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5.2 Principles of Circular Economy



SusTexEdu



Funded by the Erasmus+ Programme of the European Union

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This educational material was developed within Erasmus+ funded project [Education Partnership of Textile and Clothing Sector Materials & Sustainability \(SusTexEdu\)](#).

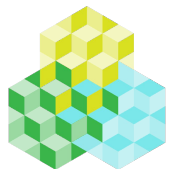
The aim of the project was to research and develop education related to the textile and clothing industry and textile materials, sustainable development and the circular economy.

Project coordinator: Metropolia UAS

Partners: Hogent (BE), Mome (HU), Omnia (FI), TTHK (EE), TTK UAS (EE), University of Borås (SE)

Funding: [Erasmus+](#)

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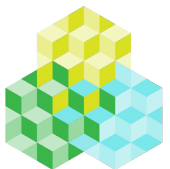
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About this learning material:

This learning material was piloted with second year students of Fashion and Clothing bachelor's degree programme at Metropolia UAS (level 6) on the course Circular Economy and Standards in Fashion and Clothing(5 cr). The theoretical course was held on-site.

This learning material is targeted for students that require basic knowledge about circular economy in the context of textiles and clothing.

Before studying this learning unit, the students should have some basic understanding of different sustainability aspects in the textile and clothing sector.



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Learning unit information

▼ CONTENT

- ❖ Definition(s) and key principles of circular economy (CE)
- ❖ Connections between CE and sustainable development
- ❖ Material cycles in a circular economy

▼ COMPETENCE OBJECTIVES

After completing the unit, the student is able to:

- ❖ describe the idea of a circular economy and its key principles
- ❖ explain how CE connects to sustainable development
- ❖ to provide examples of circular material cycles
- ❖ to identify connections between circularity and their own field.

▼ WORKLOAD

The learning unit corresponds to one (1) ECTS, approximately 27 hours.

- ❖ Lectures, 2 x 2 hours
- ❖ Learning activities, 2 x 2,5 hours
- ❖ Independent assignment, 6 hours
- ❖ Independent learning, 11 hours
- ❖ Online quiz, 1 hour



Photo by Essi Karell

Introduction to CE

Principles of Circular Economy
PART 1

Today...

- ❖ ...we consider what the circular economy means and go through how others have tried to define it.
- ❖ ...we will look at concepts such as *linear economy* and *sustainable development* and learn how the circular economy is related to them.
- ❖ ...we begin to understand what connections the circular economy has with the textile and clothing industry.

Learning activity 1.

What is meant by circular economy?

Think independently:

What do you already know about the circular economy?

What is the first thing that comes to mind when you think of the word circular economy?

Write down your thoughts.

5 min

Learning activity 1.

What is meant by circular economy?

In groups of 2-3 people:

Discuss, what kind of idea do you have about the circular economy?

How might your perceptions differ?

10 min

Learning activity 1.

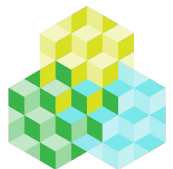
What is meant by circular economy?

In groups of 2-3 people:

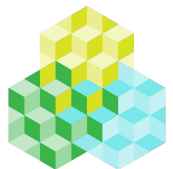
Based on your current knowledge, how would you *define* the circular economy?

Write down a short (a couple of sentences) definition.

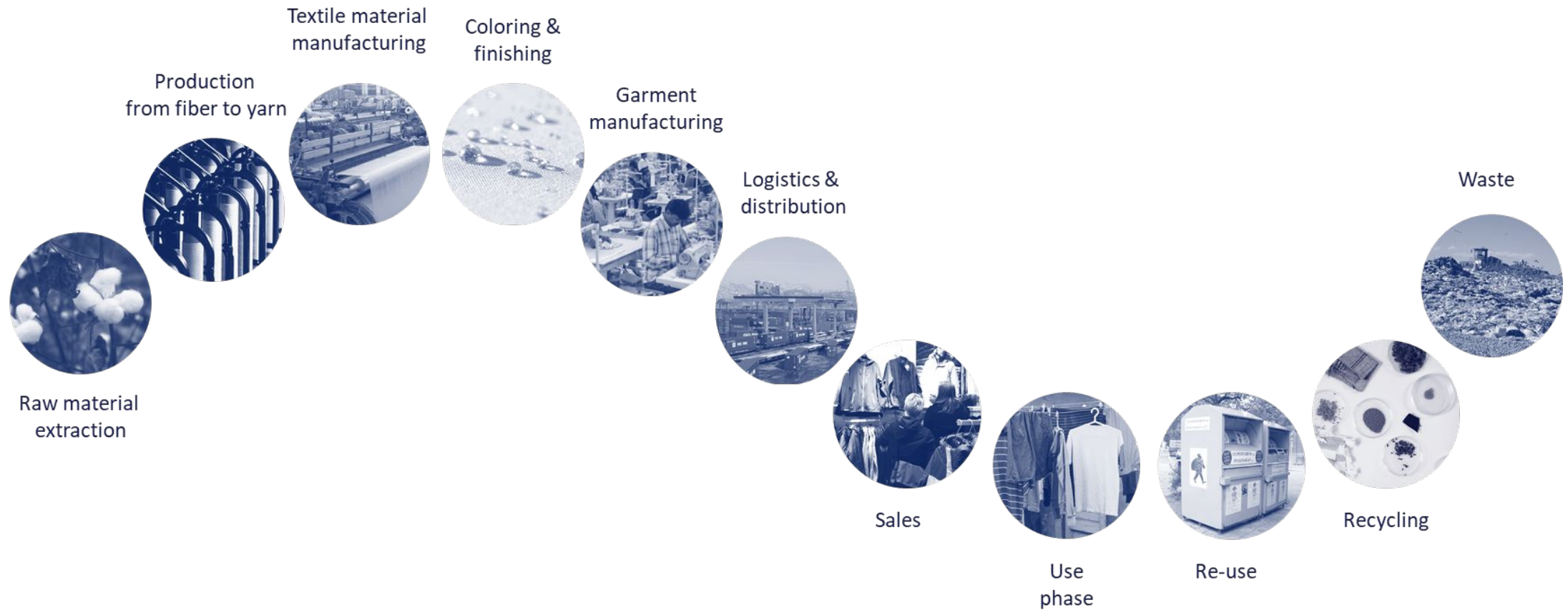
10 min



In order to understand why the circular economy is being talked about so much at the moment, we need to understand the current models of production and consumption.



