### MOVECO Toolbox

### NEW MATERIAL PATHWAYS

DATE, PLACE, COUNTRY

NAME OF PRESENTER, ORGANIZATION



### Aims of this tool

Raising awareness about current material use and possible alternatives Assessing current (linear) models of material use

Developing skills to move towards new material pathways with a more circular approach

Providing incentives for changing the way we think about material use in general

Stimulating openminded thinking for further work on the subject

NEW MATERIAL PATHWAYS

### Content of this tool

- Introduction to the topic: why we need to find new material pathways
- Material choice: looking at advantages and disadvantages
- Introduction of examples to illustrate the shift from linear to circular economy
- Introduction to the methodology used in this section of the training
- Introduction to the worksheets
- Guiding slides for group work
- Further information: literature and links

### Introduction to the topic – general information

It is not only environmentally friendly, but also economical to keep materials and resources in the system (loops) as long as possible It is not only about protecting the planet, it is also about growing your business – and saving money, too!

Different materials have different characteristics - it depends on the use and/or re-/up-/downcycling) which material makes sense for a product

Not all new materials are "good" – and not all wellknown materials are "bad"

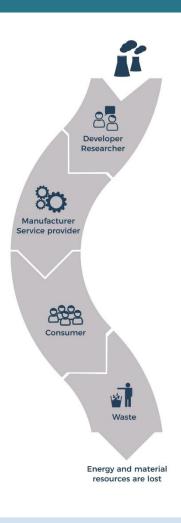
### Introduction to the topic – general information

design

manufacturin g

use

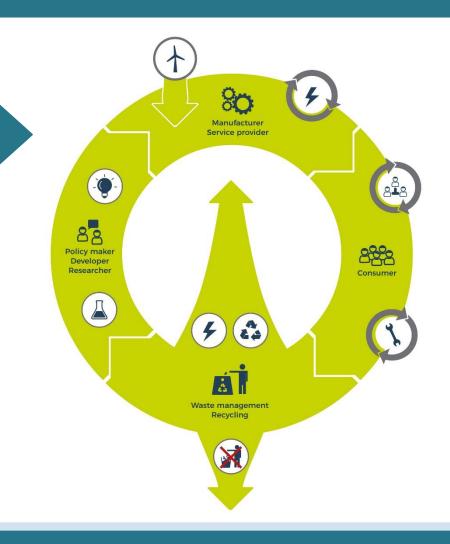
end-of-life



Linear vs. circular –

What are the phases?

Where do we loose material/resources?



### Introduction to the topic - design

design

manufacturin 9

use

end-of-life

- · Design impacts the materials used and consequently the possibility to recycle or reuse at the end of life of the product
- · The intended use of the product needs to be reflected in the design
- The material chosen will impact the production process, including energy and water use and production waste
- ... it is all connected! Circular economy thinks in loops and although a new product idea frequently begins at the design phase, it is not really the "first" phase at all but a good starting point – for example with a life-cycle analysis

### Introduction to the topic - manufacturing



manufacturin g

use

end-of-life

#### Focus needs to shift

- from product production only to include sustainable sourcing (environmental impacts, economic aspects, working and social conditions)
- to production site (energy efficiency, heat and water (re)use, emission reduction, material flows and waste management)
- to distribution and logistics (transport distances, packaging, mode of transport)

Circular economy examines other, connected systems as well, and takes into account impacts that might transfer from other systems

### Introduction to the topic - use

design

manufacturin g

use

end-of-life

The linear economy focuses on single, intended uses and quick product successions, moving rapidly through resources, materials and products

The circular economy focuses on multiple, alternative uses and new business models, keeping resources, materials and products in the loop

- Products are designed from components that can be taken apart in order to recycle or refurbish
- Services take the place of products, sharing instead of ownership
- Upcycling and downcycling give new lives to products

