CIRCULAR ECONOMY MANUAL

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CESAR PROJECT
www.cesar-project.eu

cesar CIRCULAR ECONOMY SKILLS AND AWARENESS RAISING

Co-funded by the Erasmus+ Programme of the European Union

CONTENTS

FOREWORD

The **CESAR Project – Circular Economy Skills and Awareness Raising** is a KA202 Project (Strategic Partnerships for Vocational Education and Training) funded by the Erasmus+ Programme of the European Union, which started in October 2020 for a period of two years.

The partnership consists of 7 partners from 5 different countries (Finland, Germany, Italy, Portugal, and Spain), with a common commitment to raise awareness for Circular Economy among the educational and training communities.

The following material has been compiled in 2021-2022 with an aim to:

- Raise awareness regarding Circular Economy and its benefits.
- Promote awareness among teachers and students about greener methodologies and approaches.
- Establish student initiatives to investigate local and regional problems that require sustainable and/or circular solutions.
- Improve students' skills within circular economy, helping to prepare the future workforce for the challenges of transitioning from a linear economy to a circular economy.

The partnership has designed and developed a set of educational training materials to be used primarily by teachers in Vocational Education and Training courses. However, the materials can also be used for all other scholar education and courses that aim to promote awareness raising and skills development of students within the topic of circular economy.

The material is divided into different learning chapters, with each area focusing on a subtopic within circular economy.

The material has been tested and validated in several learning contexts of Vocational Education and Training in all the partnership countries.

PART A: INTRODUCTION TO CIRCULAR ECONOMY

Our planet's natural capital is over-used, reducing its future regenerative capacity. Prior to the corona pandemic, the Earth Overshoot Day date has continuously occurred earlier every year for a longer period. According to the NGO Global Footprint Network, the ecological resources of the Earth are used 1.75 times faster than the regenerative capacity of ecosystems.

By modifying our consumption habits, through reduction, reuse, recovery and recycling of materials and energy, it could become possible to delay the impoverishment of resources. The Communication of the European Union (EU) "*Towards a circular economy: A zero waste programme for Europe*" highlights that "valuable materials are leaking from our economies. In a world where demand and competition for finite and sometimes scarce resources will continue to increase, and pressure on resources is causing greater environmental degradation and fragility, Europe can benefit economically and environmentally from making better use of those resources. Since the industrial revolution, our economies have developed a 'take-make-consume and dispose' pattern of growth —a linear model based on the assumption that resources are abundant, available, easy to source and cheap to dispose of. It is increasingly being understood that this threatens the competitiveness of Europe."

In 2015, the European Commission established a unique comprehensive strategy, the Circular Economy Package, aiming to close the resource loop by introducing measures covering the whole life cycle of products and materials – from production and consumption to management of waste and its re-use as secondary raw materials in the economy. The suggested measures also tackle climate change with energy savings and reduced greenhouse gas emissions and include the first-ever European Strategy for Plastics.

A circular economy is part of the modernization and transformation necessary for supporting the EU in its aim to become the world's first major economy to go climate neutral by 2050, as per the long-term strategy put forward by the Commission in November 2018.

1. WHAT IS CIRCULAR ECONOMY?

Circular economy is a phrase that can be heard and seen everywhere. However, it seems the true meaning of the concept is still unfamiliar to many. The objective of this introduction is to present the topic in a simple and interesting manner and provide a basis for further exploration within the different subtopics.

Circular economy is a sustainable way of living, where emphasis is placed on resources that are already in use - as little new material as possible is derived from the nature reserves. This applies to both professional and private life.

Circular economy is the opposite of linear economy. **Linear economy, which modern society has been practicing since industrialization, means that products are manufactured, used, and discarded.** In the manufacture of products, by-products and waste are formed, which are also disposed of. The impact on the environment is great in a linear economy and finite resources are running out. Circular economy in turn means that the product is manufactured and used. By-products and waste from production are also utilized and reused or recycled. When the product's life cycle is over, all its parts are recycled. **In an ideal circular economy, little to zero waste is formed.**

Looking beyond the current "take-make-waste" -extractive industrial model, a circular economy aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles:

- Design out waste and pollution
- Keep products and materials in use
- Regenerate natural systems

LEARN MORE ABOUT THIS:

https://www.ellenmacarthurfoundation.org/circular-economy/concept

The philosophy of Circular Economy consists of the replacement of open production systems, based on a linear consumption model, where resources are targeted, extracted, processed, and transformed into waste after consumption, by closed systems that reuse resources and conserve energy (McDonough & Braungart, 2002). These systems are regenerative, where resources, waste, emissions, and energy losses are minimized through the slowing, closing, and narrowing of resource and energy loops.

This concept is based on 3 principles (Ellen MacArthur Foundation, 2015):

- Preserving and enhancing natural capital.
- Optimizing yields from the resources in use.
- Fostering system effectiveness (minimizing negative externalities).

Most business models developed under these three principles can be categorized according to the ReSOLVE framework (Lewandowski, 2016), developed by the Ellen MacArthur Foundation, which describes a set of six actions that can be implemented to promote the transition to a Circular Economy, namely:

- **Regenerate** - Actions that preserve and improve Earth's biocapacity, renewable energy and materials, reclaim, retain, and regenerate health of ecosystems, return of recovered biological resources to the biosphere.
- **Share** - Actions that keep product loop speed slow, maximize utilization of products by sharing them among users, reuse products throughout their technical lifetime, prolong life through maintenance, repair, and design for durability.
- **Optimize** - Actions that increase the performance/efficiency of a product, remove waste in production and the supply chain, leverage big data, automation, remote sensing, and steering.
- **Loop** – Actions that keep components and materials in closed loops and prioritize inner loops.
- **Virtualize** – Actions that deliver utility virtually.
- **Exchange** – Actions that replace old materials with advanced non-renewable materials, applying new technologies.

At the European Environment Agency level, the Circular Economy characteristics are described as (EEA, 2016):

- Less inputs and use of natural resources.
- Increased share of renewable and recyclable resources and energy.
- Reduced emissions.
- Fewer material losses/residuals.
- Keeping the value of products, components, and materials in the economy.

2. UNDERSTANDING THE CHANGING NEEDS: FROM LINEAR TO CIRCULAR ECONOMY

Circular economy plays an important part in enabling as many people as possible to have an opportunity to live a good or at least tolerable life, far into the future. We must learn to live in a more sustainable manner.

During recent centuries, the human population has lived as if the earth's resources were infinite. A lot of waste has been dumped, resources are at risk of running out and the environment has been placed under constant burden. The economy has been linear. When the concept of sustainable development was coined in 1987, it was begun to realize that we need to review how we use resources so that they can also meet the needs of future generations.

Circular economy is a paradigm shift where we move from an open or linear system to a closed system where raw materials circulate.

LEARN MORE ABOUT THIS:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6427659/

3. WHY IS IT IMPORTANT TO INCLUDE CIRCULAR ECONOMY IN VOCATIONAL EDUCATION?

Regarding Circular Economy, the **key lies within professional life**. As private consumers we can do a lot, but in the end, regardless of industry, the actions we take within working life is where the greatest impacts can be created for sustainability.

4. THE CIRCULAR ECONOMY AND THE UN SUSTAINABLE DEVELOPMENT GOALS

The Circular Economy is strongly connected with the UN Sustainable Development Goals, and holds particular promise for achieving multiple SDGs, including the following: 6 – Clean Water and Sanitation; 7 – Affordable and Clean Energy; 9 – Industry, Innovation and Infrastructure; 11 – Sustainable Cities and Communities; 12 – Responsible Consumption and Production; 14 – Life Bellow Water; 14 – Life on Land.

LEARN MORE ABOUT **The Global Goals**

5. CIRCULAR JOBS ON CIRCULAR ECONOMY

Employment opportunities directly related to Circular Economy are trending. Regardless of industry, we can all have an impact on our ecological footprint in our daily work – minimizing our negative footprint and emphasizing our positive handprint.

Circular jobs can be divided into three different types: core, enabling and indirect circular jobs.

A core circular job is an occupation that is immediately related to one or more of the core strategies of circular economy. This includes for example jobs in repair, waste and resource management, and renewable energy. Responsibilities within such occupations may include:

- Focus is placed on maintenance and repair to ensure maximal usage of a product. Ecological and economical aspects are also considered – i.e., evaluating when a product is still ecological to repair or will it provide more benefit when recycled and used to manufacture or repair another product.
- Renewable and reusable resources are used energy efficiently, regenerative resources are prioritized.
- Waste is used as a resource; waste is reused or recycled.
- Quality assessment of the used raw materials, analysis of their longevity and recycling qualities.

An enabling circular job is defined as an occupation that supports circular activities and enables circular economy. These jobs are essential for circular economy and are for example within the field of education, technology, design, and leasing.

An indirect circular job does not have an immediate connection to circular economy but provides for example services to the core strategies of circular economy. The work in such an occupation does not directly promote the transition from a linear economy to a circular economy, but as earlier mentioned, all occupations can implement various strategies into their work to provide services to core and enabling circular jobs.

PART B: BUILDING BLOCKS OF CIRCULAR ECONOMY IN VOCATIONAL EDUCATION

Each building block is presented in a similar manner, from introduction to the topic to links for further reading. The chapters can be used together as a more comprehensive education package for covering the basics of circular economy, or as individual, separate entities. The goal has been to present each topic in an appealing, interesting, and easy to read and understand manner, not limited to text, but also animations, pictures, etc.

The building blocks of Circular Economy presented in this manual are:

- Eco-design
- Life-long materials and products
- Regenerative resources
- Waste as a resource
- New business models
- Digitization
- Collaboration and changes in human behavior

1. ECO-DESIGN

Eco-Design is an aspect which is especially important in projects that have a large environmental impact or use of natural resources. For example, the building industry is in a great roll. This does not however mean that you couldn't or shouldn't apply eco-design principles to even the smallest of projects. All industries can benefit from eco-design practices.

When manufacturing new products, there are three factors that should be emphasized; the use of sustainable materials, the amount of required energy for production is minimal, and the design of the product enables recycling or reuse after the product's lifecycle has come to an end.

1.1 Introduction

What is Eco-design?

According to NI Business info, Eco-design is the principle of producing goods and services that meet your customers' needs while:

- using the minimum levels of resources
- having a minimum impact on the environment and society

Eco-design involves designing or redesigning products, services, processes, or systems, with the aim to avoid, or repair damage to the environment, society, and the economy.

Eco-design is present all around us - in sustainable flooring, green energy heating systems, eco-friendly packaging, and even recyclable products.

Eco-design principles

There are ten core environmental considerations at the heart of eco-design:

- using materials with less environmental impact
- using fewer materials overall in the manufacture of products
- using fewer resources during the manufacturing process
- producing less pollution and waste
- reducing the environmental impacts of distributing products
- ensuring that products use fewer resources when they are used by end customers
- ensuring that products cause less waste and pollution when in use
- optimizing the function of products and ensuring the most suitable service life
- making reuse and recycling easier
- reducing the environmental impact of disposal

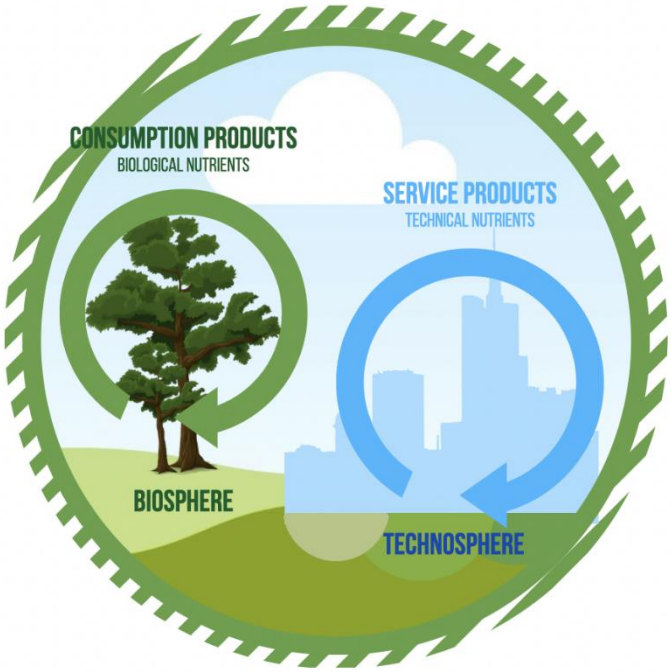
Products and services should be evaluated according to these principles and their environmental impact, as well as the potential for improvement or change.

