DIN 4102-1 and DIN 75200)
- Naturally antibacterial fibres
- Compostable (DIN EN 14119)
- Chemical resistance
- Fibres with smooth surface (ideal for people with sensitive skin)
- Fibres regulating climate

Adaptations made at the manufacturing phase by the manufacturer/service provider, including sourcing

- Made out of milk which is not suitable for food use (and usually has to be disposed expensively as unused secondary waste otherwise)/discarded milk
- Water- and energy-efficient, zero-waste spinning process of Qmilk fibres

Adaptations made at the product use phase, including adaptations by consumers

- Biopolymers (granulate, film)
- Fibres (textile, yarn, felt, nonwovens, paper, composite, wipes, spunlaces, …)
- Cosmetics (microbeads, creams, …)

Adaptations made at the end-of-life phase, including waste collection/recycling

- Qmilk fibres are
  - compostable (DIN EN 14119),
  - biodegradable in compost after a few weeks, and
  - break down free of residues within a few months

5. TEMPLATES OF WORKSHEETS

In the following, there are four empty worksheet templates for the participant/readers to work with in the workshop or individually – to be filled out.

The circular economy model will be dissected into individual phases: product design, sourcing/manufacturing/distribution, product use and end-of-life – following the green MOVECO circle, which you also find in the presentation and the brochure. Those will serve as starting points to talk about the participant`s own current product situation. By examining each phase, the discussion should show some opportunities to move from the linear to the circular economy model. It will not be possible to shift to the circular model completely in all cases, but it should provide a starting point to familiarize themselves with the concept of the new circular economy, get creative about the current material use, and discover new material pathways for their own materials used and/or other materials they can incorporate.

Circular Economy Toolbox
New Material Pathways – Worksheet

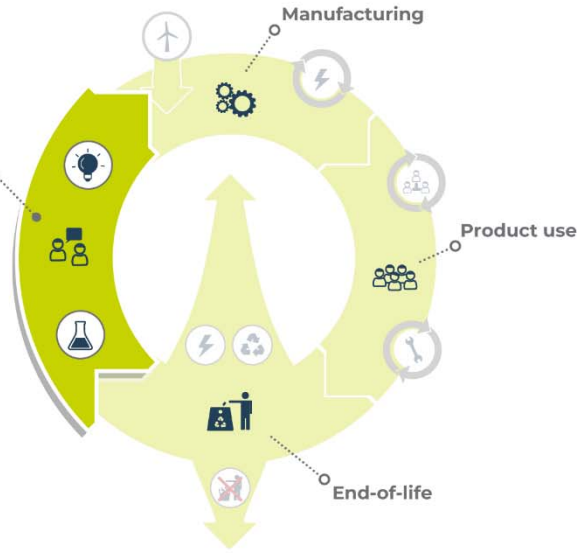
Interreg
Danube Transnational Programme
MOVECO

Product design

1 Think outside the box at the development stage:

Product design for the future – focus not only on the product development itself but also on

- the resources (energy and materials) used for production and their environmental footprint use of land, water, air, pollution (noise, toxic substances), impact on climate
- the recycling potential
- the possibilities to repair and to extend product lifetime
- the opportunities to reuse
- the possibility to sell a service instead of a product
- and think ahead to the production process



Case study – describe your product:

Current situation

resources / footprint	recycling potential	repair potential	reuse potential
•	•	•	•
•	•	•	•
•	•	•	•

Potential future situation

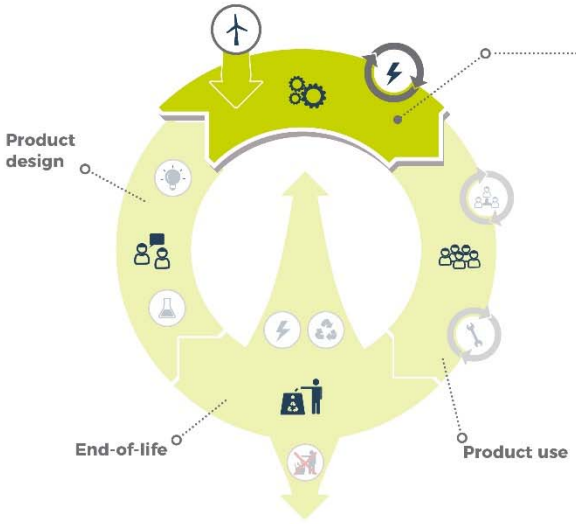
resources / footprint	recycling potential	repair potential	reuse potential
•	•	•	•
•	•	•	•
•	•	•	•