### Introduction to the topic – end-of-life

design

manufacturin 9

use

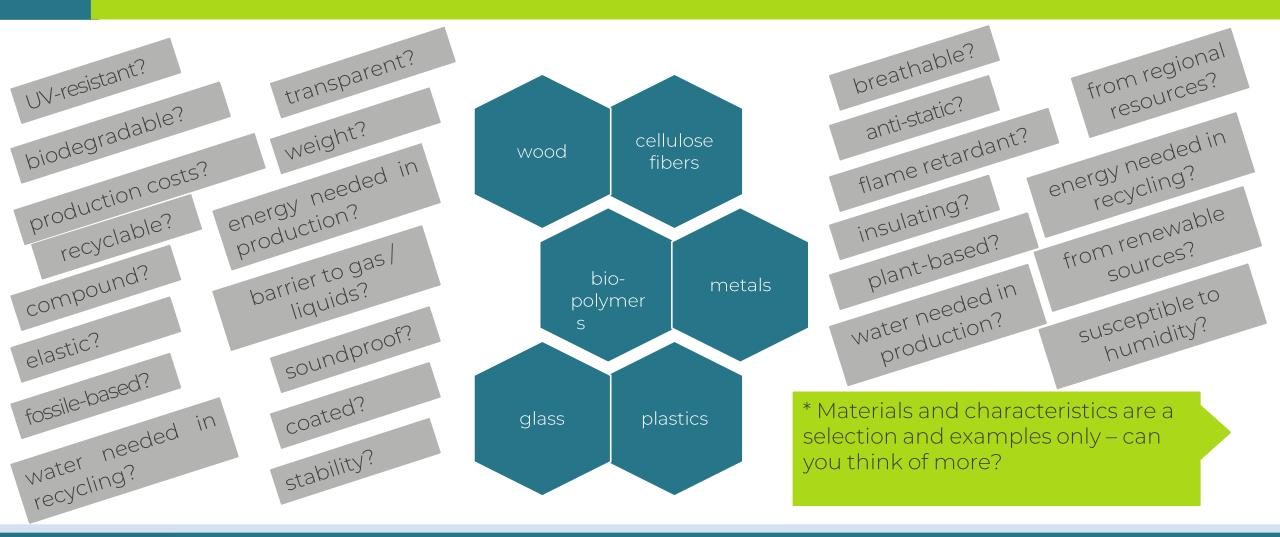
end-of-life

In the linear economy, the motto seems to be "out of mind, out of sight" (make-use-dispose)

In the circular economy, the traditional "end-of-life" of the product is not the end, but rather a new beginning

- Reuse, re-/up-/downcycling of components or whole product
- · (Re)integration into in the original loop (same product/process) or into another loop (new product/process), also as secondary material
- Avoiding landfilling at all costs, phasing out is still possible, choosing incineration as last means (and only with energy recovery)

# Make your choice: material selection\*





### Case studies

How can a product use materials differently?

How can the production process become more sustainable?

Which impact does the design of the product have?

Can waste turn into a new product?

Let's have a look at some case studies to get an idea...



### Case studies

#### Packaging

Landpack (straw replaces styrofoam)

Frosch (Cradle to Cradle®)

#### Electronics

Telekom (service instead of product)

Fairphone (component manufacturing)

Zebra (remanufacturing)

Rowenta (eco-design, life-cycle-approach)

Iskraemeco (service instead of product)

#### Construction

Ekopanely (fibres from renewable resources)

HMCon & SK-Tex (insulation from textile waste)

#### Agriculture

Brocker Möhren (99% use of natural product)

#### Textiles

TRIGEMA (Cradle to Cradle®)

Qnature (fibres from milk protein)

### Packaging trends and challenges

The packaging market is growing worldwide – despite instable raw material prices

Growing demand for the development of environmentally friendly materials, packaging designs and end-of-life processes to improve packaging sustainability

Packaging (esp. plastic) receives intense scrutinity along the supply chain

Innovations and new material pathways needed

## Case study: Packaging Landpack – straw replaces styrofoam



- Sustainable insulation packaging from straw – innovative, ecological, compostable
- Thermal packaging made of straw



Landpack GmbH Puchheim GERMANY www.landpack.de/en

Images: ©Landpack GmbH

### Case study: Packaging Straw replaces styrofoam

#### DESIGN

- Insulation and shock absorption, moistureregulating
- 100% natural product, no additives
- 100 % renewable resources
- Comparable thermal conductivity values as styrofoam – but less expensive and more environmentally friendly

#### USE

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

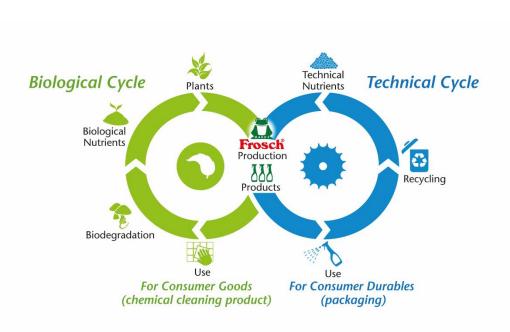
#### MANUFACTURING

- Straw as a side product from regional farmers (no competition with food production)
- Minimal primary energy and negligible water consumption
- Climate-neutral production