Linear model of production and consumption



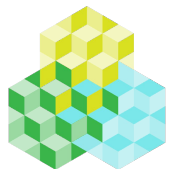
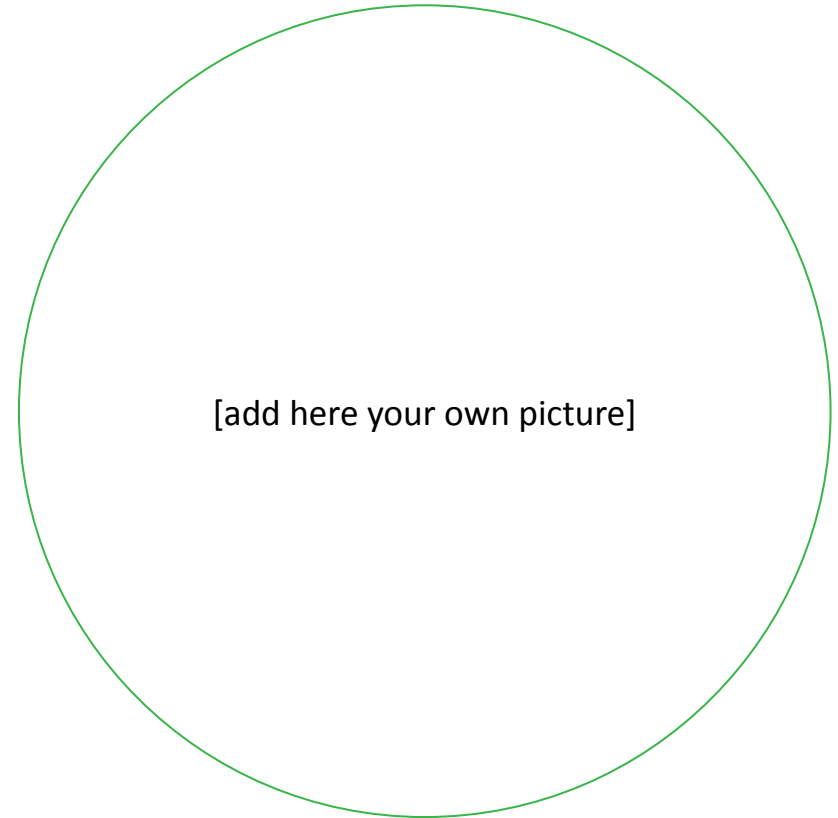
Raw materials

97% of the fibers used in the clothing and textile industry come from virgin sources.

57% polyester (non-renewable, energy-intensive, microfiber problem)

27% cotton (water crisis, forced labour, toxicity)

Sources: Ellen MacArthur Foundation (2017), Gullingsrud (2017)



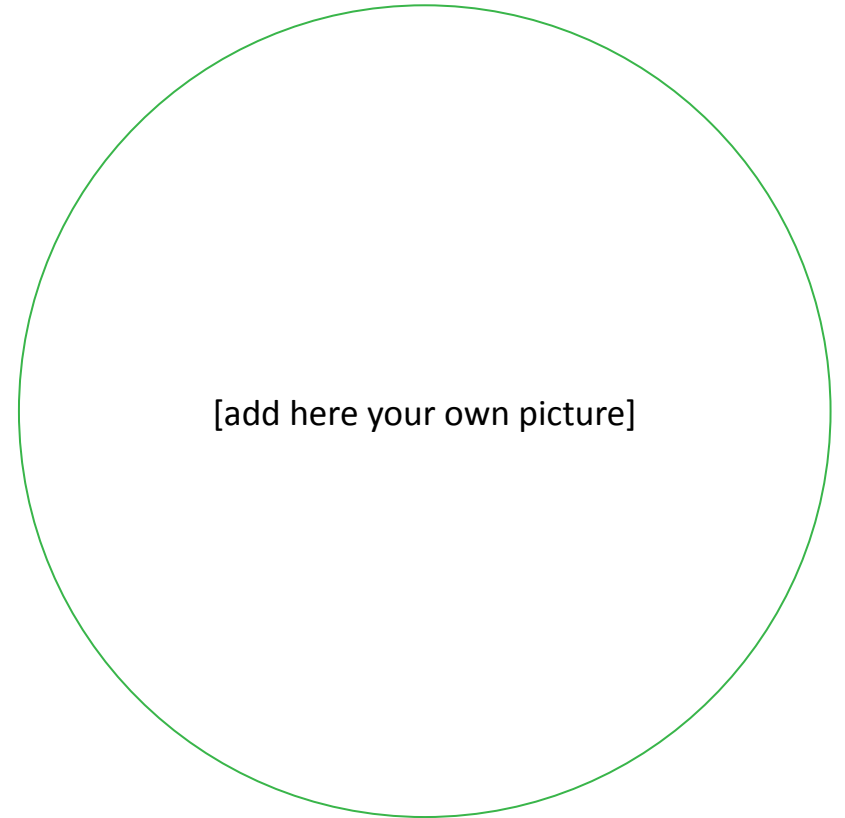
Production processes

17-20% of all water pollution caused by industry is caused by textile dyeing and finishing processes.

Up to 25-30% of the material is wasted during the production of fabric and clothes.

Inhumane and dangerous working conditions.