Project co-funded by European Union funds (ERDF, IPA) | www.interreg-danube.eu/moveco

5.2. MANUFACTURING

Circular Economy Toolbox
New Material Pathways – Worksheet

Interreg
Danube Transnational Programme
MOVECO



Manufacturing

2 Think integrated – when planning or examining the production process, consider:

- the sourcing of the energy and material resources
- the possibility to increase resource efficiency (energy, materials) and to use secondary resources in the production process
- the condition of the production site (impact on environment through water, energy use or emissions)
- the process itself
- the distribution

Case study – describe your production:

Current situation

sourcing	condition site	process	distribution
•	•	•	•
•	•	•	•
•	•	•	•

Potential future situation

sourcing	condition site	process	distribution
•	•	•	•
•	•	•	•
•	•	•	•

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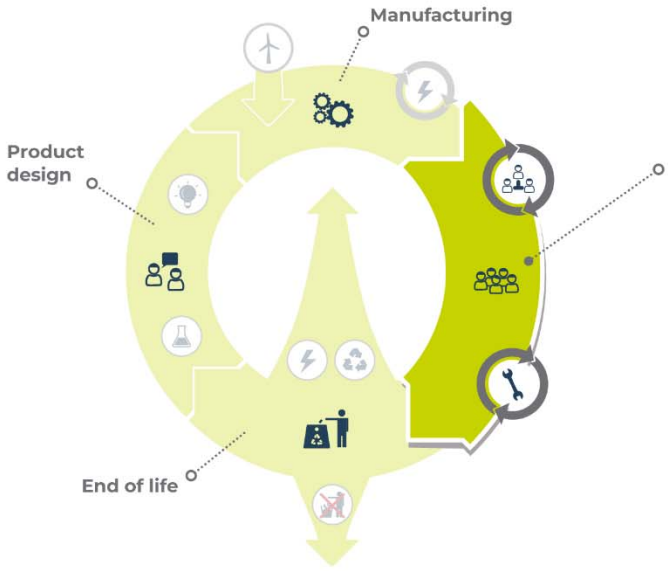
5.3. PRODUCT USE

Circular Economy Toolbox
New Material Pathways – Worksheet

Interreg
Danube Transnational Programme
MOVECO



Product use

3 Think ahead – anticipate possible uses for the product next to the original intended purpose, including:

- repair potential
- sharing potential
- upcycling potential
- recycling potential (access, actual recycling in next step)

Case study – describe your product:

Current situation

repair potential	sharing potential	upcycling potential	recycling potential
•	•	•	•
•	•	•	•
•	•	•	•

Potential future situation

repair potential	sharing potential	upcycling potential	recycling potential
•	•	•	•
•	•	•	•
•	•	•	•