#### **END-OF-LIFE**

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

### Case study: Packaging Recyclable packaging by Frosch



- Cradle to Cradle®
   Take Produce and
   Use Reuse
- Closing biological and technological cycles
- Environmental focus and user awareness



Werner & Mertz GmbH Rheinallee 96 55120 Mainz GERMANY www.frosch.de

Images: ©Werner & Mertz GmbH



# Case study: Packaging Recyclable packaging by Frosch

#### DESIGN

- Product recipes environmentally friendly
- Standard packaging sizes minimize production waste and material use + only three basic materials (PET, cardboard, glass)
- Plastic packaging PET only can be recycled more easily (within own "Rezyklat Initiative")

#### USE

- Refill packaging
- Consumer dialogue/blog: tips for correct product use & DIY (upcycling)
- Standardized sizes but larger quantities available upon request

#### MANUFACTURING

- Sewage) water treatment and –reuse
- Energy saving in production + use of renewable energy
- Environmental management system (DIN ISO 10001, EMAS)
- Renewable, plant based raw materials

#### **END-OF-LIFE**

- PET becomes secondary resource
- Under development: product labels that are fit for the circular-economy (close a loop)
- Three basic materials: higher recycling rate
- Re-use possible (refill)



### Electronics trends and challenges

Production requires use of | Waste of electrical and scarce and expensive resources (e.g. around 10% i of gold worldwide), high energy consumption

Frequently: single-use, non-recyclable products

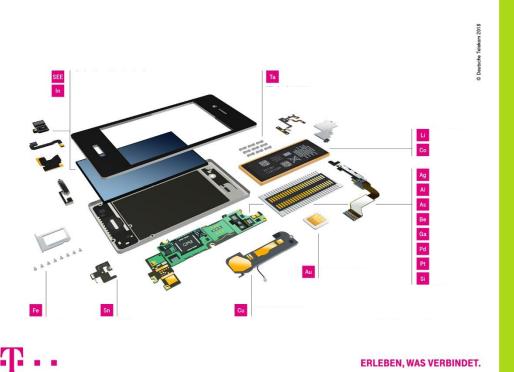
electronic equipment (WEEE) is one of the fastest growing waste streams in the EU (9 million tonnes in 2005, 12 million tonnes by 2020)

WEEE is a complex mixture of materials and compontents (hazardous content) - can cause major environmental and health problems

Material and resource recycling becomes more and more important



### Case study: Electronics Telekom – Recycling and reuse of mobile phones



Finding new material pathways for existing products

- Return system
- Recycling schemes
- Refurbishment for reuse
- Donations from reuse and recycling for social and environmental projects



Telekom Deutschland GmbH Bonn GERMANY www.telekom.de

Images: ©Telekom Deutschland GmbH

### Case study: Electronics Telekom – Recycle, reuse and lease electronics

- Modular, easy to disassemble, repair and remanufacture phones added(e.g. Fairphone)
- Construction of routers: sturdier material + lease instead of ownership (service instead of product)

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

- Facilitation of legitimate second-hand markets
- Campaigns: increasing awareness in consumers and businesses(return phones, return resources)
- User-friendly collection systems, easier repair (partnership with Reparando)
- Routers: lease, free take-back or exchange to newer model

- Take-back schemes for smart phones
- Collected devices either reused or properly recycled
- Joint initiative "Handysammelcenter" online platform for free collection and proper recycling (sale of resources = donation for charity)

### Case study: Electronics Fairphone – the first modular smartphone



- Modular design
- Production more environmentally friendly and socially more responsible
- Replacement of parts possible
- (self) repair possible
- Recycling possible



Fairphone B.V Amsterdam NETHERLANDS www.fairphone.com

Images: ©Fairphone BV

### Case study: Electronics Fairphone – the first modular smart phone

#### DESIGN

- Durable materials
- Modular design / components
- Affordable spare parts
- Movement to new business models

#### USE

 Control of user over phone: disassembly, repair, replacement/upgrade of parts

www.interreg-danube.eu/moveco

- Affordable spare parts
- Longer use possible

#### MANUFACTURING

- Sourcing from conflict-free origins
- Supply chain transparency
- Combination of environmental and social responsibility (incl. partner programs)

#### **END-OF-LIFE**

- Reuse encouraged
- Take-back and recycling programmes
- Proper recycling ensures re-entry of materials as resources for other phones or products

### Case study: Zebra Computers



- Existing product is refurbished
- Extended life by reuse
- Proper recycling of components



ZEBRACOMP nlc, s.r.o. Banská Bystrica SLOVAKIA www.zebracomp.sk

Images: ©ZEBRACOMP nlc, s.r.o.