When should you consider eco-design?

Projects with a significant environmental impact or natural resource use are the best candidates for an eco-design transformation. However, eco-design principles can be applied to even the smallest of projects by emphasizing the following:

- maximize the use of sustainable materials
- use the least amount of energy necessary
- design a product so that it can be recycled or reused at the end of its lifecycle

LEARN MORE ABOUT **Eco-design**



C2C: Cradle to Cradle: Adapted from https://www.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail

One man's garbage is another man's treasure. Eco-design can entail collaboration between several industries or companies. Waste produced by or excess materials used by one manufacturer may be the main resource for another manufacturer.

Eco-design is the production of products and services that satisfy the customers' needs, while simultaneously using minimal resources and having as little as possible impact on the environment and society. In eco-design, a new product is designed (or old ones are redesigned) from recycled or waste materials. After a product's lifecycle as such has come to an end, the product is reused to create something new, and thus zero or minimal waste is created. Eco-design is common in our environment and is found e.g., in recyclable and organic products.

There are ten important aspects to eco-design:

1. Use of products with less environmental impact.
2. Reduction of the amount of material needed in the manufacture of a product.
3. Use of fewer resources in the manufacture of a product.
4. Reduction of the amount of waste and pollution caused by production.
5. Reduction of environmental impact when the product is distributed.
6. Ensuring that the product requires fewer resources even when it is used by the customer.
7. Ensuring that the product causes less waste and emissions when used.
8. Optimization of the function of products so that they can be repaired if they break.
9. Make reuse and recycling as easy as possible.
10. Reduction of environmental impact when the product is thrown away.

The concept of "Cradle to Cradle" design was first introduced by architect William McDonough and chemist Michael Braungart. Instead of a system where products have a lifecycle from cradle to grave, McDonough and Braungart presented a circular system where no waste is produced. Cradle to cradle thus entails that instead of producing waste during manufacturing, all components are reused. In case waste is produced, it should be recyclable.

LEARN MORE ABOUT **Cradle to Cradle** and **Eco-design**

NB: More on Cradle to Cradle design in the chapter ***Life-long materials and products***

Design for the environment (eco-design)

Designing for the Environment (DfE) is a principle that calls for minimizing the negative environmental impacts of a product across its life cycle. DfE includes several design principles:

- Designing for Maintainability/Reparability
- Designing for Recoverability/Recyclability
- Designing for Flexibility
- Designing for Reuse
- Designing for Disassembly
- Designing for Energy Efficiency
- Packaging Minimization
- Life Cycle Thinking
- Material Safety
- Green Chemistry, among others

LEARN MORE ABOUT **THIS**

Eco-design of products

The aim of ecological designing, or eco-design, is to ensure that consumers have access to products with high energy efficiency performance but low environmental impact. Eco-design requirements integrate environmental aspects and life cycle thinking into the product design phase.

In practice, eco-design requirements usually concern products' energy consumption during use and gradually become stricter.

LEARN MORE ABOUT **Eco-design of products**

Designer's eco analysis

Each year the designers have been asked to grade the eco friendliness of their product as regards to the following aspects in the design and production stages:

1. Foresight, planning and design.
2. Selection of materials
3. Production process
4. Package and logistics
5. Use, durability, and maintainability
6. Recyclability

The stories and Eco analyses of the entries exhibited in series of Eco Design exhibitions can be read here.

LEARN MORE ABOUT **Eco-design**

Does eco-design only apply to these products?

LEARN MORE ABOUT ECO-DESIGN:

https://ec.europa.eu/growth/industry/sustainability/product-policy-and-ecodesign_en

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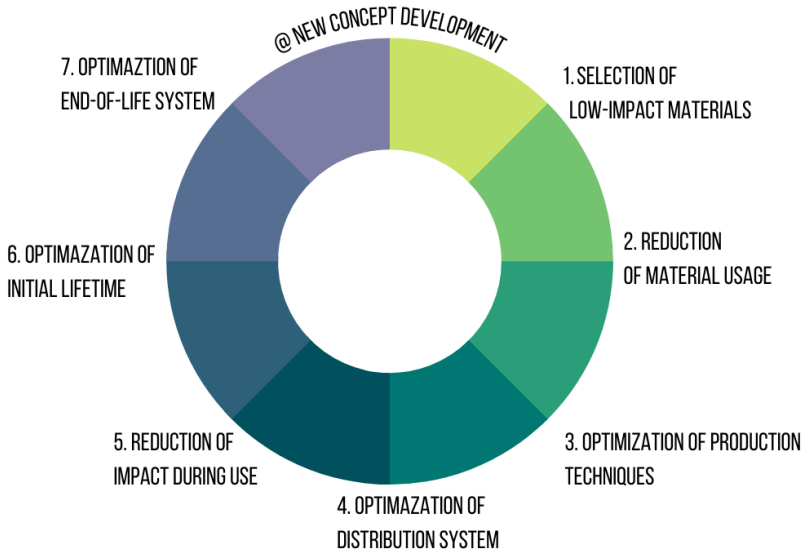
https://www.nibusinessinfo.co.uk/content/what-ecodesign



Adapted from: The Eco-design strategy wheel. (Source: Brezet and van Hemel 1997: 81) | Download Scientific Diagram (researchgate.net)

1.2 Best practice cases

Best Practice Case # 1

EcoUp

"We help the construction sector in the green transition"

EcoUp is a Finnish company that produces Ekovilla; a carbon-neutral thermal insulation made from recycled wood fibers. The wood fibers originate from old newspapers collected in the region of the plant. Ekovilla stores CO2 in durable structures for decades, and after that, Ekovilla can be further recycled in several ways. Ekovilla can be reused as they are when a building is demolished. At the end of its life cycle our insulation can be used for energy production or it can be diluted and used for soil improvement.

EcoUp also re-uses several waste materials from demolished buildings. The materials are sorted, cleaned, and crushed. The crushed grains can then be transformed into geo-polymers that can be used as non-virgin raw material for

- Asphalt
- Yard stones
- Construction screed and grout materials
- Construction and decorative elements such as acoustic panels, kitchen counter tops and tiles

LEARN MORE ABOUT ECOUP:

The circular economy group EcoUp manufactures carbon-neutral thermal insulation and reuses material from demolition: "We help the construction sector in the green transition" - Sitra

Example Of Eco Design #1:

Malongo Ek'Oh Espresso Machine (2013 *EcoProduct Award for Sustainable Development*): programmed anti-obsolescence design, modular, easy to repair, solid materials, European manufacturing, economical in electricity consumption, recyclable (75%) … Associated with coffee from fair trade, these machines offer services that are equivalent, or even superior, to those of the competition.

Example Of Eco Design #2:

CAMIF Conso' localization service: the consumer can choose online the equipment item of his/her house (furniture, bedding …) according to the proximity of the place of production to his/her home. This allows the decrease of CO2 emissions at the delivery stage and is a good example of an aspect of the eco-design approach implemented by the manufacturer.

Example Of Eco Design #3:

Adidas-Parley shoes and clothes were born out of a partnership between the sports company and the eco-awareness organization. They came up with a design-conscious solution to fight the plastic pollution problem and its impacts on the marine environment.

Example Of Eco Design #4:

IKEA's Kungsbacka kitchen is also made from recycled plastic bottles and wood.

Example Of Eco Design #5:

Some of Lego's elements (the famous bricks) are now made of plant-based plastics. They're 98% polyethylene, made from sugar cane.

Example Of Eco Design #6:

Nestlé recently announced it will sell Haagen-Dazs ice-cream in reusable, double-walled steel packaging.

Example Of Eco Design #7:

LED bulbs don't have mercury and use significantly less energy compared to CFL bulbs. Yet, they also have some downsides.

Example Of Eco Design #8:

Patagonia's (sportswear) organic cotton is also an example of how cotton can be grown wasting less water and not harming the environment with polluting chemicals.

Example Of Eco Design #9:

Toothbrushes made from bamboo are biodegradable. The use of bamboo as a raw material has several advantages; it is a lightweight material that grows at an incredibly fast speed, it does not require to be replanted after harvesting, and it is stronger than steel. However, as China is the main producer of commercial bamboo, the carbon footprint for global transportation should not be disregarded.

Example Of Eco Design #10:

Sustainable cellphone cases made from recycled plastic or wood.

LEARN MORE ABOUT **the examples of Eco-design**

A local example from Raseborg, Finland, is the company "Planet loves trees", a company that was founded to enable change in the corporate world. They believe that companies today want to act sustainably and with responsibility but finding the right solutions for it might be challenging. The company is among others involved in a project in Tanzania, that focuses on increasing natural carbon sinks through tree planting. The project is realized in cooperation with local schools, farmers, and organizations.

LEARN MORE ABOUT **Planet loves trees**

1.3 Tips for how to best implement the principles into practice in education

Practical tasks to involve students in the classroom or in virtual learning:

Tip #1: What is Eco-Design? Use current and well-known examples of Eco-Design and discuss the impact they can have.

Tip #2: Study eco-labels and discuss how you can make sustainable choices. Have the students search online sights for local and global eco-labels and discuss how familiar or unfamiliar the labels are, what value the students place on make sustainable choices and what impact labeling has on their consumption habits.

Tip #3: The opposite of Eco-Design. Watch the documentary "The true cost" with the students. Discuss the different problems with fast fashion. (Documentary can be found **here.)**

Tip #4: Dismantling of a product. Collect a few broken products from your household or school such as electronics, shoes, and pencils. Let the students disassemble the object and study how it is designed. Design an alternative to this product by using sustainability strategies.

LEARN MORE ABOUT THIS:

- https://circularclassroom.com/sv/for-larare/
- https://eperusteet.opintopolku.fi/#/sv/opas/7381023/tekstikappale/7386992
- https://www.sitra.fi/en/articles/how-to-make-the-circular-economy-part-of-the-national-education-system-tips-from-finland/
- https://circula.fi/en/for-teachers-and-other-game-masters/

Students - Circular Classroom

1.4 How to motivate students to adapt the right mindset

The best way to implement the principles of "Eco-Design" into practice in education is by following the basic approach of learn by doing. It is important to encourage students to actively participate through creative thinking and resolving complex problems. This is best done by exploring the principle of eco-design through topics that the students find interesting and care about.

1.5 Questions

The following questions can be used as a guideline for testing the students' previous knowledge of the topic and to provoke discussion:

Question #1: What is Eco-Design? How is eco-design defined?

Question #2: What do different eco-labels mean and how can we make sustainable choices?

Question #3: What is the true cost of fast fashion? What impact does trendsetting have on our society and the environment?

Question #4: What are common mistakes that are made when designing products that are not sustainable?

1.6 Links to further material

Sustainable development online courses in English, Finnish and Swedish:

https://keke.bc.fi/Kestava-kehitys/english/

https://doughnuteconomics.org/

Sitra Livsstilstest

100 smarta vardagsgärningar - Sitra

ekologiska_fotavtryck_lr.pdf (triggerfish.cloud)

Första sidan - miljo.fi (ymparisto.fi)

Luonto-Liitto - Kulutus.fi –

Att leva ekologiskt - Footsteps

Ympäristöosaava (ymparistoosaava.fi)

2. LIFE-LONG MATERIALS AND PRODUCTS

2.1 Introduction

"From cradle to cradle for a better world! "

"Cradle to Cradle is all about design – designing in a way where everything we do has a positive impact. Imagine if all the things you see were good for people and planet, and that every time a company made these products, they were creating good." - Bridgett Luther, Co-founder and former president of the Cradle-to-Cradle Products Innovation Institute

"Most recycling is actually "downcycling". Every time materials are recycled, they are mixed with lesser quality metals or plastics, resulting in a lower quality material. This continues until you just have trash. Manufacturers need to design products with the goal of making sure that, at the end of the current cycle-of-use, 100% of product components can either be safely returned to the earth or returned to industry as valuable raw material".