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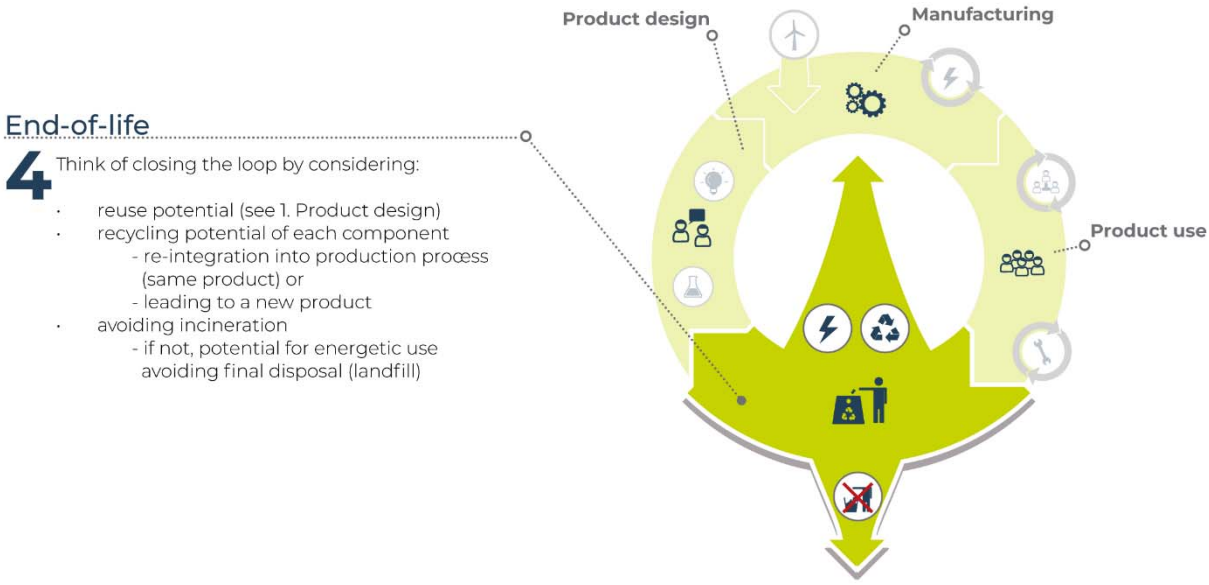
5.4. END-OF-LIFE

Circular Economy Toolbox
New Material Pathways – Worksheet

Interreg
Danube Transnational Programme
MOVECO



Case study – describe the end-of-life of your product:

Current situation

recycling potential	re-integration	new product	energetic use	incineration without energy recovery / final disposal avoided?
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•

Potential future situation

			Aim: avoiding	
recycling potential	re-integration	new product	energetic use	final disposal/incineration
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•

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6. QUIZ

6.1. QUIZ – QUESTIONS

This quiz can be used at the end of the workshop to check whether the key content has been understood and to sum up the most relevant take-home-messages. At some questions there are multiple right answers.

Why can a life-cycle assessment help when thinking about material use?

☐ It helps to look at each phase of a product's life cycle phase and examines what material properties are needed and how the material can be reused or recycled in the end

☐ It is useful to find out which material is best for an attractive design

☐ It is useful to see how much it will cost to recycle the product

Why is it necessary to look at the advantages and disadvantages of materials before making a choice? Because…

☐ … it is possible to save money by using cheap materials

☐ … it is always better to use bio-based material

☐ … there is no single answer and the advantages and disadvantages have to be weighed against each other

Is it important to start at the design phase when thinking about material use?

☐ No, the material only makes a difference when it needs to be recycled

☐ Yes, it is important to use the best replacement materials (bio-based) to create a green image for the product

☐ Yes, the way a product is designed will impact the material used and determine whether the product can be disassembled into parts that can be recycled or recycled entirely

How do manufacturing and sourcing impact the choice of the material?

☐ Some materials are more difficult to obtain and/or need special treatment at the manufacturing phase. This will mean that the production is more expensive.

☐ The origin of the raw materials might increase the CO_2 footprint of the product because of long transport routes

☐ The raw materials might be cultivated on areas that might otherwise be used for food – this might result in a competition for land and affect another cycle

☐ The manufacturing process needs to be examined because it can be optimized in terms of use of energy and water and waste and sewage water need to be recycled to close a loop at that phase already

How can consumers influence the product use phase in a positive way?

☐ Consumers can get creative and use the product in other ways than originally intended

☐ Consumers can take good care of the product so that they can pass it on for somebody else to use

☐ Consumers do not matter – it is big corporations who have an interest in producing many products that have a short life and have to be thrown away anyway

What possible options are there at the end-of-life phase for a product?