Sources: Gullingsrud (2017),
Niinimäki et al. (2020)

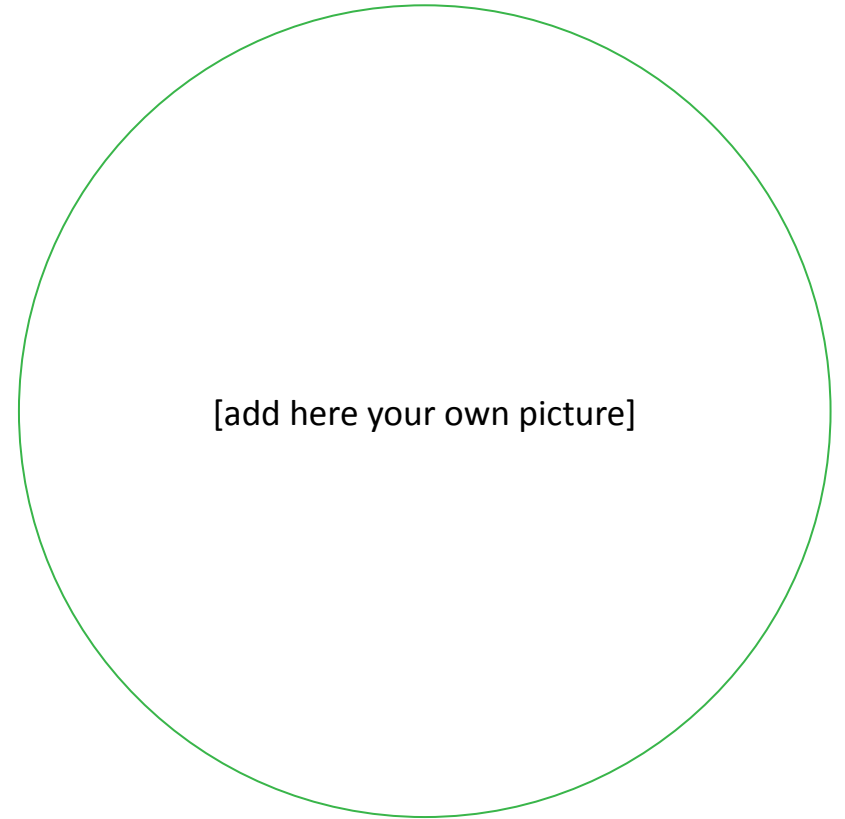


Over production

During the last 15 years, global clothing production has approximately doubled.

About 30 percent of all clothing produced worldwide is never sold.

Sources: House of Commons Environmental Audit Committee (2019), Ellen MacArthur Foundation (2017)



Sales

The global consumption of clothing is estimated at 62 million tons per year (62,000,000,000 kg).

According to some estimates, total clothing sales will triple by 2050.

Sources: House of Commons Environmental Audit Committee (2019), Ellen MacArthur Foundation (2017)

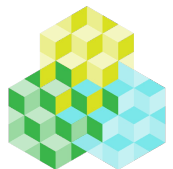
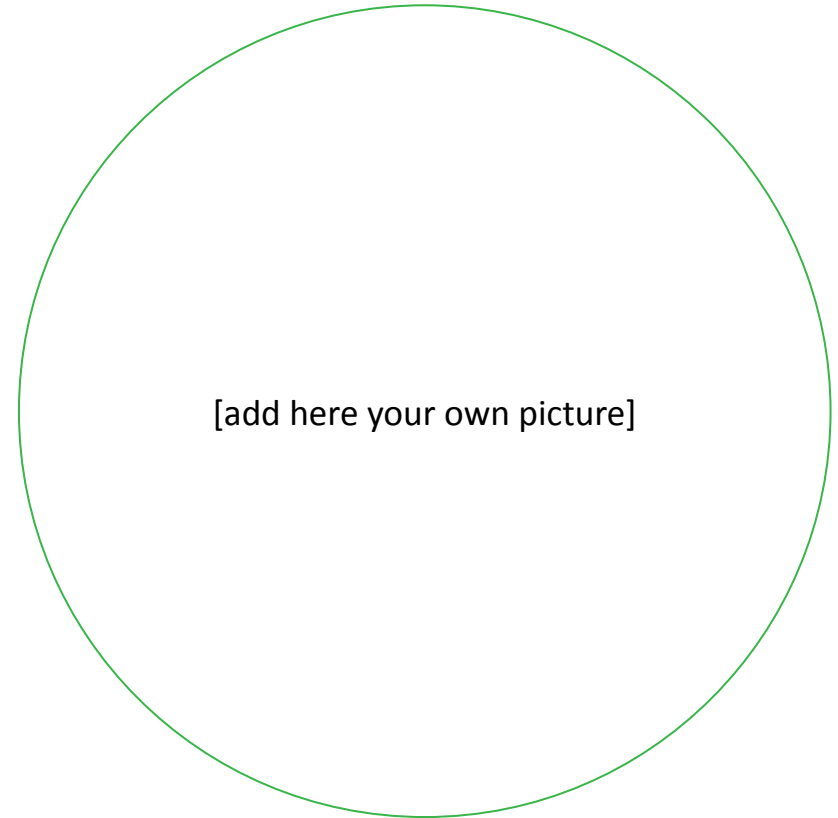
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Consumption

In the last 15 years, the use of clothing has decreased by 36% (EMF 2017).

70% of the contents of our wardrobes are in inactive use (WRAP 2012).

In Finland, 30% of clothing purchases are based on impulse purchases (Niinimäki 2011).



Reuse and recycling

There are different estimates of how much clothing is *reused*.

Only 1-5% of the material used to make clothes is *recycled* into new clothes.

73% of used textiles end up in landfills or incinerated.

Source: Ellen MacArthur Foundation (2017)

To summarise

There are many grievances in the textile and clothing industry. (The situation is similar in many other industry sectors.) Production and consumption methods are currently unsustainable.

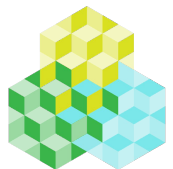
Practices must change in all industries if we want to stay within the limits of the Earth's carrying capacity.

Earth Overshoot Day

Earth Overshoot Day is computed by dividing the planet's biocapacity (the amount of ecological resources Earth is able to generate that year), by humanity's Ecological Footprint (humanity's demand for that year), and multiplying by 365, the number of days in a year.