The attention to be given a priori to materials is crucially important.

A circular economy promotes long product lives. The longer a product lasts, the less raw materials will need to be sourced. Product durability contributes to reducing the depletion of raw materials. By 2050, an estimated 9 billion people will inhabit the Earth. To meet the needs of a growing population, sustainable materials are key. One such material is steel.

Clean materials are crucial for maintaining material performance and quality in recycling processes. Material performance and reliability regarding the safety of the materials — in addition to the price — will largely determine whether consumers will buy recycled materials and derived products. Keeping material cycles clean is therefore essential for the circular economy, from both a safety and an economic point of view. This is a main area of potential synergy with EU chemicals legislation (for example REACH , EU, 2006) and the strategy for a non-toxic environment stipulated in the 7th EAP.

2.1.1 The Cradle-to-Cradle model vs Cradle to Grave Model: the role of the materials

In 2002, Braungart and William McDonough published a book called Cradle to Cradle: Remaking the Way We Make Things, a manifesto for cradle-to-cradle design that gives specific details of how to achieve the model. The model has been implemented by a number of companies, organizations and governments around the world, predominantly in the European Union, China and the United States. Cradle-to-cradle design has also been the subject of many documentary films such as Waste = Food. **NB. Refer to the chapter Eco-design for further material on cradle-to-cradle design.**

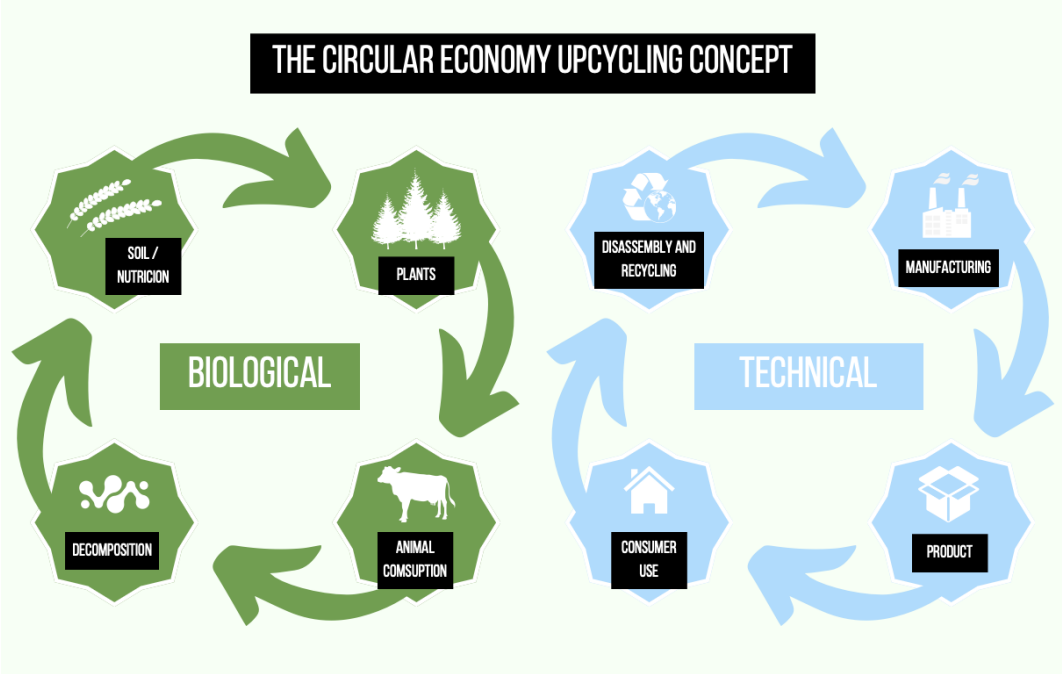
In the cradle-to-cradle model, all materials used in industrial or commercial processes, such as metals, fibers, and dyes, fall into one of two categories: *technical* or *biological* nutrients:

1- **Technical Nutrients** are strictly limited to non-toxic, non-harmful synthetic materials that have NO negative effects on the natural environment. They can be used in continuous cycles as the same product, without losing their integrity or quality. They can be used repeatedly, instead of being "downcycled" into lesser products. Technical nutrients can be considered as service products, as their use in a certain product is not limited, instead are used several times in the creation of new products.

2- **Biological Nutrients** are organic materials that, once used, can be disposed of in any natural environment and decompose into the soil, providing food for small life forms without affecting the natural environment.

The Cradle-to-Cradle model is based on the notion of ecosystem, thus meaning that all materials cycles should to be considered regarding their relationship to the ecology of the specific territories. For example, organic material from one country or landmass may be harmful to the ecology of another country or landmass, even if it would have no significant impact on its local territory.

The two types of materials each follow their own cycle in the regenerative economy, as shown in next figure:



Both categories, biological and technical nutrients, can be defined as **Long-Life Materials.**

Initially defined by McDonough and Braungart, the Cradle-to-Cradle Products Innovation Institute's five certification criteria are [7]:

- Material health, which involves identifying the chemical composition of the materials that make up the product. Particularly hazardous materials (e.g., heavy metals, pigments, halogen compounds etc.) must be reported whatever the concentration, and other materials reported where they exceed 100 ppm. For wood, the forest source is required. The risk for each material is assessed against criteria and eventually ranked on a scale with green being materials of low risk, yellow being those with moderate risk but are acceptable to continue to use, red for materials that have high risk and need to be phased out, and grey for materials with incomplete data. The method uses the term 'risk' in the sense of hazard (as opposed to consequence and likelihood).
- Material reutilization, which is about recovery and recycling at the end of product life.
- Assessment of energy required for production, which for the highest level of certification needs to be based on at least 50% renewable energy for all parts and subassemblies.
- Water, particularly usage and discharge quality.
- Social responsibility, which assesses fair labor practices.

" Cradle to Cradle (C2C) is about seeing garbage as an eternal resource and doing the right thing from the beginning. It is about making community and product development function in the same way as a healthy ecological system where all resources are used effectively, and in a cyclical way (as opposed to the current linear system that can be better described as a Cradle to Grave system).

For the C2C system to be sustainable, all materials in products need to be kept clean and should not be mixed. Alternatively, there needs to be a separation system in place that can be applied after the item is discarded. C2C methodology builds on the concept that "waste = food", meaning that what is considered waste can become food in a new product cycle.

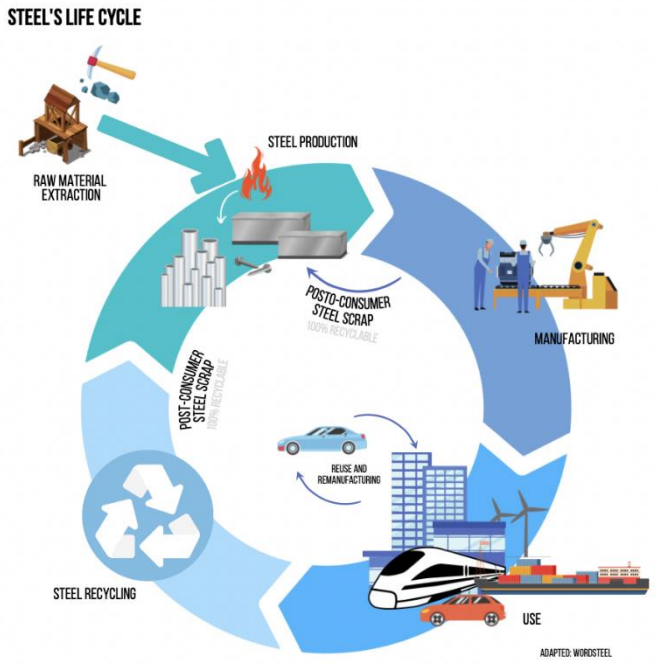
This methodology was developed by Professor Michael Braungart and William McDonough in 2001 and it has been used as inspiration in products, buildings, and production systems."

SOURCE AND READ MORE ABOUT SUSTAINABILITY GUIDE

2.1.2 Long-Life Materials within the Cradle to Cradle (C2C) model: 2 prototypes

Steel = C2C

Steel is a C2C material. The cycle of steel is closed, and steel can be both recycled and upcycled. For example, a profile of steel grade S235 can be remelted to the higher grade S460. The recycling of S235 to S460 will use just the same amount of energy as recycling of S235 to S235. An S460 steel profile possesses improved properties, such as higher strength. As a result, less material is required for a structural element (lightweight construction). The slightly higher purchase price of the S460 (about 9% higher than S235) is insignificant in comparison to the dual benefits gained.



In theory, all new steel could be made from recycled steel. However, this is not practically feasible due to the long life of steel products, given steel's strength and durability. Around 75% of steel products ever made are still in use today. Buildings and other structures made from steel can last from 40 to 100 years and longer if proper maintenance is carried out.

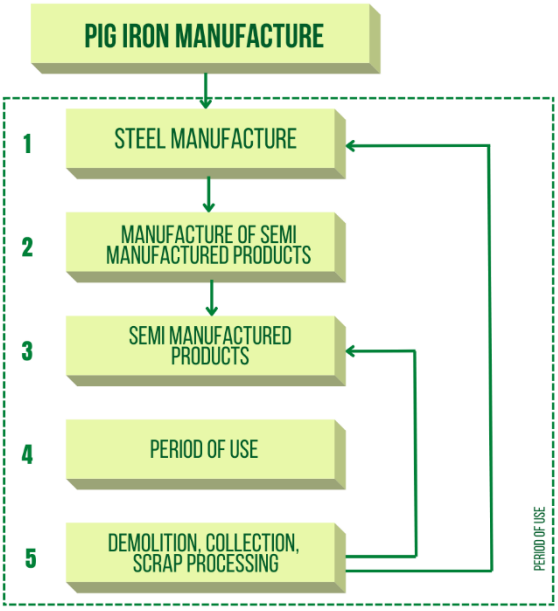
For example:

• In 1883, New York's Brooklyn Bridge became the world's first steel bridge to carry traffic. Over 130 years later it still carries over 120,000 vehicles a day.

• Completed in 1891, the Basilica of San Sebastien in the Philippines capital, Manila, remains the only prefabricated steel church in Asia. Sections were manufactured in Belgium and shipped to the Philippines where the church was assembled.

• The iconic Sydney Harbor Bridge has been carrying road and rail traffic since it opened in 1932. The bridge contains over 53,000 tons of steel waiting to be recycled. None of these structures are scheduled to be replaced in the foreseeable future.

Steel's durability is one of the key properties that make it a sustainable material. Not only does steel ensure long product life, but it also allows the reuse of countless products, from paper clips to rail and automotive components.



Biological Nutrients

Cork is a renewable natural material. When done correctly, extraction does not cause any negative impact and does not require cutting down the tree. When cork bark is carefully removed by hand, cork oaks can regenerate the bark that has been removed, and its extraction does not cause contamination. A cork oak forest has the capacity to set 6 tons of CO2 per hectare per year, in this way, Mediterranean cork oak forests capture more than 14 million tons of CO2 each year. The environmental benefits of the cork oak forests include the preservation of the plant subsoil, water retention, protection of marshes, control of erosion and, therefore, desertification and fire prevention, because of its fireproof character (source: Meforest.net)

LIFE CYCLE

Click on the image to open the video.

2.1.3 Focus On Products: European Economic Area (EEA) based reflections

Products play a key role in the economy, serving society's needs and contributing to people's identity. Designing products better, extending their useful lifetime and changing their role within the system will be crucial for the development of a circular economy.

The central aim of a circular economy is to maintain the function and value of products, components, and materials at the highest possible level and to extend the lifespan of such products. Maintaining a product's value for as long as is sensible avoids the use of natural resources and the environmental impacts associated with creating a replacement, and, although recycling captures some of these values, losses are inevitable. However, it must be kept in mind that this is not necessarily the case for inefficient durable products in which the majority of emissions are caused during their use (e.g., old cars without catalytic converters).