☐ It is best if all products end up in landfills or are incinerated ("out of mind, out of sight")

☐ Products can be reused or passed on to other people to use them in the intended use

☐ Products can be upcycled or downcycled

☐ Products can be repaired or be refurbished

☐ Products can be recycled entirely or in parts

6.2. QUIZ – SOLUTIONS

Why can a life cycle assessment help when thinking about material use?

☑ It helps to look at each phase in the life of the product and examine what material properties are needed and how the material can be reused or recycled in the end

☐ It is useful to find out which material is best for an attractive design

☐ It is useful to see how much it will cost to recycle the product

Why is it necessary to look at the advantages and disadvantages of materials before making a choice?

☐ Because it is possible to save money by using cheap materials

☐ Because it is always better to use bio-based material

☑ Because there is no single answer and the advantages and disadvantages have to be weighed against each other

Is it important to start at the design phase when thinking about material use?

☐ No, the material only makes a difference when it needs to be recycled

☐ Yes, it is important to use the best replacement materials (bio-based) to create a green image for the product

☑ Yes, the way a product is designed will impact the the material is used and determine whether the product can be disassembled into parts that can be recycled or recycled entirely

How do manufacturing and sourcing impact the choice of the material?

☐ Some materials are more difficult to obtain and/or need special treatment at the manufacturing phase. This will mean that the production is more expensive.

☐ The origin of the raw materials might increase the CO2 footprint of the product because of long transport routes – so there will be a negative image for the product in the end and it cannot be used for green marketing

☑ The raw materials might be cultivated on areas that might otherwise be used for food – this might result in a competition for land and impact another cycle

☑ The manufacturing process needs to be examined because it can be optimized in terms of use of energy and water and waste and sewage water need to be recycled to close a loop at that phase already

How can consumers influence the product use phase in a positive way?

☑ Consumers can get creative and use the product in other ways than originally intended by upcycling or downcycling it

☑ Consumers can take good care of the product so that they can pass it on for somebody else to use

☐ Consumers do not matter – it is big corporations who have an interest in producing many products that have a short life and have to be thrown away anyway

What possible options are at the end-of-life phase for a product?

☐ It is best if all products end up in landfills or are incinerated ("out of mind, out of sight")

☑ Products can be reused or passed on to other people to use them in the intended use

☑ Products can be upcycled or downcycled

☑ Products can be repaired or be refurbished

☑ Products can be recycled entirely or in parts

7. EVALUATION FORM

This brief evaluation form can be used by the trainer for feedback at the end of the workshop. It can serve to improve further editions of this workshop and/or identify needs for follow-up and/or further training (depending on audience).

Your feedback, please!

We would like to know your opinion about the workshop, in order to improve following workshops and – if you like – to provide additional information and/or support. Please answer the evaluation form and hand it back to the trainer at the end of the session or leave it on your desk when you leave the workshop.

1. How did you like the topics of the workshop?

☐ Excellent ☐ Well ☐ Adequate ☐ Mediocre ☐Bad

2. Will you be able to apply the content in your company/ for your professional surroundings?

☐ Yes ☐ Somewhat ☐No - If no, please state why

3. Which of the discussed topics did you find particularly interesting?

4. Which of the discussed topics did you find least interesting?

5. Were there topics that have not been addressed? Which you would like to have included in this section?

6. What is your feedback on the trainer?:

Qualification

☐ Excellent ☐ Well ☐ Adequate ☐ Mediocre ☐ Bad

Knowledge

☐ Excellent ☐ Well ☐ Adequate ☐ Mediocre ☐ Bad

Interaction

☐ Excellent ☐ Well ☐ Adequate ☐ Mediocre ☐ Bad

7. Is there any additional feedback you would like to give?

8. Would you like to be informed about similar trainings in the future?

☐ Yes ☐ No

9. Is there additional information you would like to receive? If so, please include your contact data (name, company, email) here.

Thank you for your feedback.