Source: [Earth Overshoot Day](#)

[Graphics from the Earth Overshoot Day]



**How are we going to stay within
the Earth's carrying capacity at this rate?**

Sustainable Development

“Sustainable development means meeting the needs of the present whilst ensuring future generations can meet their own needs.

It has three pillars: economic, environmental and social. To achieve sustainable development, policies in these three areas have to work together and support each other.

Source: [European Commission](#) (n.d.)

The “three pillars”

ENVIRONMENTAL SUSTAINABILITY

The basic condition of sustainable development is the preservation of biological diversity and the functioning of ecosystems, as well as the long-term adaptation of human economic and material activities to the sustainability of nature.

Source: Finland’s [Ministry of the Environment](#) (2023)

SOCIAL AND CULTURAL SUSTAINABILITY

The key issue is to guarantee the transfer of the conditions for well-being from one generation to the next. Continued population growth, poverty, food and health care, gender equality and the provision of education are global social sustainability challenges that have significant implications for ecological and economic sustainability.

ECONOMIC SUSTAINABILITY

Economic sustainability is balanced growth in terms of content and quality, which is not based on long-term indebtedness or the disposal of reserves.

A sustainable economy is a prerequisite for the central functions of society and thus for nurturing and increasing well-being.

In 2015, world leaders agreed on Agenda 2030, a set of 17 Sustainable Development Goals and 169 targets proposed by the United Nations.”

Source: [European Commission](#) (n.d.)