From an economic perspective, a product, for instance a fully functional car, has in most cases a higher economic value than the sum of the separate materials and components from which it is made. From an environmental perspective, an assembled car also has a higher environmental footprint than the sum of its component materials because its assembly has involved the use of additional environmental resources.

Product design determines to a large extent the product's:

a) longevity
b) reparability
c) recyclability

Product design therefore determines the circularity potential of a product.

2.1.4 Socio-political determinants of a product's lifecycle

To what extent the circularity potential is realized depends on how the product is used and treated during its full life cycle, or life cycles, in the case of successive applications. The circularity of a product is thus determined not only by the intrinsic product characteristics, but also by the system of which it is a part of.

For example, the probability that a washing machine that is designed for easy repair is in fact repaired will depend not only on the business model being used to market it, but also on the infrastructure and governance context of the country in which the washing

machine is sold and used, in addition to the cost of repairing the washing machine compared with the purchase price of a new one.

Washing machines that are part of a product-service system, and/or placed on the market in a country with low labor costs and high availability of technically skilled workers, will have a higher degree of circularity than the same machines sold in a country where a repair sector is largely absent.

As another example, the potential of the sharing economy to improve product circularity depends on the actual changes in the use intensity of goods (e.g., by increasing the occupancy rate of a car).

This ultimately depends on the actual effects of the business and consumption models used and on the potential rebound effects caused elsewhere in the system. Promoting and monitoring product circularity thus requires knowledge of the way the system in which the product plays a role behaves (e.g., a car in the transport system). For the implementation of effective business models, policy measures and consumer action, it is essential to identify and understand the systemic links between a product, the business model of which it is a part, and the societal context that determines its life-cycle.

Box 3.3 Does collaborative consumption contribute to a circular economy?

There is no straightforward 'yes' or 'no' answer to this question. This example illustrates some of the difficulties in assessing the actual environmental impact of collaborative consumption.

A study on car sharing in the United States concluded that one car-sharing vehicle replaces 9-13 vehicles among car-sharing members because they sell their vehicles or postpone purchasing one. Overall, car-sharing users reported that they walked, cycled and carpooled more, leading to decreased monthly household transport costs (Transportation Sustainability Research Centre, 2015). Another study, however, reported that this change in lifestyle does not always occur, and that the overall effect of car sharing on car use depends on the proportion of users abandoning car ownership rather than public transport (Martin and Shaheen, 2011).

2.2 Best practice cases

Best practice cases of business models based on the Cradle-to-Cradle Model and on the use of Long-Life Materials.

Best Practice Case # 1

CRADLE TO CRADLE IN THE CLEANING SECTOR: GREEN CARE PROFESSIONALS

Cradle to Cradle Cycle Model of Green Professionals Cleaning product

The brand green care PROFESSIONAL provides worldwide the first comprehensive Cleaning and Care Range with the Cradle-to-Cradle Certified TM GOLD certificate. Cradle to Cradle® is based on the design of green care PROFESSIONAL cleaners for biological or technical cycles. The challenge is in planning the product's progress through a closed material cycle, which means that product materials should be suitable for a safe and complete return to the biosphere or for recovery and good quality reuse.

Future sustainable professional cleaners should be designed in such a way that the quality of recycling fractions is improved, and recycling is done at the same or higher level. Ingredients, including pigments and additives, should be selected to preclude toxic effects during use or in other phases such as manufacturing, recycling, and reuse.

In keeping with the Cradle to Cradle® principle, crude oil, for instance, used one time to make plastic, remains in the cycle and is not irretrievably burned. The energy for recycling, as for other production processes, should be drawn, if possible, from renewable sources in an environmentally and climate-friendly fashion. A good example of this is the production of a new PET bottle from an old PET bottle.

Click on the image to open the video.

Best Practice Case # 2

CRADLE TO CRADLE IN THE FURNITURE SECTOR: HOW THE BUSINESS MODEL CHANGES

Professor Braungart, author of the book Cradle to Cradle explains how the entire industry, from the home and office furniture industry to manufacturers of upholstery materials, has embraced the Cradle-to-Cradle principles with great enthusiasm.

An increasing number of floors covering manufacturers are working according to the Cradle-to-Cradle principles.

An example is offered by Tarkett, the first wood flooring producer in Europe with Cradle to CradleTM certificate.

Made with 100% positively defined materials, Tarkett's DESSO EcoBase® carpet tile backing has achieved Cradle to CradleTM Gold-level certification, with Cradle to CradleTM Platinum level for material health. It contains an average of 80% recycled content (upcycled chalk) and is made in a plant powered exclusively by renewable electricity. The entire backing can be separated from the carpet tile and 100% recycled at Tarkett's purpose-built production line. What's more, recycling EcoBase-backed carpet tiles with ECONYL yarn delivers up to 84% CO2 savings compared to incineration.

Tarkett's DESSO EcoBase

Cradle to Cradle Cycle Certification Awarded Criteria

What is the change?

In fact, it is very simple. Manufacturers no longer sell carpets, but floor finish insurance. They no longer sell desk chairs, but healthy seating insurance that lasts for ten years. The manufacturer only provides **the service.** The customer knows that he will get a good desk chair that will survive for ten years, or that a given floor finish will keep its good looks for ten years. With this business model, the manufacturer becomes a materials bank. He sells only the use of a product, i.e., only its possession, and not its ownership.

This allows him to use much better, healthier, and more beautiful materials, not the cheapest ones. In this way, my customer becomes a friend. Durability is no longer the focus. **Rather, a clearly defined period of use through innovation is.** Then, after use, the product is returned to the manufacturer, who can recover the materials, or, alternatively, sell the raw materials: this process gives the manufacturer the necessary long-term financial security.

2.3 Tips for how to best implement the principles into practice in education

Tip #1: First in first present and debate with the students the concepts of Long-life materials and products as well as the Cradle-to-Cradle model.

Tip #2: Have the students research what kinds of long-life materials are commonly used in the local area.

Tip #3: Have the students design C2C products business models that could be used in your country/region.

Tip #4: Discuss together as a group the possible barriers and contradictions regarding the use of long-life materials and cradle to cradle design. Provide concrete case studies as a basis for reflection.

2.4 Guide questions

Engaging students in researching practices, examples and design Business Models targeted on the local context and materials.

The following guide-questions can be used to assess the students' level, promote discussion, and encourage research into the topic:

1. What is the definition of a life-long material?
2. Describe the basics of the cradle to cradle (C2C) model
3. How many C2C Certifications are there worldwide?
4. To what sectors could the Cradle model be applied in your region?
5. Can you find a local best practice and describe it?
6. Describe 1 Technical Nutrient and 1 Biological Nutrient present in your territory
7. Focus and reflections on the socio-cultural determinants of product's end-life duration

2.5 Links to further material

LEARN MORE ABOUT CRADLE-TO-CRADLE MODEL

On Steel Life Cycle
https://www.worldsteel.org/en/dam/jcr:00892d89-551e-42d9-ae68-abdbd3b507a1/Steel+in+the+circular+economy+-+A+life+cycle+perspective.pdf

On Cork (Prezi)
https://prezi.com/p/bdygy2d0at7q/cork-life-cycle/
https://www.core77.com/posts/21278/the-loops-the-industrial-lifecycle-of-cork-21278

EEA Report EEA Report No 6/2017, Circular by design, Products in the circular economy.

3. REGENERATIVE RESOURCES

3.1 Introduction

Regenerative resources are a pillar stone in a regenerative economy. Regenerative means rebuilding or restoring something that has been destroyed. Regenerative resources are thus those resources that have a restorative and positive effect on the environment. This may involve resources contributing to the restoration of climate change, soil depletion or eutrophication of seas and lakes. Regenerative resources are linked to the circular economy in that they are recyclable or compostable and thus follow the circular economy and not the linear economy. Instead of having a negative or neutral impact on the environment, regenerative resources have a positive and rebuilding impact on the environment. It could be resources that store carbon dioxide, remove nutrients from overfed waterways, or agriculture based on returning nutrients and carbon dioxide to the soil instead of depleting the soil and removing bound carbon dioxide from there.

When speaking of regenerative resources, it is also important to consider a regenerative economy.

According to Circulab, there are five principles that promote a successful regenerative and circular economy:

Principle 1: "Regenerative economy promotes sobriety, rather than abundance."

> Encouraging a clean use of resources is a must. The goal should be to create zero waste, all resources should be able to be recoverable and valued for further use after the initial products life cycle. As a concrete example from nature, a tree that has shed fruit will re-consume the nutrients from the degraded fruits and the cycle continues.

Principle 2: "Regenerative economy can work without extracting new materials."

> A clean use of materials that can be re-used promotes the absence of extraction. Extraction of raw materials (oil, minerals, metals in particular) is now responsible for more than half of greenhouse gas emissions and 80% of biodiversity losses. To regenerate and preserve ecosystems, the use of virgin resources should be minimized, and the use of energy should be restricted to flow energies, i.e., water, wind, and sun energy.

Principle 3: "Regenerative economy is a local economy that promotes interaction between actors."

> Encouraging local and territorial supply chains and value solutions provides stronger resilience to global fluctuations and demand crises. Continuous outsourcing of production to foreign territories and relying on constant import and export has a great impact on many levels. Not only do global crises affect trade, increase the carbon footprint of transportation, but also limits the local

know-how for various processes. All manufacturing and natural resources cannot be focused on a local territory but striving for maximization of the use of territorial possibilities is a good start. In 2017, China made the decision to cut back on the import of waste from America and Europe. The decision resulted in a massive repercussion. Local recycling solutions were nil in several locations, which led to the drastic result of several cities in the United States to stop sorting and recycling waste – the processing capacities were simply nonexistent. Severe issues and challenges were also faced in Europe.

Principle 4: "Regenerative economy leads to cooperation rather than competition."

Though healthy competition may be encouraged and beneficial to an economy, in a perfect world a cooperation between actors where collective intelligence is encouraged and each actor is considered at its true value is far more advantageous: "Horizontal collective intelligence makes it possible to better adapt to a complex and unstable environment. Unlike it, pyramidal collective intelligence is only suitable for stable environments. As Gauthier Chapelle clearly points out in his conference on this subject at Biomim'expo 2018, these organizations do not exist in the living world and have no capacity for adaptation, they come only from agricultural and patriarchal societies."

Principle 5: "Regenerative economy develop life and evolution, rather than destroying it."

The main goal of a regenerative economy is to promote life. With constant growth comes the need to produce and consume more. Restricting human population is not ideal, instead focus should be placed on restricting harmful actions. "To promote life is to allow the living to prosper." The best course of action is to place focus on how and what we consume, the design of products, and the use of materials and resources that are sustainable. Instead of relying on processes that are harmful to the ecosystem, emphasize "products or services that capture carbon, regenerate soils and biodiversity, and improve air and water quality."

Though the concept of regenerative resources is relatively new and is not yet fully defined in all fields, it is used in agriculture. Regenerative resources have great potential. It can be anticipated that in the future we will use resources that we have never thought of as resources before.

"According to the OECD, the world's middle class now represents 1.7 billion people. The resource consumption of this population corresponds to the equivalent of 1.7 Earth planets. By 2030, this middle class is expected to reach 4 billion people."

Visit: **Circulab**

The only way to curb resource consumption is to find alternative resources, i.e., regenerative resources.

Regenerative agriculture uses regenerative resources. "Regenerative Agriculture" describes farming and grazing practices that, among other benefits, reverse climate change by rebuilding soil organic matter and restoring degraded soil biodiversity – resulting in both carbon drawdown and improving the water cycle".

Regen-Ag Definition 2.23.17.pdf (regenerationinternational.org)

An example of regenerative agriculture is avoiding turning the earth but instead covering it or growing cover crops. Turned soil emits carbon dioxide and does not bind water. Cultivated or covered soil binds water and prevents carbon dioxide from being emitted into the atmosphere. The fertility of the soil is increased by adding compost, animal manure, rotating crops and keeping the soil covered or cultivated. This rebuilds the soil's balance of microorganisms, improves the structure of the soil, and streamlines the circulation of nutrients in the soil. Fertilizer in turn destroys this balance, depletes soil and overflow nutrients leak into watercourses. To try to save the pollinators, crops are also grown for them. For the same reason, monocultures with low biodiversity are avoided.