8. GLOSSARY

Bio-based material: **"“Bio-“is Greek for life. Bio-based material refers to a products main constituent consisting of a substance, or substances, originally derived from living organisms. These substances may be natural or synthesized organic compounds that exist in nature. This definition could include natural materials such as leather and wood, but typically refers to modern materials. Many of the modern innovations use bio-based materials to create products that biodegrade. Some examples are: cornstarch, derived from a grain and now being used in the creation of packaging pellets; bio-plastics created with soybean oil, now being used in the creation of many modern products like tractors, water bottles, and take away cutlery." [6] Biodegradable material: “A material which microorganisms can break down into natural elements (i.e. water, biomass, etc.).”[7]**

Biological metabolism: The natural processes of ecosystems are a biological metabolism, making safe and healthy use of materials in cycles of abundance[8]

Biological nutrient: A material used by living organisms or cells to carry on life processes such as growth, cell division, synthesis of carbohydrates and other complex functions. Biological Nutrients are materials that can biodegrade safely and return to the soil to feed environmental processes[9]

Cascading: see MOVECO fact sheet “Circular Economy: Terms & Definitions”

Compostable material: “Materials that can be disposed with biological materials and decay into nutrient-rich material.“[10] Circular economy - regenerative economy in which resource input and waste, emission, and energy leakage are minimized by slowing, closing, and narrowing energy and material loops

Cradle-to-Cradle®: see MOVECO fact sheet “Supporting Tools for a Circular Economy”

Cradle to Grave: “A Cradle to Grave system is a linear model for materials that begins with resource extraction, moves to product manufacturing, and, ends with a “grave” – when the product is disposed of in a landfill or incinerator”[11]

Decision: “shall be binding in its entirety. A decision which specifies those to whom it is addressed shall be binding only on them”[12]

Directive: “shall be binding, as to the result to be achieved, upon each Member State to which it is addressed, but shall leave to the national authorities the choice of form and methods”[13]

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[6] https://sustainabilitydictionary.com/2006/02/17/bio-based-material/ (26.03.2018) // “A material that is partially, or entirely made of biomass.” https://www.ceguide.org/Glossary (26.03.2018)

[7] https://www.ceguide.org/Glossary (26.03.2018)

[8] Cradle to Cradle terminology – MBDC-http://www.c2cproducts.com/detail.aspx?linkid=1&sublink=26

[9] Cradle to Cradle terminology – MBDC-http://www.c2cproducts.com/detail.aspx?linkid=1&sublink=26

[10] https://www.ceguide.org/Glossary (26.03.2018)

[11] Cradle to Cradle terminology – MBDC-http://www.c2cproducts.com/detail.aspx?linkid=1&sublink=26

[12] European Network of Environmental law Organizations 2012 Implementation of the Waste Framework Directive in the EU Member States

[13] European Network of Environmental law Organisations 2012 Implementation of the Waste Framework Directive in the EU Member States

Down-cycle: to recycle (something) in such a way that the resulting product is of a lower value than the original item : to create an object of lesser value from (a discarded object of higher value)[14] see: MOVECO fact sheet "Circular Economy: Terms & Definitions"

Eco-effectiveness: "The central strategy in the cradle-to-cradle development method and seeks to create industrial systems that emulate healthy natural systems. The central principle of eco-effectiveness is that "waste equals food." The concept was developed in response to some of the perceived limitations of eco-efficiency which critics claim only slow down the rate of environmental depletion and don't reverse the production of unused or non-recycled waste".[15]

Eco efficiency: "Management philosophy that aims at minimizing ecological damage while maximizing efficiency of the firm's production processes, such as through the lesser use of energy, material, and water, more recycling, and elimination of hazardous emissions or by-products."[16]

Ecological sustainability: "a bio-centric school of sustainability thinking that, based on ecology and living systems principles, focuses on the capacity of ecosystems to maintain their essential functions and processes, and retain their biodiversity in full measure over the long-term contrasts with technological sustainability based on technical and engineering approaches to sustainability"[17]

Ecosystem: the interactive system of living things and their non-living habitat[18]