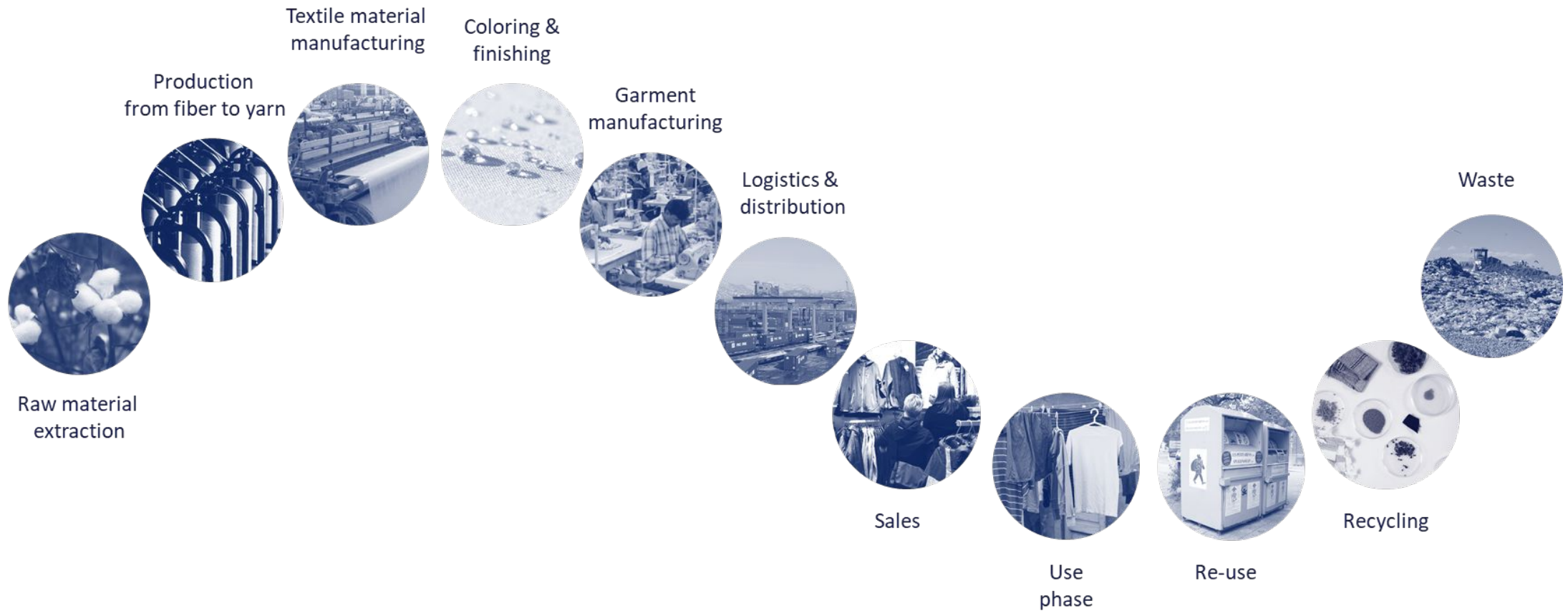
THE SUSTAINABLE DEVELOPMENT GOALS

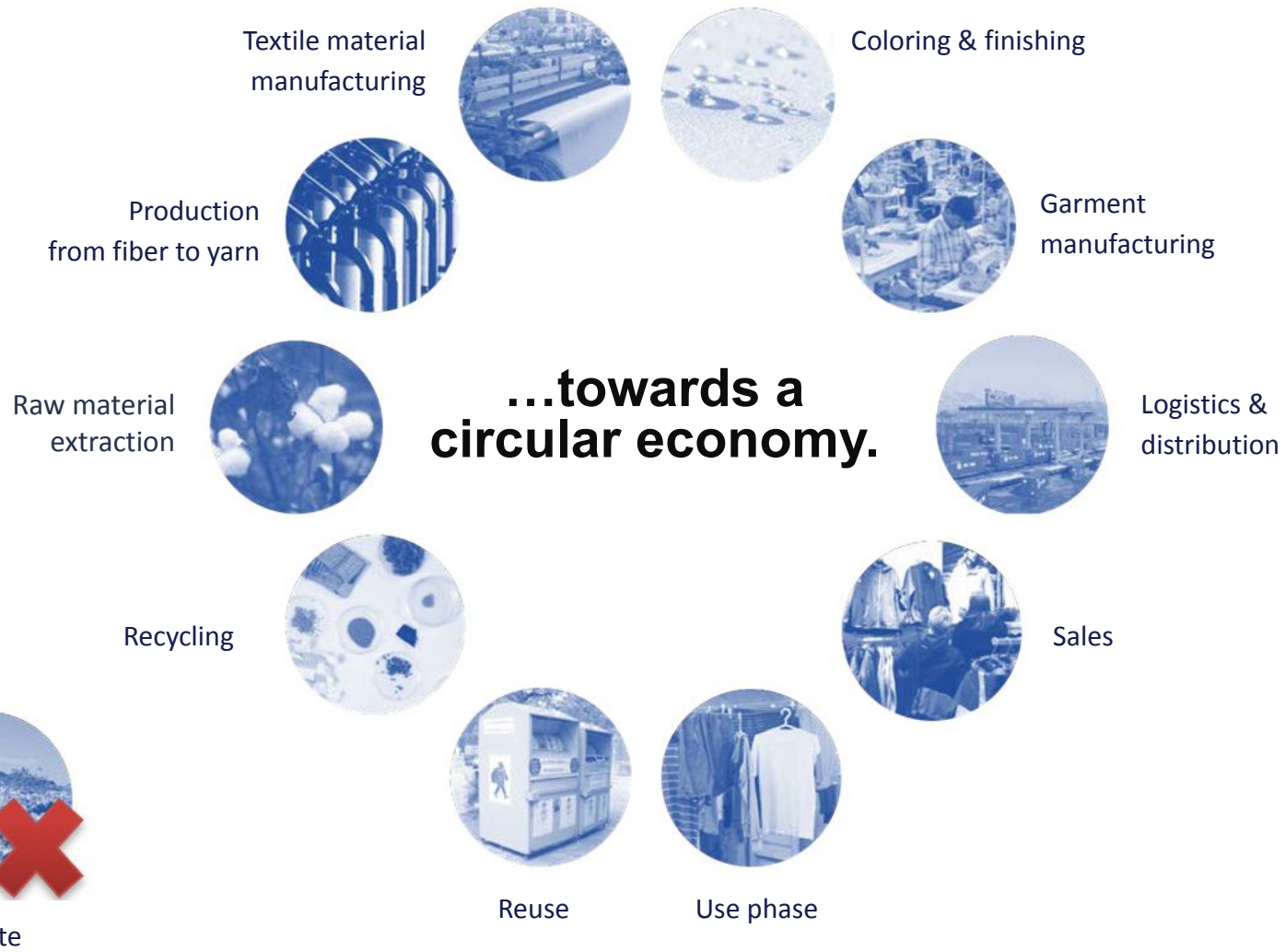


Picture source: [United Nations](#)

The circular economy can be seen as a "means" by which sustainable development can be achieved.

From the linear model of production and consumption...





How to define a circular economy?

Circular economy in a nutshell

An economic model where the goal is to save natural resources by keeping raw materials, materials, products and their various components in use for as long as possible. This can happen, for example, by borrowing, renting, reusing, repairing, refurbishing and recycling.

→ **Longevity of products and preservation of the value of resources.**

The circular economy is the basis of zero emissions. The purpose is to close the material, energy and nutrient cycles, so that there is as little waste and wastage as possible.

→ **Waste = resource / raw material**

Circular economy in a nutshell

The "promise" of the circular economy is a more environmentally friendly business compared to the current linear economy.

With the circular economy, it is possible for companies to seek business growth without burdening the environment, within the limits of the earth's carrying capacity.

→ **Decoupling**

Terminology

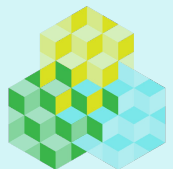
ECONOMY

The word economy generally refers to interactions between people and institutions and activities in which various commodities are produced, distributed, exchanged and consumed.

LINEAR ECONOMY

In a linear economic system, natural resources are used for the needs of production and consumption, often on a one-time basis, after which the waste generated in production and consumption is discarded.

Source: SYKE (2020)



Terminology

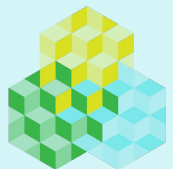
DECOUPLING

Separating things that have been connected until now so that both can be realized independently of each other. For example, decoupling economic growth from consumption of natural resources* or emissions.

NATURAL RESOURCE

any substance in nature that can be used (by humans). Natural resources are typically divided into renewable (e.g. wood, water) and non-renewable (e.g. natural gas, crude oil) natural resources.

Source: SYKE (2020)



Definitions of CE

“The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible. In this way, the **life cycle of products is extended**.

In practice, it implies **reducing waste to a minimum**. When a product reaches the end of its life, its materials are kept within the economy wherever possible. These can be productively used again and again, thereby **creating further value**.”

Source: European Parliament

More definitions...

“An economic model which does not focus on producing more and more goods, but in which **consumption is based on using services** – sharing, renting and recycling – instead of owning. Materials are not destroyed in the end, but are used to make new products over and over again...”

Source: [Sitra](#)

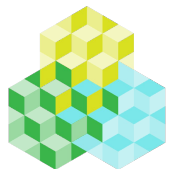
One more...

"In a circular economy, products and the materials they contain are kept in use for as long as possible through recycling, reuse of materials or services. [...]"

However, the circular economy is much more than recycling. Its operating models include, among other things, the efficient utilization of materials in product design, services that extend the product's life cycle, and redirecting products to reuse, for example, through second-hand trade.

According to the waste hierarchy, the primary goal should always be to preserve the product in its original purpose for as long as possible."

Source: [Finnish Textile & Fashion Association](#)



Learning activity 2.

Back to previous thoughts

In groups of 2-3 people:

As a group, you previously wrote down how you would define a circular economy.

Did any new ideas arise during the lecture? Would you define the circular economy somehow differently now? How?

5-10 min

→ General discussion

Assignment 1.

Circular economy related publication

Part 1. Look for publications related to the textile and clothing industry that discuss the circular economy. The publication can be, for example, a chapter of a book, a short report, a news or research article. Take a look at the publications you find and choose one of them to read. Answer the following questions related to the publication and return your notes via Moodle platform.