3.2 Best practice cases

Best Practice Case # 1

An inspiring example from Finland

woodio

Composite materials are becoming of great relevance within the building branch. Companies such as Metsä Group are making massive investments to find new ways to support the use of underutilized side-streams into long-lived, value-added products.

Using a combination of a side-stream material as the main raw material and a product storing carbon dioxide (CO2) for a long time is anticipated to become very competitive when comparing the environmental footprint of a new biomaterial against the existing commercial solutions of today.

Image source: woodio.fi

Best Practice Case # 2

ECOLAN: "2021 IS A RECORD YEAR FOR ASH FERTILIZATION IN FINLAND"

The company Ecolan processes ash originating from energy production into fertilizers and earth construction materials. Juha Ahvenainen, the company's CEO, explains that there is global interest in restoring nutrients to forests in the form of ash fertilizers. Ecolan produces fertilizers and construction materials from ash generated in the burning of biomass, coal, or peat in the energy industry.

LEARN MORE ABOUT **ECOLAN**

LEARN MORE ABOUT THIS:

https://www.sitra.fi/en/projects/interesting-companies-circular-economy-finland/#the-most-interesting-companies-in-the-circular-economy-in-finland-2-1

3.3 Tips for how to best implement the principles into practice in education

Regenerative resources is a topic which is probably best approached through open discussion, brainstorming and various group activities. For students within the agricultural field, there are many concrete and tangible examples available, but other industries are still lagging, and imagination is key.

1. Have the students consider what practices, i.e., products or services are necessary in their daily lives:
    a. Which of these products are produced locally?
    b. For imported goods, are there local options?
    c. What kind of know-how would be required for local manufacturing?
    d. Where would the raw materials come from?

2. Brainstorm together or have the students research alternative raw materials for products generally produced from virgin resources.

3. Have the students provide examples of local / territorial best practices of the use of regenerative resources

4. Discuss the possibilities and challenges of creating a regenerative economy

3.4 How to motivate students to adapt the right mindset

Regenerative resources and the possibility of creating (and sustaining) a regenerative economy are concepts that may be challenging to understand. To motivate the right mindset, it is important to focus on matters that are interesting out of the recipient's point of view. Encourage students to think outside the box. What would a perfect world look like in their opinion? What do we want from our lives, what do we want to pass on to further generations? Are we willing to stand the consequences of not making a change? Provoke discussion and encourage students to challenge their daily decisions.

3.5 Links to further material

- https://johnnurmisensaatio.fi/sv/projekt/
- https://www.stjm.fi/en/circular-economy-textiles/
- https://www.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail
- https://bioenergyinternational.com/biochemicals-materials/metsa-spring-invests-in-wood-composite-tech-developer-woodio
- https://circulab.com/regenerative-economy-definition/

4. WASTE AS A RESOURCE

4.1 Introduction

Europe's economy depends on an uninterrupted flow of natural resources and materials, including water, crops, timber, metals, minerals, and energy carriers. Imports provide a substantial proportion of these materials. Increasingly, this dependence could be a source of vulnerability, as global competition for natural resources increases.

According to the European Environmental Agency (EEA), "in recent years, the concept of the circular economy and related policies have tackled resource use, production, consumption, and waste at a high level. This concept aims to close material loops by maintaining the value of products, materials, and resources in the economy for as long as possible. This effectively reduces waste generation and the use of virgin material, hence also reducing associated pressures".

The article "Waste: a problem or a resource?" from the European Environmental Agency states that "Europe generates large amounts of waste. Waste is not only an environmental problem, but also an economic loss. On average Europeans produce 481 kilograms of municipal waste per year. An increasing share of this is recycled or composted, and less is sent to landfill". Municipal solid waste (MSW) and its management is an environmental concern. With the development of concepts like sustainability and circular economy, as well, as with the development of society's conscience towards these issues MSW management progressed from basic disposal to recycling and resource recovery.

Recycling materials from waste, as well as recovering energy, are crucial in a circular economy point of view, in order 'to close the loop'. Waste disposal should be phased out and, where it is unavoidable, it must be controlled to be safe for human health and the environment.

Therefor, *"Can we change the way we consume and produce in order to generate less waste, while using all waste as a resource?"*

Our production models are strongly related to the amount of waste we generate.

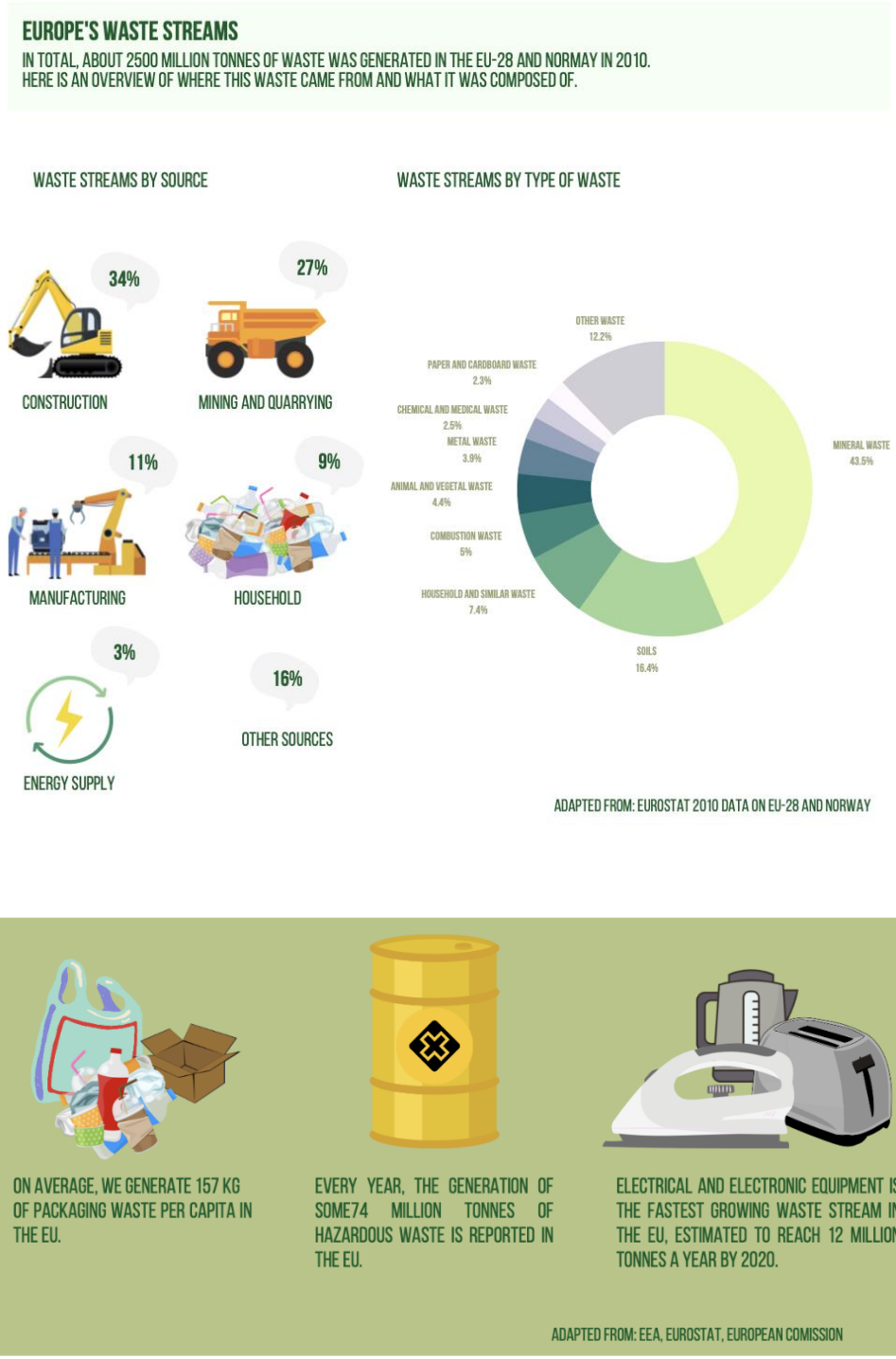
It is then important to stablish end-of-waste criteria instruments since a systematic technical, economic, and environmental evaluation allows to assess if a recyclable waste material is safe for the environment and is of a high enough quality to no longer must be classified as waste.

There is, however, a large range of waste types and complex waste-treatment paths (including illegal ones) that makes it difficult to get a clear overview of the waste created and its situation. There are data, though of differing quality, for all types of waste.

Visit the Websites for further information

https://www.eea.europa.eu/themes/waste/intro

https://www.eea.europa.eu/publications/signals-2014/articles/waste-a-problem-or-a-resource



Europe's waste streams (Adapted from EEA)

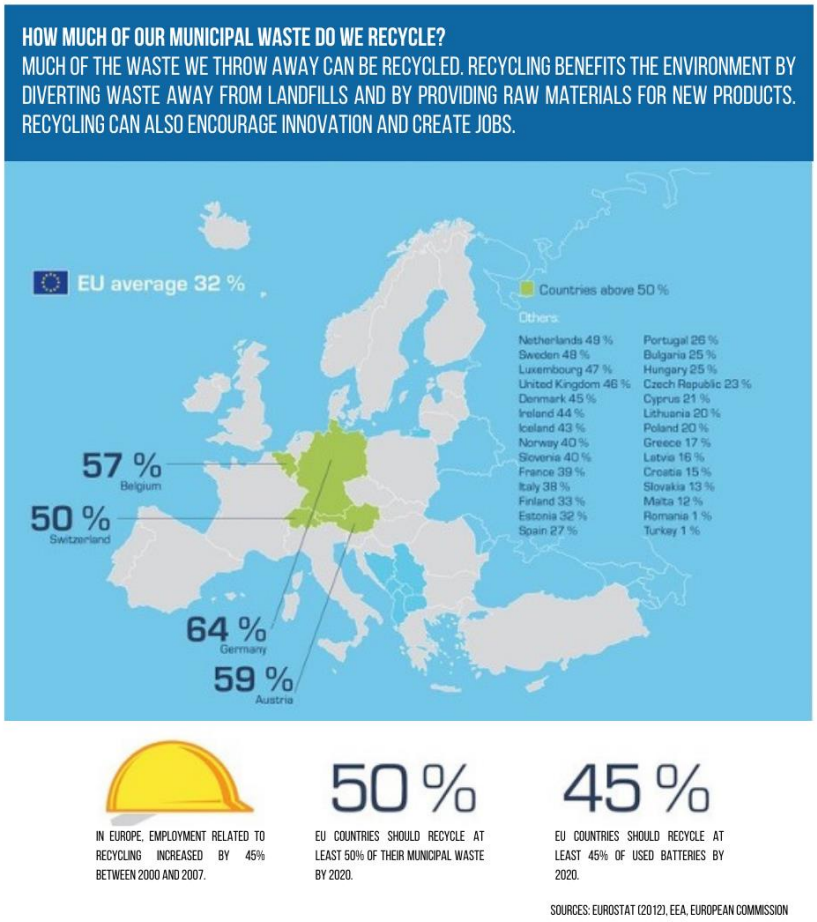
Visit the Website for further information

https://www.eea.europa.eu/publications/signals-2014/articles/waste-a-problem-or-a-resource

In Europe, the EU waste legislation is strongly connected to waste management changes. The European Waste Framework Directive (WFD) delineates a waste management hierarchy:

Prevention → Preparing for re-use → Recycling → Recovery → Ending with disposal

It aims to prevent waste generation as much as possible, to use waste that is generated as a resource and to minimize the amount of waste sent to landfill.



How much municipal waste is recycled?