Ecosystem redesign: a coherent framework for redesigning our landscapes, buildings, cities, and systems of energy, water, food, manufacturing and waste through the effective adaptation to and integration with nature's processes[19]

Energy efficiency: "Energy efficiency improvements refer to a reduction in the energy used for a given service (heating, lighting, etc.) or level of activity. The reduction in the energy consumption is usually associated with technological changes, but not always since it can also result from better organization and management or behavioral changes ("non-technical factors")."[20]

Energetic use: incineration of waste material that includes the use of the generated heat and energy for other processes

(Final) disposal: see MOVECO fact sheet "Circular Economy: Terms & Definitions"

Incineration: Waste destruction in a furnace by controlled burning at high temperatures. Incineration removes water from hazardous sludge, reduces its mass and/or volume, and converts it to

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[14] Merriam Webster dictionary

[15] https://sustainabilitydictionary.com/2005/12/03/eco-effectiveness/visited 26/02/2018

[16] http://www.businessdictionary.com/definition/eco-efficiency.html -visited 01.03.2018

[17] Orr D (1992) Ecological literacy: education and the transition to a post-modern world. State University of New York Press, Albany.

[18] Tansley AG (1935) The use and abuse of vegetational concepts and terms. Ecology 16:284–307 doi:10.2307/1930070

[19] with adaptations from https://www.researchgate.net/publication/301966198_Regenerative_Development_regenerative_development_and_Design (26.06.2018)

[20] https://hub.globalccsinstitute.com/publications/energy-efficiency-recipe-success/definition-and-scope-energy-efficiency (26.03.2018)

a non-burnable ash that can be safely disposed of on land, in some waters, or in underground pits. However, it is a highly contentious method because incomplete incineration can produce carbon monoxide gas, gaseous dioxins, and/or other harmful substances.[21]

Innovation: production or adoption, assimilation, and exploitation of a value-added novelty in economic and social areas[22]

Landfilling: "The disposal and burying of solid waste. The degradation of the waste results in the creation of local air and water pollution."[23]

Lean production: approach to management that focuses on cutting out waste, whilst ensuring quality[24]

Life-cycle: series of stages in form and functional activity through which a system passes between successive recurrences of a specified primary stage[25]

Life-cycle analysis: see MOVECO fact sheet "Supporting Tools for a Circular Economy"

Life-time: the duration of the existence of a given particular system[26]

Locational patterns: the patterns that depict the distinctive character and potential of a place and provide a dynamic mapping for designing human structures and systems that align with the living systems of a place[27]

Negative externality: occurs when production and/or consumption imposes external costs on third parties outside of the market for which no appropriate compensation is paid[28]

Optimization: finding an alternative with the most cost effective or highest achievable performance under the given constraints, by maximizing desired factors and minimizing undesired ones[29]

Permaculture: a system of agricultural and social design principles centered around simulating or directly utilizing the patterns and features observed in natural ecosystems[30]

Place: the unique, multi-layered network of ecosystems within a geographic region that results from the complex interactions through time of the natural ecology (climate, mineral and other deposits, soil, vegetation, water and wildlife, etc.) and culture (distinctive customs, expressions of values, economic activities, forms of association, ideas for education, traditions, etc.)[31]

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[21] http://www.businessdictionary.com/definition/incineration.html (27.06.2018)
[22] with adaptations from http://www.ericshaver.com/the-many-definitions-of-innovation/ (27.06.2018)
[23] https://www.ceguide.org/Glossary (26.03.2018)
[24] with adaptations from https://www.tutor2u.net/business/reference/introduction-to-lean-production (27.06.2018)
[25] https://www.merriam-webster.com/dictionary/life%20cycle (26.06.2018)
[26] With adaptations from https://en.wikipedia.org/wiki/Lifetime (26.06.2018)
[27] https://www.researchgate.net/publication/273379786_Regenerative_Development_and_Design (25.06.2018)
[28] with adaptations from https://www.economicshelp.org/micro-economic-essays/marketfailure/negative-externality/ (26.06.2018)
[29] http://www.businessdictionary.com/definition/optimization.html (26.06.2018)
[30] https://en.wikipedia.org/wiki/Permaculture (27.06.2018)
[31] https://www.researchgate.net/publication/273379786_Regenerative_Development_and_Design (25.06.2018)