- ❖ Why did you choose that publication?
- ❖ Who or what entity wrote/published it? When?
- ❖ What is the main message of the publication?
- ❖ What does the circular economy mean in the textile and clothing industry?
- ❖ Would you recommend reading the publication to other students? What could your fellow students learn from it?
- ❖ Include a link to the publication in question, if it can be found online.



Assignment 1.

Circular economy related publication

Part 2. Getting to know the assignments of peer students

Check out the assignments returned by others and comment on one of them via Moodle platform before the next lecture. [Further instructions might be needed.]

Assignment evaluation: failed/passed.



Photo by Essi Karell

Key principles & the importance of circular economy

Principles of Circular Economy
PART 2

Last time...

- ❖ ...we considered what the circular economy means and went through how others have tried to define it.
- ❖ ...we looked at concepts such as the linear economy and sustainable development and learnt how the circular economy relates to them.

WHAT DO YOU REMEMBER SPECIFICALLY ABOUT THESE?

A short conversation with a neighbor.

After this session...

- ❖ ...we understand even better what connections the circular economy has with the textile and clothing industry.
- ❖ ...we can tell about the meaning of the circular economy and name the key principles of the circular economy.
- ❖ ...we can describe how different types of materials and products can circulate in the circular economy.

Key principles of circular economy

- 1) Systems thinking
- 2) Resilience through diversity
- 3) Elimination of waste and pollution
- 4) Closed loops
- 5) Use of renewable energy sources
- 6) Regenerating nature

Key principles of circular economy

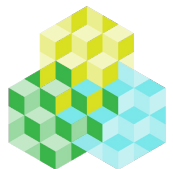
1) Systems thinking

Systems thinking offers a comprehensive approach to understanding the interconnections between different things and processes and thus also possible solutions to various problems.

In order to move to a circular economy, the current production and consumption systems must be completely rethought. It is important to understand how things are connected and affect each other.

[Example]

[Some case example(s) that illustrate well
this principle]



Key principles of circular economy

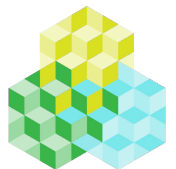
2) Resilience through diversity

Production systems (including business models and distribution networks) should be flexible and adaptable. Diverse systems are more resistant to external "shocks" or disturbances than systems that are built simply for e.g. efficiency, and to maximize performance.

Source: Ellen MacArthur Foundation (2013)

[Example]

[Some case example(s) that illustrate well
this principle]



Key principles of circular economy

3) Elimination of waste and pollution

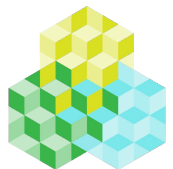
Waste and pollution are design flaws and not inevitable byproducts of the things we make. In the design phase, the preservation of the value of resources should be taken into account; reuse, repairability, remanufacturing, recycling.

By changing our way of thinking and utilizing new materials and technologies, we can ensure that they are not created in the first place.

Source: Ellen MacArthur Foundation (2013)

[Example]

[Some case example(s) that illustrate well
this principle]



Key principles of circular economy

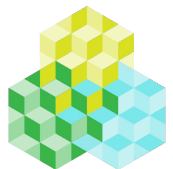
4) Closed loops

The circular economy is based on continuous material, energy and nutrient cycles. Bio-based raw materials and biodegradable materials from nature circulate in *biological cycles*. In *technical cycles*, man-made products and materials are kept in circulation through, for example, reuse, repair, remanufacturing and recycling.

Source: Ellen MacArthur Foundation (2013), SYKE (2020)

[Example]

[Some case example(s) that illustrate well
this principle]



Key principles of circular economy

5) Use of renewable energy sources

Different systems should strive to operate with renewable energy (e.g. hydro and wind power, solar energy) instead of using fossil fuels. Fossil fuels are non-renewable natural resources and burning them creates gases such as carbon dioxide, which contribute to global warming.

[Example]

[Some case example(s) that illustrate well
this principle]

Key principles of circular economy

6) Regenerating nature

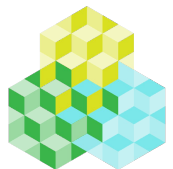
In nature, there is no concept of waste, but everything is food for someone else. Practically everything we consume comes from nature. The use of raw materials obtained from nature should be such that nature has time to recover.

By developing new business models, we can enable more sustainable consumption, where value is created by using the product - and not so much by owning it.

Source: Ellen MacArthur Foundation (2013)

[Example]

[Some case example(s) that illustrate well
this principle]



Background of CE thinking

The circular economy has been talked about for decades with different concepts and many ideologies are associated with it. Hence, it is difficult to trace its origin precisely.

Examples include e.g. cradle-to-cradle, product-service systems, sharing economy.

More information from the different schools of thoughts can be found, for example, from the Ellen MacArthur Foundation's guide "[What is the circular economy?](#)"

Learning activity 3.

Schools of thought

In pairs: You get two of the following terms to work on. Find out what they mean.
Take notes.

- ❖ cradle-to-cradle
- ❖ blue economy
- ❖ performance economy
- ❖ biomimicry

20min + discussion

Learning activity 4.

Why do we need circular economy?

Discussion in groups of 3:

- ❖ What are the concrete benefits of the circular economy for society?
- ❖ What about the benefits for individual companies?

Think about the questions through the three pillars of sustainable development.

Write your thoughts on [Google Jamboard or similar].

approx. 15 min

The importance of circular economy

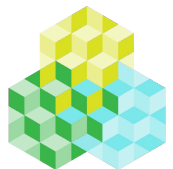
- 1) Environmental perspective
- 2) Economic perspective
- 3) Social perspective

The importance of circular economy

1) Environmental perspective

Population growth: The world's population growth increases the demand for raw materials and other resources, but there are still only a limited amount of essential raw materials. The growth of the middle class from 3.2 billion to 5.2 billion people by 2030 (means a significant increase in the consumption of raw materials at the current rate.