### Case study: Electronics Zebra Computers – Refurbishmet

 Renovation of old electronic devices, replacement of non-functional parts

- Transparency in providing information about condition of devices
- New 24 months guaranty with the possibility to extend it up to 4 years
- Lower price compared to a new device (buying incentive)
- Environmental awareness raising

- Battery or other components change/hardware update in case of bad condition
- Replacement of non-functional parts
- Adjustment of the keyboard to local (Slovak) conditions

- "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

### Case study: Electronics Rowenta – Modular electronic products



- Life-cycle analysis
- Eco-design approach
- Environmental optimizations at each stage

ROWENTA (GROUPE SEB)
Czech Republic
www.rowenta.com/environ
mental-commitment

Images: ©ROWENTA (GROUPE SEB)

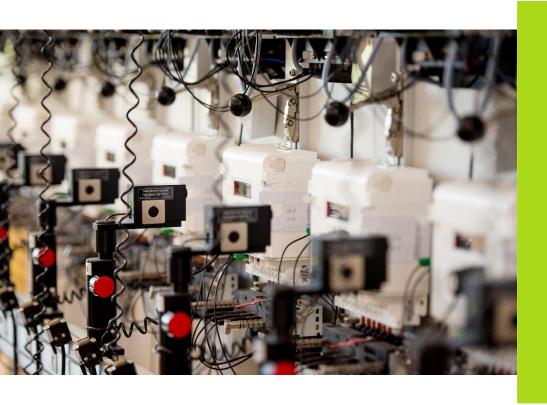
### Case study: Electronics Rowenta – Modular electronic products

- Designed to be easily repaired, dismantled and reassembled
- Product design with a limited number of materials to facilitate the sorting waste
- Spare parts stored separately allows repairs up to 10 years after purchase
- Modifications based on operational feedback so that the new generation of products is even easier to repair
- Commitment to repair electrical products for up to 10 years
- Reasonable costs of repairing
- 6,500 professional repair facilities around the world (= easy access for consumers)

- Use of recycled materials
- Optimization of the flow of the recycled raw material supplied to the production plants.
- Products meet new energy saving and efficiency standards

- 79% of the products can be recycled
- Complete circular economy cycle implementation (cooperation with waste management company)

### Case study: Electronics Iskraemeco – Recycling of electronics



 Smart electricity meters: digitalization and modular product design

> Iskraemeco, d.d. Kranj SLOVENIA www.iskraemeco.com

Images: ©lskraemeco, d.d.

### Case study: Electronics Iskraemeco – Recycling of electronics

#### **DESIGN**

- Modular design, project to include recycled plastics, less conflict materials
- Increased material efficiency, smaller lighter meters
- Design for Switch to less hazardous chemicals
- Lower energy consumption

#### USE

- Increased durability
- Adaptability
- Interoperability
- Upgradeability

#### MANUFACTURING

- Accountability, supplier benchmarking
- Resource traceability, transparent supply chain
- Lean production, continuous improvement of material, energy and water efficiency, waste reduction
- Packaging: 100% recyclable & allows increase in shipment load
- Logistics: transport supplier must comply with EURO 6 standards

#### **END-OF-LIFE**

- Extended life span: 20 years
- Easy disassembly
- Recyclability
- Reversed flows recycled materials

### Construction trends and challenges

Construction industry consumes about

- 1/2 of extracted materials
- 1/2 of energy consumption

Construction sector produces one third of total waste

EU objective: increase re-using, recycling & recovery of construction and demolition waste to min. of 70% (weight) by 2020

The construction industry is one of the most resource intensive industries in Europe

### Case study: Construction Ekopanely – Ecological construction materials



- Ecological vapour permeable construction panels
- Made from renewable resources (straw) and recycled materials (cardboard)
- Produced at high temperatures and under high pressure to create a core of compressed straw using no bonding agents



EKOPANELY SERVIS s.r.o.
Přelouč
CZECH REPUBLIC
www.ekopanely.com

Images: ©EKOPANELY SERVIS s.r.o.

### Case study: Construction Ekopanely – Ecological construction materials

#### **DESIGN**

- Construction boards made from renewable resources
- Recyclable, insulation properties
- Energy saving, fire resistance

#### USE

- Life-time of the product: up to 100 years
- Can be used for internal partition walls, ceiling construction, cladding and also for all exterior work
- Easy to install, which leads to significant savings in any construction projects, recyclable

#### MANUFACTURING

- Made from straw coming from regional farmers and recycled materials (recycled cardboard)
- Production without hazardous substances
- Negative carbon footprint ensured by the low CO2 emission production process

#### **END-OF-LIFE**

- Eco-boards without surface treatment are recyclable and can be used to produce new ecoboards
- Waste eco-boards are compostable or can be used as natural heating fuel

### Case study: Construction <u>HMCon & SK-Tex – insulation from textile waste</u>



- Dry construction system of acoustic partition walls developed jointly by the company HMCon and SK-TEX
- Construction boards produced by green technology, recycling textile waste



HMCon Slovakia s.r.o., Trnava SK-Tex s.r.o, Bratislava SLOVAKIA www.hmcon-slovakia.sl www.sk-tex.com

Images: ©HMCon Slovakia s.r.o. and SK-Tex s.r.o.