Recommendations and opinions: shall have no binding force [32]

Recycling: see MOVECO fact sheet "Circular Economy: Terms & Definitions"

Refurbishment: "The refurbishment of something is the act or process of cleaning it, decorating it, and providing it with new equipment or facilities."[33]

Regenerative design: a system of technologies and strategies, based on an understanding of the inner working of ecosystems that generates designs to regenerate rather than deplete underlying life support systems and resources within socio-ecological wholes[34]

Regenerative development: a system of technologies and strategies for generating the patterned whole system understanding of a place, and developing the strategic systemic thinking capacities, and the stakeholder engagement/commitment required to ensure regenerative design processes to achieve maximum systemic leverage and support, that is self-organizing and self-evolving[35]

Regulation: shall have general application. It shall be binding in its entirety and directly applicable in all Member States. – Source - Article 288 TFEU,[36]

Remanufacturing: "The process of cleaning and repairing used products and parts to be used again for replacements."[37]

Restorative design: sometimes called restorative environmental design; a design system that combines returning polluted, degraded or damaged sites back to a state of acceptable health through human intervention[38]

Resource efficiency: "A percentage of the total resources consumed that make up the final product or service."[39]

Reuse: see MOVECO fact sheet "Circular Economy: Terms & Definitions"

Secondary resource/ secondary raw materials: "Waste materials that are recovered, recycled and reprocessed for use as raw materials."[40]

Servitization: refers to industries using their products to sell "outcome as a service" rather than a one-off sale[41]

Source to sink: simple linear flows from resource sources (farms, mines, forests, watershed, oilfields, etc.) to sinks (air, water, land) that deplete global sources and overload/pollute global sinks[42]

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[32] http://eur-lex.europa.eu/summary/chapter/environment.html?root_default=SUM_1_CODED%3D20,SUM_2_CODED%3D2003&locale=en

[33] https://www.collinsdictionary.com/de/worterbuch/englisch/refurbishment (26.03.2018)

[34] Mang, Pamela & Reed, Bill. (2017). Update Regenerative Development and Design 2nd edition.

[35] https://www.sciencedirect.com/science/article/pii/S2212609015300327 (26.06.2018)

[36] http://eur-lex.europa.eu/legal-content/en/TXT/HTML/?uri=CELEX:12016E288

[37] https://sustainabilitydictionary.com/2005/12/03/remanufacturing/ (26.03.2018)

[38] https://www.researchgate.net/publication/273379786_Regenerative_Development_and_Design (24.06.2018)

[39] https://sustainabilitydictionary.com/2005/12/03/remanufacturing/ (26.03.2018)

[40] https://sustainabilitydictionary.com/2005/12/03/remanufacturing/ (26.03.2018)

[41] https://www.k3syspro.com/servitization/ (24.06.2018)

[42] https://www.researchgate.net/publication/273379786_Regenerative_Development_and_Design (25.06.2018)

Stewardship: ethic of companies, organizations and individuals that embodies the responsible planning and management of resources[43]

Sourcing: "the act of getting something, especially products or materials, from a particular place"[44]

System thinking: holistic approach of analysis and planning that focuses on the way the parts of a system interrelate each other and how systems work over time and within the context of larger systems[45]

Technical metabolism: "Modelled on natural systems, the technical metabolism is MBDC's term for the processes of human industry that maintain and perpetually reuse valuable synthetic and mineral materials in closed loops"[46]

Technical nutrient: "A material that remains in a closed-loop system of manufacture, reuse, and recovery called the technical metabolism, maintaining its value through infinite product life cycles "[47]

Upcycle: "to recycle (something) in such a way that the resulting product is of a higher value than the original item: to create an object of greater value from (a discarded object of lesser value)"[48]