Visit the Website for further information

https://www.eea.europa.eu/publications/signals-2014/articles/waste-a-problem-or-a-resource

Waste affects ecosystems and our health. A poor waste management can severely affect Ecosystems. The marine ecosystem is one simple example, where the ingestion and entanglement of waste represents severe threats to marine species.

We should also consider the indirect impact of waste in ecosystems. Everything that is not recycled or recovered from waste represents a loss of raw material as well as other inputs used in the chain (production, transport, and consumption phases of the product). Environmental impacts in the life-cycle chain are considerably higher than those in the waste management phases alone.

Economic loss and burden to the society is another waste impact. When the 'residues' are discarded, all the inputs (land, resources, energy, labor, etc.) used in its extraction, production, dissemination, and consumption phases are also lost.

Managing waste is also expensive, since creating an infrastructure for collecting, sorting, and recycling is pricey, but on the other hand, after is completed, recycling can generate profits and create jobs.

We should also take in consideration that what we consume and produce in Europe can generate waste somewhere else on the planet.

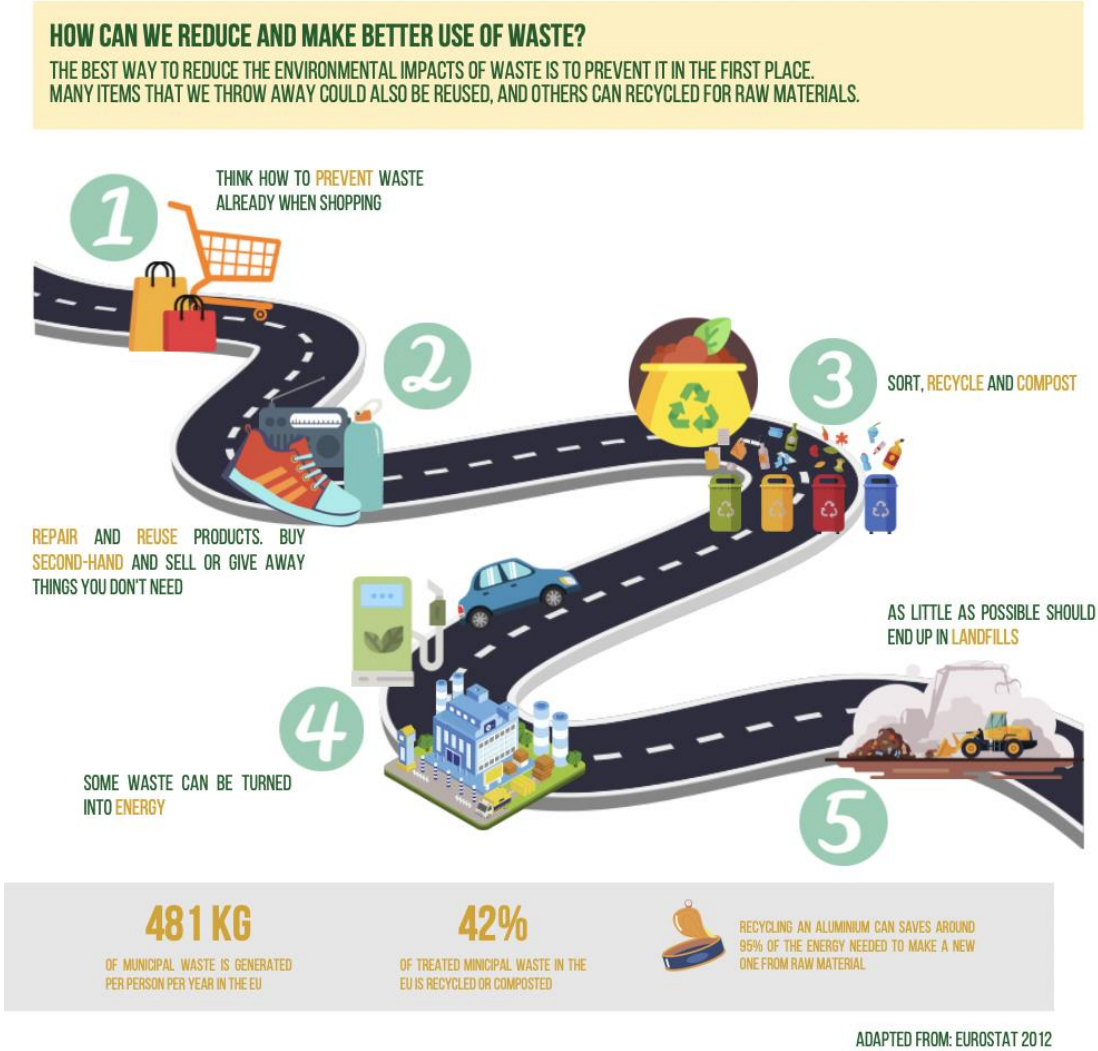
What if we could use waste as a resource and, in this manner, decrease the necessity for extraction of new resources?

Making a new product requires a lot of materials and energy. Raw materials must be extracted from the earth, and the product must be fabricated then transported to wherever it will be sold. Extracting fewer materials and using existing resources would help prevent some of the impacts created along the chain (save natural resources, protect the environment, and save money).

EU's Roadmap to a Resource Efficient Europe defines, as a key objective, the use of waste as a resource. The Roadmap also emphasizes the necessity to guarantee high-quality recycling, eliminate landfilling, limit energy recovery to non-recyclable materials, and stop illegal shipments of waste.

Visit the Website for further information

https://ec.europa.eu/environment/resource_efficiency/



Reduce and make better use of waste (EEA)

According to the Environment Action Programme to 2020 of the European Commission, the 7th Environment Action Programme (EAP) "identifies stepping up resource efficiency as one of its three key objectives to meet the 2050 vision of 'living well, within the limits of the planet':

- to protect, conserve and enhance the Union's natural capital.
- to turn the Union into a resource-efficient, green, and competitive low-carbon economy.
- to safeguard the Union's citizens from environment-related pressures and risks to health and well-being".

Visit the Website for further information

https://www.eea.europa.eu/publications/signals-2014/articles/waste-a-problem-or-a-resource

https://ec.europa.eu/environment/action-programme/

Did you know that the biggest fraction of municipal solid waste, in many countries, is kitchen and gardening waste?

This type of waste, when collected separately, can be turned into an energy source or fertilizer. Anaerobic digestion is a waste treatment method that involves submitting bio-waste to a biological decomposition process like the one in landfills, but under controlled conditions. Anaerobic digestion produces biogas and residual material, which in turn can be used as fertilizer, like compost.

Did you know that in the EU, an estimated 20% of the total food produced is lost or wasted (FUSIONS, 2016), while 33 million people cannot afford a quality meal every second day (Eurostat, 2018)?

Households generate more than half of the total food waste in the EU (47 million tons) with 70% of food waste arising at household, food service and retail (FUSIONS, 2016).

Globally, approximately a third of all food produced for human consumption is lost or wasted (FAO, 2011).

According to the European commission "food is lost or wasted **along the whole food supply chain**: on the farm, in processing and manufacture, in shops, in restaurants and canteens and in the home. The reasons for food waste vary widely and can be sector-specific".

The EU Platform on Food Losses and Food Waste issued a set of key recommendations for action in food waste prevention to inspire and encourage public and private players to act.

Consumers and industries can play an important role in reducing food waste. Often with minimal effort, food waste can be reduced, saving money, and helping to protect the environment.

There are numerous actions around European Countries that are engaged in food waste prevention.

Visit the Website for further information

https://food.ec.europa.eu/system/files/2021-05/fs_eu-actions_action_platform_key-rcmnd_en.pdf

https://food.ec.europa.eu/safety/food-waste_en

Farm to Fork chain

E-waste is the fastest growing waste stream in the EU and less than 40% is recycled.

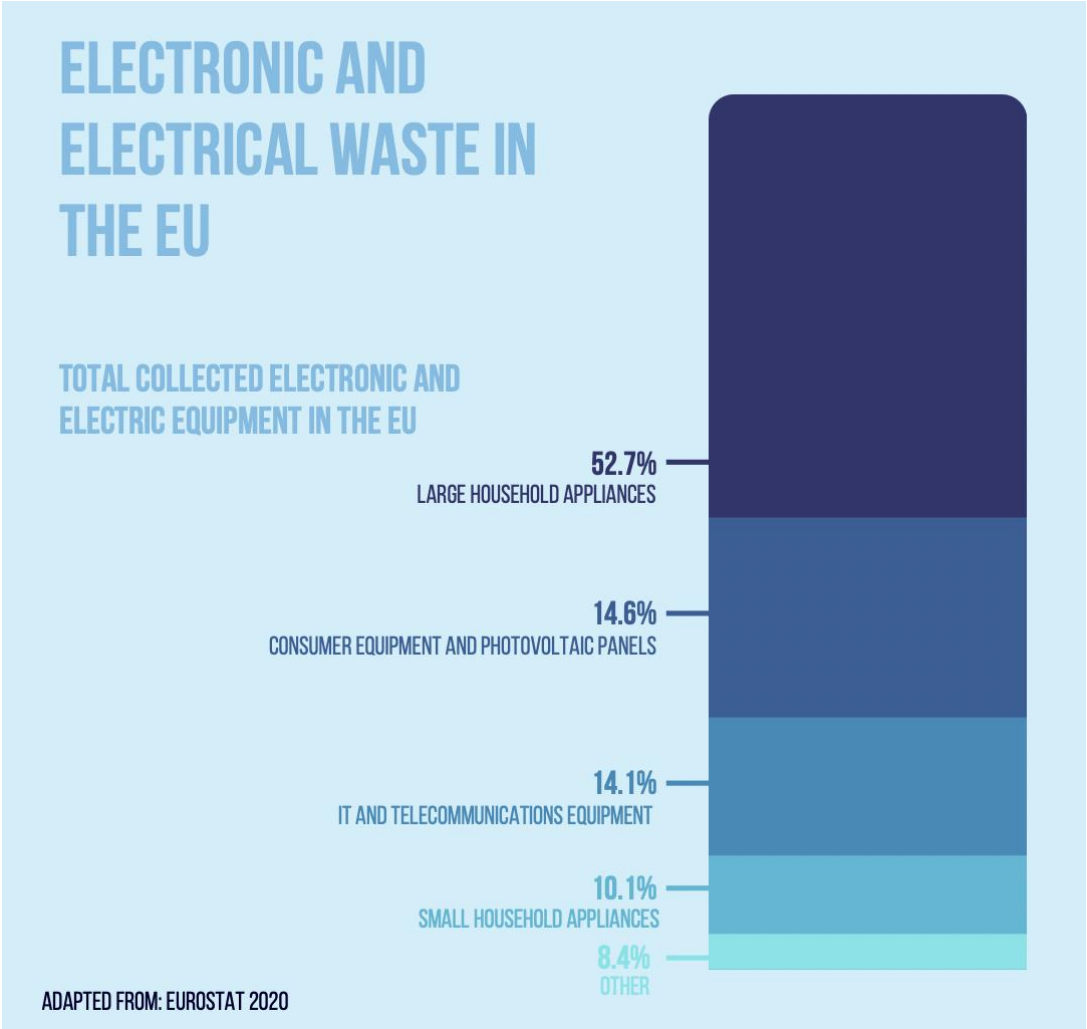
Electronic devices and electrical equipment are an important part of modern life. Washing machines, coffee machines, smartphones, computers, etc. play an important role in our day-to-day life. However, the waste they generate has an enormous impact on society's ecological footprint.

What is e-waste? Electronic and electrical waste, or e-waste, covers a variety of different products that are thrown away after use. This includes:

- Large household appliances, such as washing machines and fridges,
- IT and telecommunications equipment,
- Consumer equipment and photovoltaic panels (video cameras, fluorescent lamps)
- Small household appliances (vacuum cleaners, toasters).