Source: ESPAS (2019)



The importance of circular economy

1) Environmental perspective

Earth's limited resources and capacity: Global consumption of materials such as biomass, fossil fuels, metals and minerals is expected to double in the next 40 years (European Commission, 2020). Annual waste generation in the European Union is predicted to increase by 70 percent by 2050 (European Commission, 2020).

The importance of circular economy

1) Environmental perspective

Climate change: The extraction and use of raw materials has a significant impact on the environment. It also increases energy consumption and carbon dioxide emissions, which is connected to climate change.

→ **In a circular economy, the rational use of raw materials and materials could ensure the sufficiency of natural resources and slow down global warming.**



The importance of circular economy

1) Environmental perspective

According to the International Resource Panel, approximately 50 percent of greenhouse gas emissions and as much as 90 percent of the loss of nature due to changes in land use are the result of the use and processing of natural resources. The circular economy plays a key role in achieving global climate and nature goals.

Source: Sinervo et al. (2022)

The importance of circular economy

1) Environmental perspective

“The circular economy can stop the loss of nature worldwide and restore biodiversity to the year 2000 level by 2035.”

The key is to introduce circular economy solutions in four key sectors, which are: Agriculture and food, buildings and construction, **textile and fiber sector**, forest sector.

Source: Forslund et al. (2022)

The importance of circular economy

2) Economic perspective

In addition to the environmental benefits, the transition to a circular economy could improve

- ❖ reliability of supply of raw materials,
- ❖ to increase the competitiveness of companies,
- ❖ create new jobs (up to 700,000 by 2030)
- ❖ enhance innovation and
- ❖ increase economic growth.

Source: European Parliament (2023)

The importance of circular economy

2) Economic perspective

Preventing the generation of waste, eco-design and reusing materials could bring savings to EU companies.

Source: European Parliament (2023)

The importance of circular economy

3) Social perspective

[The European Green Deal](#) is essentially linked to the circular economy. The program mentions as (social) benefits of the circular economy, e.g.

- ❖ clean air, clean water, healthy soil and biodiversity
- ❖ switching to public transport
- ❖ healthy and reasonably priced food
- ❖ creating future jobs
- ❖ providing the necessary training during the transition.

Source: European Commission (n.d.)

Was something missing?

Assignment 1. Discussion

Circular economy related publication

General discussion:

- ❖ What considerations did you make when looking for publications related to the textile and clothing industry?
 - What types of publications did you find?
 - Who writes on the topic?
- ❖ On what basis did you choose the publication you read?
- ❖ What observations did you make about the publications chosen by others?

Assignment 1. Discussion

Circular economy related publication

Write down:

- ❖ What did you learn about yourself?
- ❖ What did you learn in a professional sense?

5 min

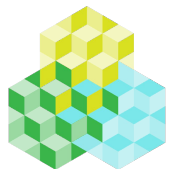
Material cycles in the circular economy

In the circular economy, we talk about closed (continuous) cycles.

The circular economy is often described with *the butterfly diagram* presented by the Ellen MacArthur Foundation, which separates biological and technical cycles/cycles.

In the context of the textile and clothing industry, it is essential for us to look specifically at what happens in technical cycles.

[The Butterfly diagram e.g. by [Ellen MacArthur Foundation](#)]



[The biological cycle of the butterfly diagram
e.g. by [Ellen MacArthur Foundation](#)]

“On the left-hand side of the butterfly diagram is the biological cycle, which is for materials that can biodegrade and safely return to the earth.”

“This cycle mainly concerns products that are consumed, such as food. However some other biodegradable materials, such as cotton or wood, may eventually make their way from the technical cycle into the biological cycle once they have degraded to a point where they can no longer be used to make new products.”

Source: [Ellen MacArthur Foundation](#) (2022)

“On the right-hand side of the butterfly diagram is the technical cycle, relevant for products that are used rather than consumed.”

“The diagram shows that smaller inner loops are surrounded by the larger outer loops. These inner loops are where most value can be captured.”

“The outermost loop, recycling, is therefore the stage of last resort in a circular economy.”

Source: [Ellen MacArthur Foundation](#) (2022)

[The technical cycle of the butterfly diagram
e.g. by [Ellen MacArthur Foundation](#)]

CE terminology

BIOLOGICAL CYCLE circulates bio-based raw materials and biodegradable materials originating from nature. The biodegradable ones are returned to nature as elements through biochemical cycles. However, bio-based materials are not always biodegradable.

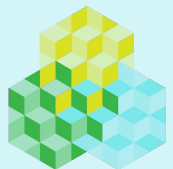
Source: [SYKE \(2020\)](#)

CE terminology

TECHNICAL CYCLES circulate materials that are **man-made and based mainly on non-renewable natural resources** (e.g. metals). Technical materials cannot be returned to nature's cycles, but the cycle requires other types of measures.

In a circular economy, technical materials remain in circulation as efficiently as possible through **repairing, reusing, remanufacturing** and **recycling products**, so that virgin raw materials are needed as little as possible. In addition, the aim is to return the surplus material generated during the processing of the material and the manufacturing of the product back into circulation.

Sources: [Circular.now \(n.d.\)](#), [SYKE \(2020\)](#)



CE terminology

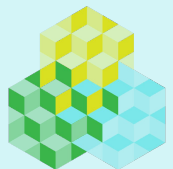
REUSE

is the reuse of a product, such as a textile, or a part of it, for the same purpose for which it was originally designed. For consumers, the sale and purchase of used goods is made possible for example through various online platforms and flea markets.

REMANUFACTURING

the used product or component is updated, repaired or manufactured to be equivalent or better than the new one. The remanufacturing process restores the added value of the material that it had in the original product or component.

Sources: [SYKE \(2020\)](#), [STJM \(n.d.\)](#)



CE terminology

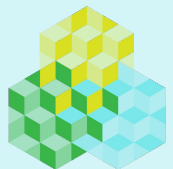
TEXTILE RECYCLING

is an activity in which textile waste* is made into a product, material or substance either for the original purpose or for another purpose. Textiles can be recycled using either a mechanical, chemical or thermal methods. Utilization of textile waste or material as energy, nor flea markets or recycling centers, does not count as recycling.