Upcycling: see MOVECO fact sheet "Circular Economy: Terms & Definitions"

Waste: see MOVECO fact sheet "Circular Economy: Terms & Definitions"

More: https://www.ceguide.org/Glossary

[43] https://en.wikipedia.org/wiki/Stewardship (24.06.2018)
[44] https://dictionary.cambridge.org/dictionary/english/sourcing (26.03.2018)
[45] https://searchcio.techtarget.com/definition/systems-thinking (27.06.2018)
[46] Cradle to Cradle terminology – MBDC-http://www.c2cproducts.com/detail.aspx?linkid=1&sublink=26
[47] Cradle to Cradle terminology – MBDC-http://www.c2cproducts.com/detail.aspx?linkid=1&sublink=26
[48] Merriam Webster dictionary

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Further reading / links

MOVECO documents

- MOVECO 2017. Brochure "Your trash is my treasure". http://www.interreg-danube.eu/approved-projects/moveco/section/best-practice
- MOVECO 2018. Checklist to support SMEs. http://www.interreg-danube.eu/uploads/media/approved_project_output/0001/18/d80bd307d6bb83b4d1afe341dae0b177a96a2259.pdf
- MOVECO 2018. Fact Sheet - Supporting Tools for a Circular Economy. http://www.interreg-danube.eu/uploads/media/approved_project_output/0001/14/572a016a8d386225c44c5870f4cb3188461d299b.pdf
- MOVECO 2018. Fact Sheet - Circular Economy: Terms and Definitions http://www.interreg-danube.eu/uploads/media/approved_project_output/0001/14/b61410d76c124dcc94d55ff624be01f53972e29f.pdf
- MOVECO 2018. Fact Sheet - Information on Circular Economy. http://www.interreg-danube.eu/uploads/media/approved_project_output/0001/14/b61410d76c124dcc94d55ff624be01f53972e29f.pdf

EU circular economy key documents

- Circular Economy - Implementation of the Circular Economy Action Plan http://ec.europa.eu/environment/circular-economy/index_en.htm

- Towards a circular economy https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/towards-circular-economy_en
- Circular economy https://ec.europa.eu/growth/industry/sustainability/circular-economy_en
- Circular economy - overview http://ec.europa.eu/eurostat/web/circular-economy

EU plastics strategy key documents:

- EU Strategy for plastics in the Circular Economy - brochure ec.europa.eu/environment/circular-economy/pdf/plastics-strategy-brochure.pdf
- Factsheets on the strategy for plastics in a circular economy https://ec.europa.eu/commission/publications/factsheets-european-strategy-plastics-circular-economy_en
- Factsheet - changing the way we use plastics ec.europa.eu/environment/waste/pdf/pan-european-factsheet.pdf

Case studies:

- Landpack: www.landpack.de
- Frosch: www.frosch.de, www.frosch.de; https://ganzheitlich-nachhaltig.de/, https://werner-mertz.de/ and information provided by the press contact of Werner & Mertz GmbH.
- Qnature: www.qmilkfiber.eu
- Rowenta: www.groupeseb.com
- Zebra: www.zebracomp.sk
- Iskrameco: www.iskraemeco.com
- Telekom (DE): www.telekom.de, plus information sent by the contact for information and sustainability, presentation »Ressourceneffizienz in einer digitalen Welt – kann Mobilfunk auch nachhaltig sein?« (»Resource efficiency in a digital world – can mobile communication be sustainable after all?«) given at the forum in the context of the German Resource Efficiency Prize in January 2018 in Berlin.
- Fairphone (NL): www.fairphone.com, https://www.fairphone.com/en/about/press/?ref=footer, plus information as provided their German PR agency Muxmäuschenwild.
- Brocker Möhren: www.brocker-moehren.de
- Ekopanely: www.ekopanely.com
- HMCon: www.hmcon-slovakia.sk
- SK-Tex: www.sk-tex.com
- Trigema: www.trigema.de
- Qnature: www.qmilkfiber.eu

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