Visit the Website for further information

https://food.ec.europa.eu/horizontal-topics/farm-fork-strategy_ro



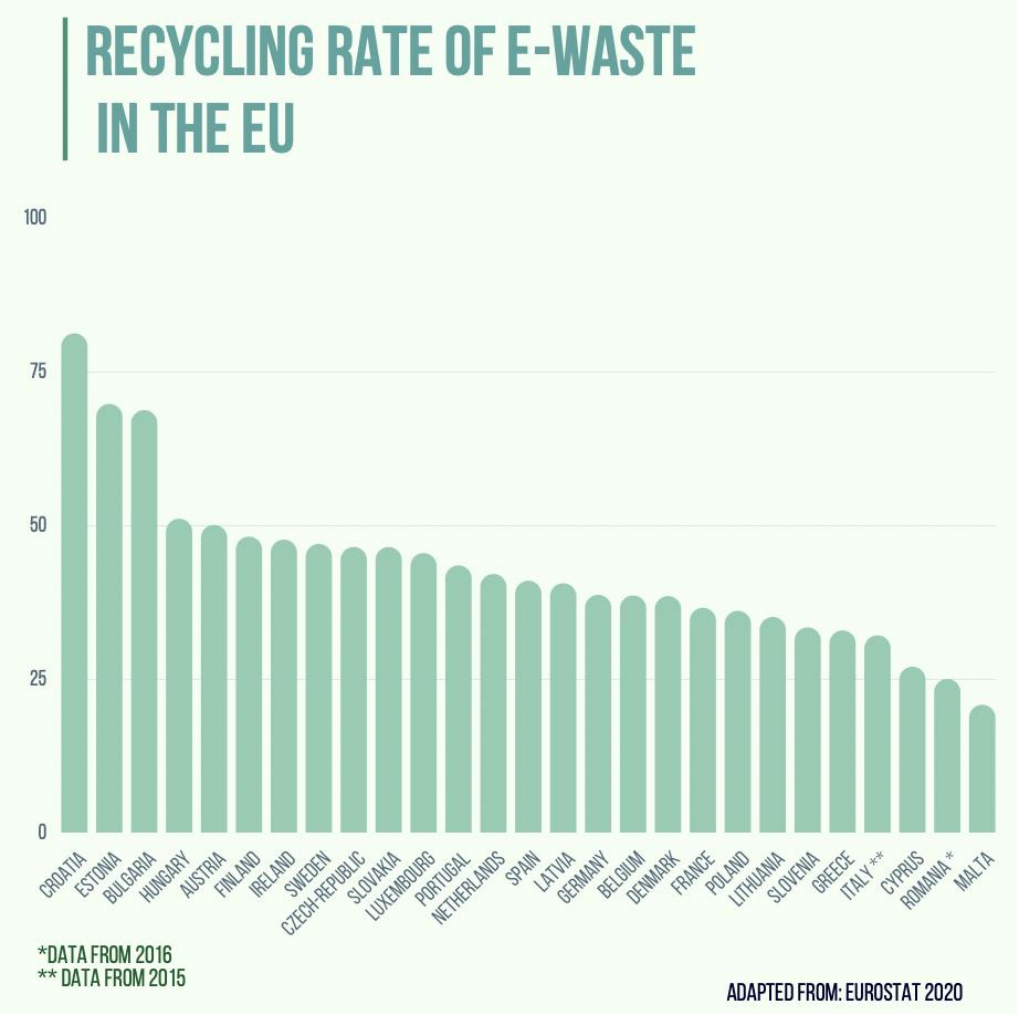
E-waste in EU

When we analyze the image above, we can see that less than 40% of all e-waste in the EU is recycled.

Visit the Website for further information

https://www.europarl.europa.eu/news/en/headlines/society/20201208STO93325/e-waste-in-the-eu-facts-and-figures-infographic

Recycling practices vary among EU countries:



Recycling rate of e-waste in EU

Electronic and electrical equipment contains potentially harmful materials that pollute the environment. Furthermore, most of rare minerals needed in modern technology come from countries that do not respect human rights.

The new circular economy action plan from European Commission has, as one of its priorities, the reduction of electronic and electrical waste. The European Parliament strives for the European Union to promote longer product life through reusability and reparability.

Visit the Website for further information

https://www.europarl.europa.eu/news/en/headlines/society/20201208STO93325/e-waste-in-the-eu-facts-and-figures-infographic

4.2 Best practice cases

The Best Practice cases for Waste as a Resource have been divided into four categories:

- Preventing food waste (cases 1-3)
- Re-use / Recover plastic waste (case 4 & 5)
- E-waste (case 6 & 7)
- Organic waste (cases 8-10)

Best practice case #1

Preventing food waste

Click on the image to open the video.

TOO GOOD TO GO APP – DENMARK/INTERNATIONAL

Founded in 2016, Too Good To Go's mission is to reduce food waste, allowing establishments to sell food in excellent condition for consumption and giving to the application users the opportunity to consume meals and food in a conscious and tasty way, contributing to a more sustainable world.

Too Good To Go is present in more than 13 countries, in Europe and the United States of America, and has more than 30,000 establishments as partners. Countries as France, Italy, Germany, Denmark, Spain, United Kingdom, Switzerland, The Netherlands, Norway and

Portugal already part of this movement.

Visit **Too Good To Go's Website**

Best practice case #2

Minimizing food waste

REFOOD – PORTUGAL /INTERNATIONAL

REFOOD aspires to a new world where everyone has the food they need; where all the food produced will primarily feed people; where citizens actively participate in the management of the precious resources of the community, and where everyone assumes the power, right and obligation to transform the world into a better place.

REFOOD is an independent, citizen-oriented, 100% voluntary, charitable, eco-humanitarian community that works to eliminate food waste and hunger in each neighborhood. Re-food operates in and for the community, through volunteers and avoiding any cost or investments that do not serve its mission. Re-food has a low-cost/high-productivity model that improves the quality of life of people in need, while strengthening the social fabric of the local community.

Visit **Re-food's website**

Best practice case #3

Minimizing food waste

FRUTA FEIA (UGLY FRUIT) – PORTUGAL

The Fruta Feia cooperative arises from the need to reverse the tendencies of standardization of fruits and vegetables that have nothing to do with issues of safety and food quality.

This project aims to combat market inefficiency by creating an alternative market for "ugly" fruit and vegetables altering consumption patterns. A market that generates value to farmers and consumers.

The main objective of the Fruta Feia is to reduce the tons of quality food that is returned to the soil every year by farmers and thereby also avoid unnecessary waste of the resources used in its production, such as water, arable land, energy, and time.

By changing consumption patterns, this project intends that in the future all fruit and vegetable products with quality, regardless of size, color, and shape, will be marketed in the future.

As parallel impacts are the awareness of the population to the problem of food waste and the fact that ugly foods are not junk, and the possibility of consuming products of the time and region at a lower price.

Visit **Fruta Feia Website**

Best practice case #4

Plastic waste

DECATHLON / QUECHUA - INTERNATIONAL

Everyone knows Decathlon and Quechua. Probably most of you have or had a Quechua Fleece. But did you know that Quechua hiking fleeces are made from plastic bottles?

Decathlon decided to take an Eco-design approach when producing their products.

Eco-design consists of taking the environment into account from the first design stages and throughout the entire product's life cycle.

In practical terms, it's about thinking through how to make it possible to reduce its impact on the environment during its whole lifespan.

A product thought through (or redesigned) with an eco-design approach that still fulfils the same function as a conventionally made one, while additionally offering an environmental benefit: an eco-designed running t-shirt remains before everything else a good running t-shirt!

Visit **Decathlon / Quechua Website**

Click on the image to open the video.

Best practice case #5

Plastic waste

ADIDAS - INTERNATIONAL

Plastic waste is a problem that has been side-lined for too long, and it's time to turn things around. At Adidas, they are changing the game with innovation.

In 2015, Adidas introduced the first ever running shoe made from upcycled plastic waste - the beginning of their partnership with Parley for the Oceans. Through this collaboration, plastic waste was intercepted on beaches and coastal communities before it reached the ocean and gave it new life as an adidas x Parley product. That first shoe marked a turning point for Adidas - it symbolized change for not only Adidas, but for the entire fashion industry.

Click on the image to open the video.

Click on the image to open the video.

Visit **Adidas – plastic bottles into shoes**

Best practice case #6

E-waste

EXCESS MATERIALS EXCHANGE (EME) – THE NETHERLANDS

Excess Materials Exchange (EME) is an innovative online platform which allows companies to buy and sell excess material through matching demand with surplus supply that would have otherwise been wasted.

EME is determined to accelerate the global transition to a circular economy – and play a part in creating a more viable planet. By showing the financial and ecological value of materials. By challenging companies to design and produce their goods in a more efficient and circular manner. And by making matches. A whole lot of matches.

The EME digital platform unlocks the maximum potential of the world's excess materials and products by matching them to their highest value uses. They are determined to fundamentally change the waste game - by introducing an innovative way of doing business that becomes the industry standard. That way, EME will speed-up the world's transition to a circular economy and pull their weight in creating a clean planet for everyone.

The main Value of ENE is to unlock potential daily. Give materials, products and waste streams that are considered worthless a new high-value reuse destination.

Click on the image to open the video.

Visit **EME's Website**

Best practice case #7

E-waste

NIMBLE - USA

Nimble is a USA company that produces Tech products from sustainable materials. Nimble uses sustainable materials, like recyclable aluminum and plant-based bioplastics. The products are super sleek, featuring soft-touch TPE which requires less energy to produce, and are also 100% free of plastic packaging and harmful inks and dyes.

The social impact brand has also partnered with Homeboy Recycling to help make recycling e-waste easy and accessible. Every product comes with a disposal pouch to empower you to responsibly recycle your old e-waste. Simply print the pre-paid label from Nimble's website and send it to their team to recycle your e-waste for free!

Visit **Nimble's Website**

Best practice case #8

Organic waste

How Sweden is turning its waste into gold:

Click on the image to open the video.

Best practice case #9

Organic waste

LISBON COMMUNITY COMPOST – PORTUGAL

LISBOA A COMPOSTAR

Lisboa a Compostar is a project aimed at providing training in composting, offering a home compost bin to residents who have space to install it and continuous support by Câmara Municipal de Lisboa (Lisbon Municipality) to residents who show an interest in reducing their domestic waste, producing fertilizer that can be used in their patio, backyard, or garden.

For those that don't have space, the Câmara Municipal de Lisboa (C.M. Lisboa) has installed 10 community composters.

Home composting avoids sending recyclable waste to incineration. In 2017 alone, more than 640 tons of common waste were collected daily in Lisbon, 40% of which was biodegradable, sent for incineration.

C.M. Lisboa proposes to reverse this process at source, providing citizens with a way to recycle this waste in their homes, with economic and environmental advantages. Instead of throwing away the leftovers from meals preparation, specifically fruit and vegetables, in the rubbish bin, these are put it in the compost bin and covered with small branches, herbs and leaves. Then, nature does its work! It's very simple and natural. The compost is the result of the biological transformation process, called composting. In this process we obtain a fertilizer or compost that in the soil works as an agricultural corrector, nourishing the soil, improving its physical and chemical properties and its structure, avoiding the costly and polluting consumption of chemical fertilizers.

Click on the image to open the video.

Best practice case #10

Organic waste

DUTCH VILLAGE GETS POWER FROM PIG POO

Almost 250,000 tons of pig manure will be converted into biogas

The small village of Zenderen, in the east of the Netherlands, will soon harness the big power of pig poo. At Elhorst-Vloedbelt, a former landfill site, approximately 250,000 tons of pig manure will soon be converted into biogas and raw materials in a manure biogas plant.

The biogas will then be upgraded to biomethane in a biogas upgrading system, which has a capacity of 1,000 cubic meters of biomethane per hour. That is comparable to the annual gas consumption of approximately 3,000 households.

The supplier Bright Biomethane will provide the biogas upgrading technology to the Dutch waste management firm Twence. Maarten Holtkamp, Sales Director at Bright Biomethane, said: "Manure digestion in combination with biomethane production provides an emission reduction effect.

"The methane from manure is put to good use by producing the renewable natural gas. This way, the methane is not released into the atmosphere. The manure does not remain in the stables and goes to the manure digester as fresh as possible."