### Case study: Construction <u>HMCon & SK-Tex – insulation from textile</u> waste

#### **DESIGN**

- Different material used (textile waste) end product by design and properties similar to traditional product (thickness, high sound insulation, fire resistance)
- Plus: improved thermal-insulation to traditional product (e.g. glass wool)
- Designed in a way that it is easy to disassemble later on

#### USE

- 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

#### **MANUFACTURING**

- Waste from another industry (industrial textiles) is recycled and turned into resources (no primary raw materials need to be used – saves resources and avoids waste)
- Eco-friendly production techniques, no harsh chemicals
- Manufacturing process more energy efficient

#### **END-OF-LIFE**

- 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 again up to four times (closed loop)

### Food and agriculture trends and challenges

Increasing demand for food: growing world population, changing diets with growing wealth

88 million tonnes of food wasted annually in the EU (FUSIONS, 2016) – also water and energy, high emissions

Collaboration needed to prevent food waste – involve farmers, food manufacturers, retailers, consumers, restaurants, public authorities

Sustainable natural resource base is needed to make food systems more efficient and circular

### Case study: Food and agriculture Brocker Möhren – zero waste carrot production



- Zero waste carrot production
- 99% of the carrot
   harvest can be
   marketed by
   diversified use of by products thanks to
   improved harvesting
   and processing
   techniques

Brocker Möhren GmbH & Co.KG Willich GERMANY www.brocker-moehren.de

Images: ©Brocker Möhren GmbH & Co.KG

### Case study: Food and agriculture Brocker Möhren – zero waste carrot production

#### **DESIGN**

- Diversification of product range
- Primary products: Carrots
- Secondary products: Juice, animal feed
- Special marketing for small carrots

#### USE

 Brocker Möhren's marketing improves the visibilty of imperfect vegetables by selling small carrots (but difficult to influence consumer behavior during use phase)

#### MANUFACTURING

- Environmentally friendly processing: multiple water cycles, energetic efficiency, etc.
- Logistics: renewable energy sources for logistic centre
- Sustainable agriculture

#### **END-OF-LIFE**

- Avoiding unnecessary packaging, use lightweight packaging and reusable systems for storage and transport
- Avoiding food waste at producer side: 100% of carrots are processed; 99% are used in the food and animal feed sector, 1% goes to biogas plant

### Textile trends and challenges

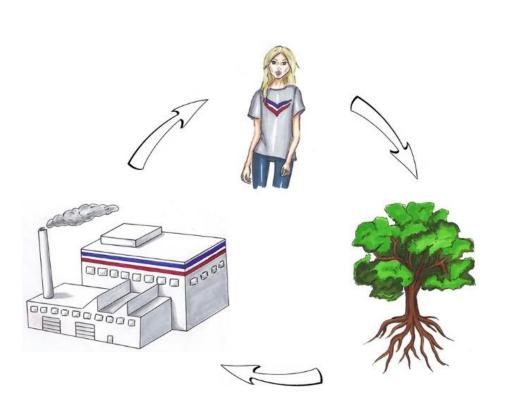
To produce 1 kg of cotton it takes about 10,000 litres of water (Mekonnen and Hoekstra, 2011)

Cotton growth accounts for 24% of global insecticide sales (WWF 2018) The lifecycle of clothes is accelerating (compared to 2000, 60% more clothes are bought today) and the clothes are worn half as long (Greenpeace, 2016)

73% of clothes are
landfilled or incinerated
and less than 1% of fibres
are recycled back into
clothing production (Ellen
MacArthur Foundation,
2017)

Fashion is considered as the second most polluting industry in the world

### Case study: Textiles TRIGEMA – 100% recyclable shirt



The organic garments including all materials used for the production of the TRIGEMA shirt are recyclable and 100% compostable in an ecologically safe way



TRIGEMA Inh. W. Gruppe.K. Josef-Mayer-Str. 31-35 72393 Burladingen GERMANY www.trigema.de

Images: ©TRIGEMA Inh. W. Grupp e.K.