*TEXTILE WASTE

is a discarded textile that is no longer fit for reuse as such, i.e. it is broken or dirty. This type of textile currently belongs to mixed waste (until 2025), from which it is diverted mainly to be used as energy.

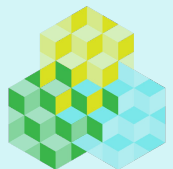
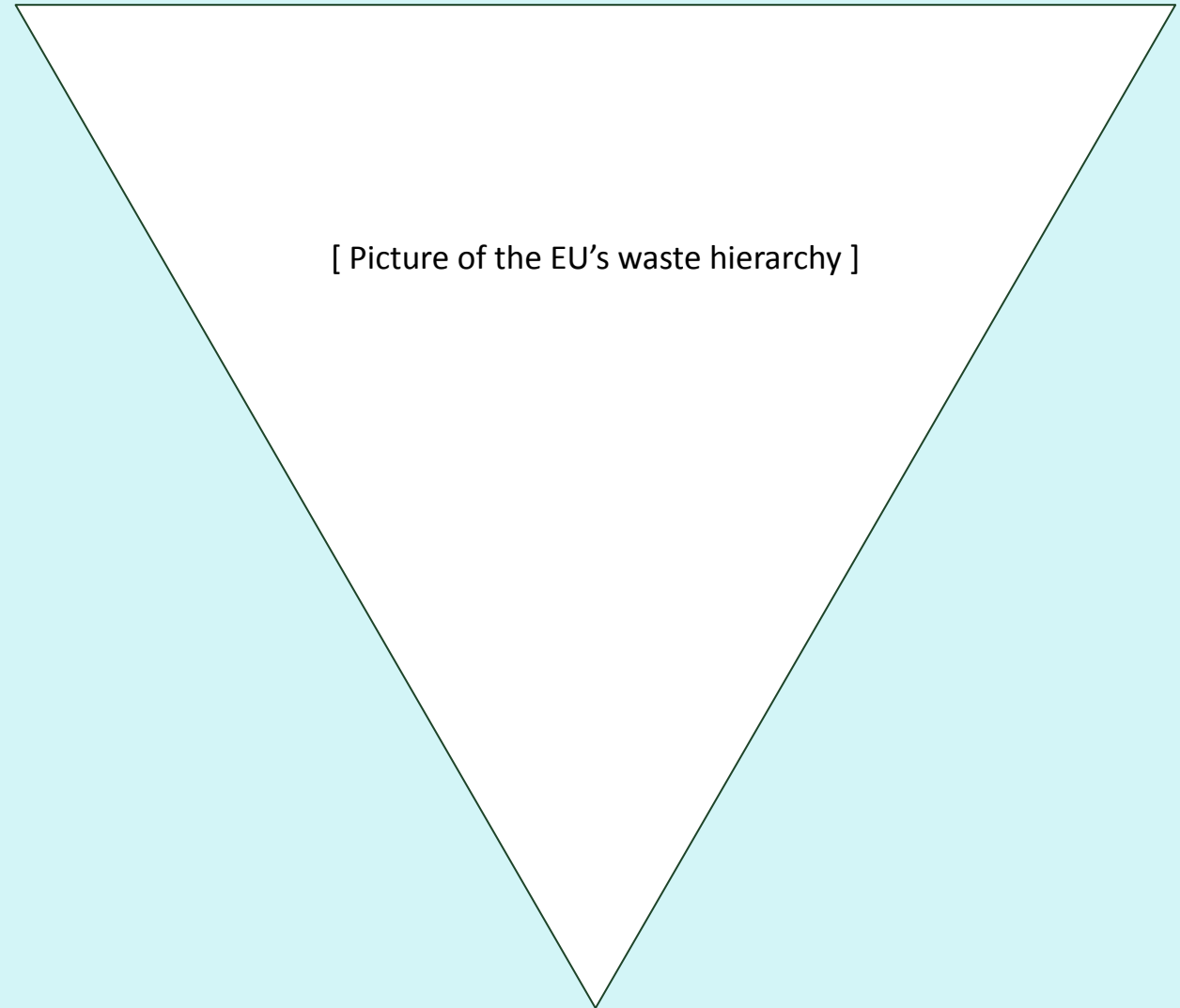
Sources: [SYKE \(2020\)](#), [STJM \(n.d.\)](#)



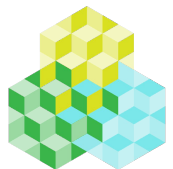
WASTE HIERARCHY

The priority order of waste management operations. The waste hierarchy is defined in the EU waste directive.

The similar hierarchy can also be seen in the butterfly diagram of the circular economy.



[Reminding about how the Butterfly diagram e.g. by [Ellen MacArthur Foundation](#) looks in order to compare it to the waste hierarchy.]



Learning activity 5.

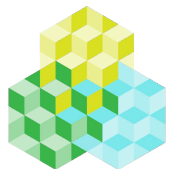
Draw and clarify

Independently OR in pairs:

Part 1. Draw a similar diagram on A3 paper and add explanations to the terms appearing in the technical cycle.

Part 2. Find out what the terms related to the biological cycle mean and complete them in your diagram. You can use the website of the [Ellen MacArthur Foundation](#) and other sources.

30 min



Online quiz

Independently

Prepare for the online quiz by studying the content of these lectures.

You can use the learning material during the quiz. When you start the quiz, you have 30 minutes to complete it. You can try the quiz twice.

[LINK TO THE ONLINE QUIZ*]

*The questions and the format of the quiz is up to the lecturer.

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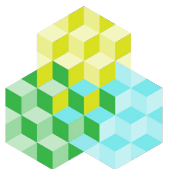
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Visit [the project website](#) to see all the intellectual outputs of the project.



Photo by Essi Karell



SusTexEdu

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