### Case study: Textiles TRIGEMA – 100% recyclable shirt

#### DESIGN

- Based on Cradle to Cradle® concept
- Material health: no toxic substances/colorants
- Material reutilization: shirt/yarn fully recyclable/compostable

#### USE

- Consumer health aspect: organic cotton without any harmful (toxic) substances
- Buying fair and locally produced clothing helps safeguarding European jobs, protect the close and far environment, and shows alternatives to fast fashion industry

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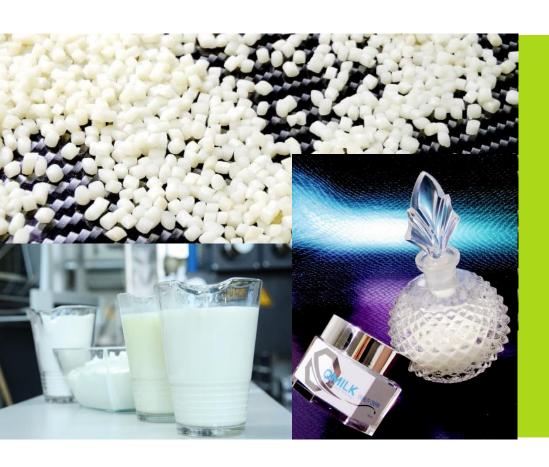
#### MANUFACTURING

- Environmentally friendly organic cotton production: soil fertility, water stewardship, waste water treatment, avoid textile wastes
- Code of Conduct: fair working conditions, labor rights and financial security for farmers
- Economic sustainability: no costs for mineral fertilizer and pesticides

#### **END-OF-LIFE**

- All resources used for the production of the organic shirts can be reinserted in the natural nutrient cycle after the end of the product life
- Fully compostable and biodegradable

### Case study: Textiles QMilk – Biopolymers based on renewable resources



- Biopolymers made out of the milk protein casein from non-food milk and renewable raw materials
- Biopolymer granulate/film – Fibres – Cosmetics



Qnature UG Hemmingen GERMANY <u>www.qmilkfiber.eu</u>

Images: ©Qnature UG

### Case study: Textiles QMilk – Biopolymers based on renewable resources

#### **DESIGN**

- Free of solvents, plasticizers and adimids
- Flame retardant, antibacterial, compostable (DIN EN 14119)
- Chemical resistance

#### USE

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

#### MANUFACTURING

- 100 % based on renewable raw materials and non-food milk
- Made out of milk which is not suitable for food use (and is expensively disposed so far as unused secondary waste)/discarded milk
- Water- and energy-efficient, zero-waste spinning process of QMILK fibres

#### **END-OF-LIFE**

- Compostable (DIN EN 14119)
- Breaks down free of residues

### Finding your new material pathways...

... by doing some detective work on your product, business model and processes

### Introduction to the methodology

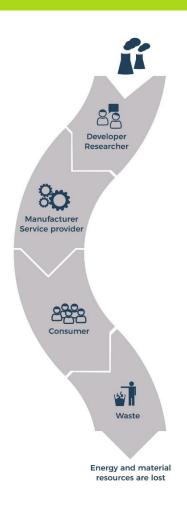
Taking the traditional process apart – by dissecting it into individual steps

Guiding questions to examine the traditional process, at each step Guiding questions to think about closing the loop, at each step

Comparison between status-quo and desired new, circular model Deduction of potential options for implementation

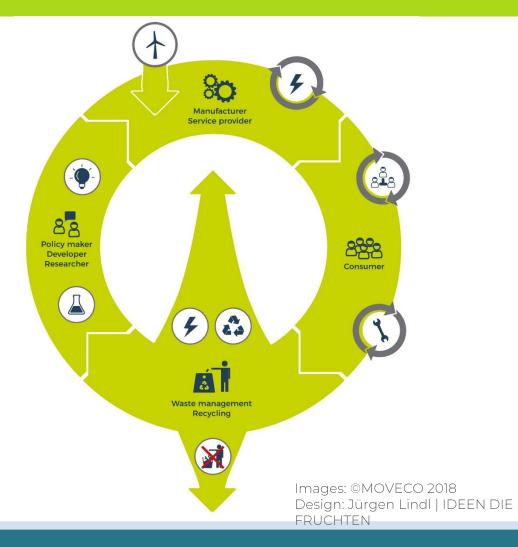
...with worksheets

### Two processes – linear vs. circular

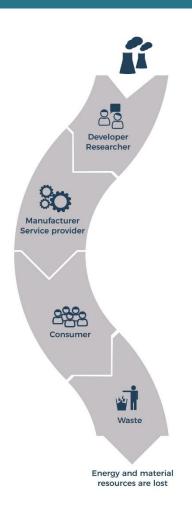


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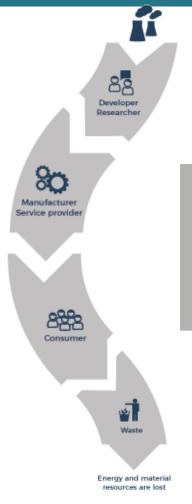
Get involved and think about creating new material pathways



#### Examination of current status



Step 1: Examination of the current status



Energy and material resources are lost

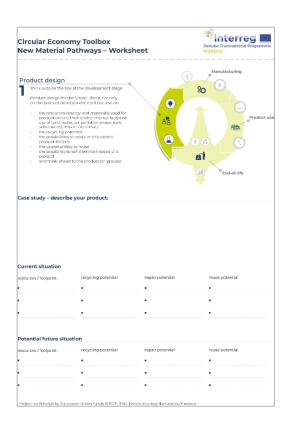
### Moving towards new material pathways

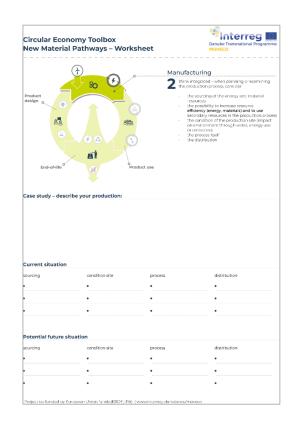


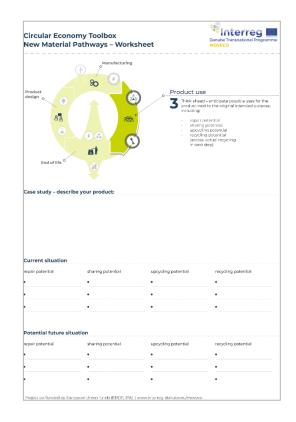
Step 2: Inspire new ideas by thinking outside the box to close the loop

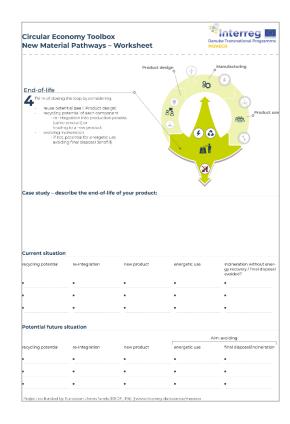


#### Introduction to the worksheets







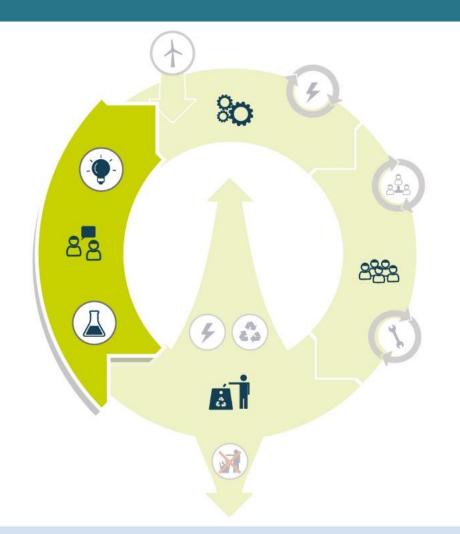




### Let's get started...

At each step, use the three power point slides provided in the following as introduction and guidance Group work on the worksheets (step by step) and discussions (at each step) Note down any questions, ideas and further remarks on a flip chart or an extra sheet of paper for the final discussion

### Product design phase – aims of this step



Think outside the box at the development phase: 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
- recycling potential
- possibilities to repair and to extend product lifetime
- opportunities to reuse
- possibility to sell a service instead of a product

... and think ahead to the production process



## Product design – group work & discussion



Case study

Describe your product

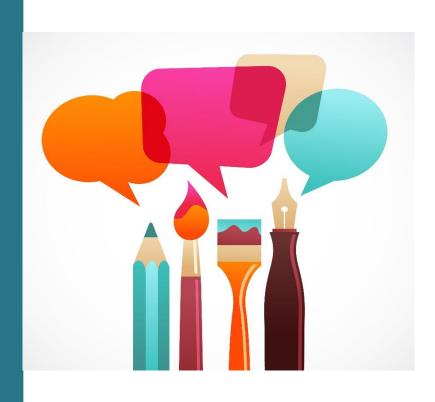
Current situation

- Repair potential
- Sharing potential
- Upgrading potential
- Recycling potential

Images: ©Depositphotos, ID:6152101, marish

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### Product design – group work and discussion



#### Potential future situation

Describe potential future improvements in your product design

#### Re-imagine your product

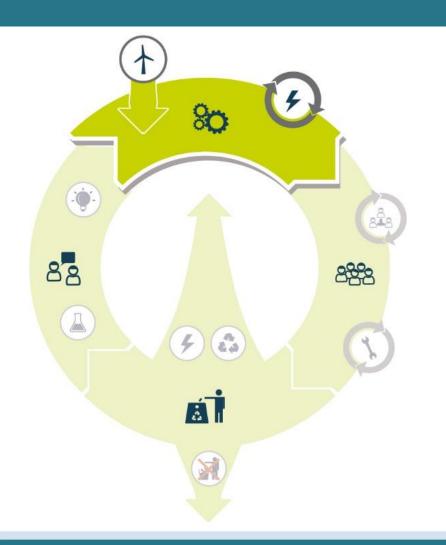
- Resources/footprint
- Recycling potential
- Repair potential
- Reuse potential

Images: ©Depositphotos, ID:6152101, marish

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Project co-funded by European Union funds (ERDF, IPA).

### Manufacturing phase – aims of this step



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

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

## Manufacturing – group work and discussion



Case study

Describe your production

Current situation?

Sourcing

- Condition site
- Process
- Distribution

Images: ©Depositphotos, ID 69535501, tele52

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### Manufacturing – group work and discussion



#### Potential future situation

Describe potential future improvements in manufacturing of your product

#### Re-imagine your production

#### Sourcing

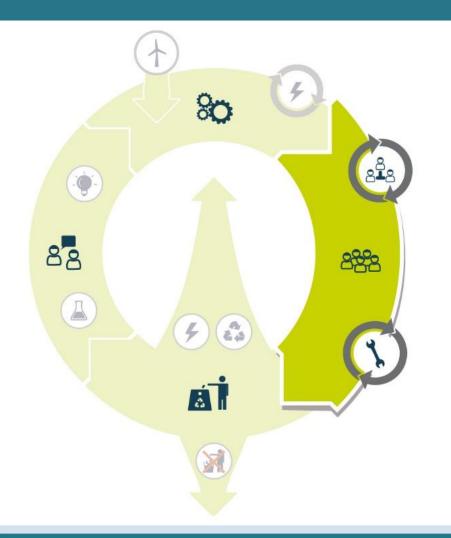
- Condition site
- Process
- Distribution

Images: ©Depositphotos, ID 69535501, tele52

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### Product use phase – aims of this step



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)



### Product use – group work and discussion



Case study

Describe the use of your product

Current situation?

- Repair potential
- Sharing potential
- Upcycling potential
- Recycling potential

Images: ©Depositphotos, ID:42523891, dashadima



### Product use - group work & discussion



#### Potential future situation

Describe potential future improvements of using your product

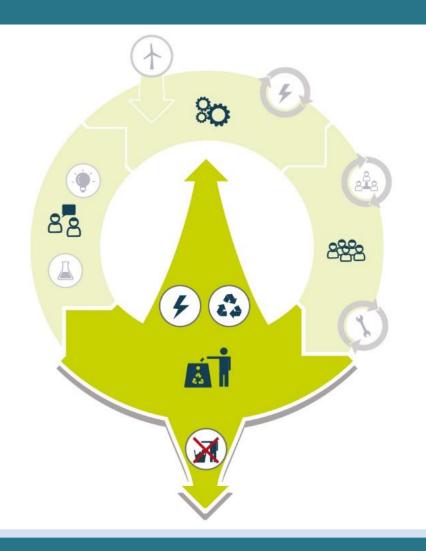
# Re-imagine the use(s) of your product

- Repair potential
- Sharing potential
- Upcycling potential
- Recycling potential

Images: ©Depositphotos, ID:42523891, dashadima



### End-of-life phase – aims of this step



Think of closing the loop by considering

- reuse potential (see 1. Design)
- recycling potential of each component
- re-integration into production process (same product) or
- leading to a new product
- avoiding incineration

avoiding final disposal (landfill)

if not, potential for energetic use



### End-of-life – group work & discussion



#### 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 (landfill)?

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### End-of-life – group work & discussion



#### Potential future situation?

 Describe potential future improvements after using your product

# Re-imagine the end-of-life of your product:

- Recycling potential
- Re-integration / new product
- Aim: Avoiding final disposal / incineration

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Street and number

Zip code, City

COUNTRY

Website

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### **Imprint**

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