4.3 Tips for how to best implement the principles into practice in education

Some tips for how to best implement the principles of "Waste as a Resource" into practice in training and education:

Tip #1: First ask the students what waste is for them. Present the different kinds of waste and their life cycle. Explain the difference between recycle and non-recycle waste, as well as the difference between organic and recycle waste.

Tip #2: Based on Figure 3 – Organize a brainstorm with students on how to Reduce and make better use of waste, about ways of reducing waste and/or make a better use of it.

Tip #3: Try to find out, with students, other best practices related to waste as a resource. For example, search for *Bio oil – recycling used oil; black water usage*; *Tap water saving measures*; *Biogas production in community composter*, etc.

Tip #4: Create challenges that can be brought into practice on the topic *Waste as a Resource* such as: *reduce and reuse waste* – check, for example, how to make recycled paper at home, or how to create a phone case from plastic bottles.

Tip #5: If your school has the space, build a compost bin to produce compost.

4.4 How to motivate students to adapt the right mindset

Involving students in the process of turning Waste into a Resource is the best way to motivate them to get the right mindset.

Showing them how much they can get from waste, and how important it is to minimize waste, is probably the best way to motivate students. Use day-to-day examples and apply them at school.

4.5 Q&A

The following questions can be used as guidelines to test the students' current level of knowledge on the topic, or to provoke discussion.

Question #1: Does Waste affect our Health?

Answer #1: Yes! Directly or indirectly, waste affects our health and well-being in many ways: methane gases contribute to climate change, air pollutants are released into the atmosphere, freshwater sources are contaminated, crops are grown in contaminated soil and fish ingest toxic chemicals, subsequently ending up on our dinner plates…

Question #2: Is Incineration the best way to reuse plastic and promote circular economy?

Answer #2: No. Although plastic has a high calorific power since it is made from fossil fuels and generates a lot of energy, when it is burned a lot of toxic gas effluents are released which contribute to climate change, pollute the air and impact on our health. Therefore, reducing the amount of plastic is the best way to promote circular economy.

Check this video: https://www.youtube.com/watch?v=iO3SA4YyEYU

Question #3: Can high tech products be reused or recycled?

Answer #3: First, you can always try to repair your tech product (toaster, radio, coffee machine, etc.) before considering it waste. e-Waste, such as high-tech products cannot be reused, but they contain some materials that can be reused, and those are very valuable, such as rare minerals. Many parts of e-waste can also be recycled.

Question #4: *Mum always says: eat everything because there are people starving. However, there is nothing I can do about the food that I don't want to eat*. Is this true?

Answer #4: No. The first step is to buy the correct amount of food you and your family need - not too much and not too less – minimize the waste when you are shopping. Prepare your plate with less food and refill it if necessary. If there are leftovers use your

imagination and create new dishes. If, despite all your efforts, there is still food waste – compost it!

Question #5: Can industrial waste be reused?

Answer #5: Yes, depending on the waste type. Urban furniture can be produced from cement composite and recycled industrial waste (take Portuguese Larus company as an example). Also, wood wastes from wood furniture companies can be used as pellets or to build lower cost furniture (IKEA is another example).

4.6 Workshop

Trash art is a practical workshop that can help students gain a broader understanding of circular economy in a fun and interesting manner. The goals of the workshop are that the students can:

- Work according to the principles of sustainable development
- Consider the principles of life cycle thinking
- Understand the principle of circular economy, determine its importance and present development opportunities
- Assess the energy and material efficiency of a product or service by presenting appropriate development needs
- Determine the life cycle of a product and understand the overall consequences
- Discuss solutions from ethical perspectives

Students are encouraged to use trash or materials/products that would normally be disposed of, and instead create something new and useful of them. All the finished products are then set up on display and students and visitors can vote for their favorite product. The student with the most well thought out new creation wins for example a gift voucher to the movie theater, the school café, or some other service (not a physical product, as the point is also to encourage use of services, not purchase more physical products.)

An example from Axxell in Finland, where students participating in a course of sustainable development, learn how to create new things out of trash.

Trash art: **(1) Trash art video by teacher Eva-Lotta Rehnman**

(2) Facebook video

Project "Trash art" by teacher Eva-Lotta Rehnman (Karis, Axxell) and her students Merkonom21

4.7 Links to further material (websites, presentations, etc.)

Search for more information about **Waste as a Resource** here:

https://zerowasteeurope.eu/waste/

https://community.materialtrader.com/3-examples-of-using-waste-as-a-resource/

https://orsted.com/en/sustainability/our-stories/waste-is-a-resource-for-green-energy

https://circle-lab.com/knowledge-hub/circular-economy-strategies/use-waste-resource

https://www.europen-packaging.eu/sustainability/

https://www.interregeurope.eu/smartwaste/

https://www.eea.europa.eu/

5. NEW BUSINESS MODELS

"From a linear economy to a circular business model."

5.1 Introduction

A business model describes the way business is done. It consists of a set of assumptions and models by which an organization will work to create value for all stakeholders and customers.

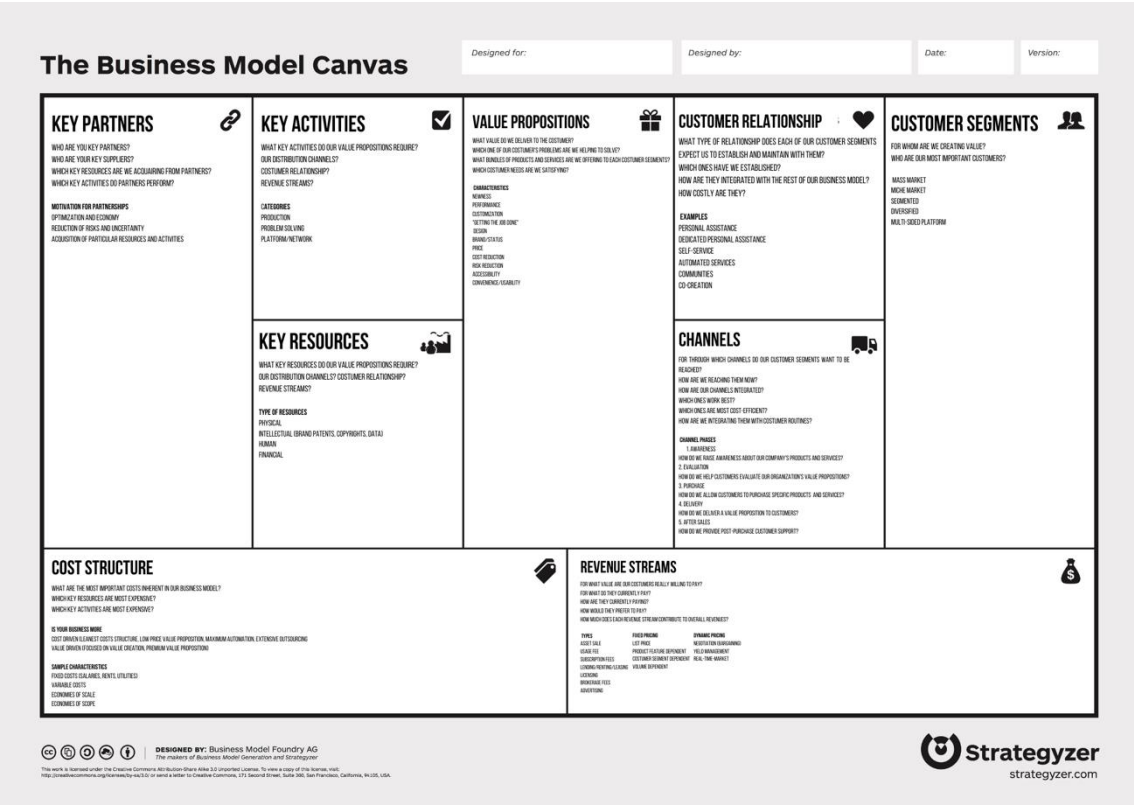
A business model is often defined by three core activities that relate to value:

1. **Value proposition** ("what value is offered to whom?"): a definition of the offered product or service and the target customer.
2. **Value creation and delivery** ("how is the value provided?"): the product or service's specific features and distribution channels.
3. **Value capture** ("how does the company generate value?"): cost structure and revenue streams.

As an example, in the case of an online multiplayer game, the value lies within playing online with other players, and the game itself is the specific way this value is created. The value is delivered by means of a digital platform, and the value is captured by the price of sold items (registration, adds, especial features, etc.) exceeding the cost of making, delivering, and updating the game.

These three core activities related to value are the basis of the **Business Model Canvas** (Osterwalder and Pigneur (2010)), one of the most common tools used worldwide to build the basis for any business model.

The Business Model Canvas allows a company to sketch or develop business models (new or pre-existing), constituting in a visual map that contains nine blocks, as shown in the figure.



LEARN MORE ABOUT **Canvas**.

Most business models today are still designed for and implemented for use in a linear economic system. The shift from a linear economy to a circular economy requires rethinking the value creation logic (what value is proposed, how value is created and delivered, and how value is captured). This can be done through innovation, change, redesigning and ultimately, adapting new business models. This requires aligning the business model with circular principles, and considering the different lifecycle phases:

1) Materials
2) Product design
3) Production and distribution
4) Use
5) End-of-life

Precious metals: from mining to recycling business models

The metal industry has been exemplary in promoting the shift from a linear economy to a circular economy. Several companies that have traditionally used a business model based on the mining and processing of ores to produce precious metals, have successfully implemented circular business models.

While their value capturing strategy is still focused on selling large volumes to global metal markets, their value creation strategy has partly or fully shifted towards the sourcing of waste metals. Waste metals are sourced either for free or for a fee, replacing the traditional use of virgin ores. To support this process change, these companies have made their production process capable of processing recycled inputs alongside or instead of virgin inputs. When the recycled materials are cheaper to process than their virgin counterparts, a shift to recycling represents a cost reduction for the company.

Furthermore, processing electronic scrap as a source of metals also solves a supply need and has the benefit of higher metal yields than those from virgin ores. Metal concentrations in virgin ores are decreasing as deposits become depleted, electronic scrap offers an alternative source of valuable metals in concentrations that exceed those of current commercial deposits.

Source: Eionet Report - ETC/WMGE 2021/2 19

Printers/copy machines in the consumer market: locked into linearity

In the consumer printer/copy machine market, the dominant business model is to sell the machine itself at a cheap price and the ink contrarily for a very high price. Consumers are locked-in to the brand of printer they own, with deliberately built-in technical barriers that block third party ink cartridges. The low price for the machine reflects the use of quality materials and components, causing short product lifetimes. While there are plenty of technical options available to increase the circularity of the copier design and increase its lifetime, such a copier would be outcompeted in the current market. Consumers typically do not consider the total cost of ownership when deciding which machine to buy. In this market, business model innovation alone will not be sufficient to create a breakthrough for circular business models.

Source: Eionet Report - ETC/WMGE 2021/2 19

Use of remanufactured car parts in the automotive industry

The automotive industry has well established systems of collecting various car parts, such as gear boxes or doors from crashed or end-of-life cars and using them to remanufacture defective or damaged cars. To achieve this, the industry uses existing networks of dealerships and car repair shops to organize the retrieval of still functioning parts and redeploying them to other car repair shops. The practice creates value for car owners by decreasing the cost of repair. Furthermore, it stimulates customer loyalty, which ensures that the local car dealerships keep receiving the recurring income from regular car maintenance. The fact that the structural design of cars within a certain brand is highly standardized greatly helps the disassembly and reintegration of parts into other vehicles. This has also created an extensive ecosystem of third-party repair shops that reuse still functioning car parts.

Source: Eionet Report - ETC/WMGE 2021/2 19

Performance-based models on the rise in the construction sector

The construction sector has recently become a particular hotspot for the development of circular performance-based service models. This can be explained by the fact that most assets in or as part of buildings – flooring, interior walls, ceiling, lighting, etc., have long use phases, high initial costs and considerable costs for maintenance and decommissioning. Developers and building owners generally assess the cost of building projects from a total lifecycle perspective; not only the construction costs, but also addressing means to avoid excessive costs and hassle in dealing with repairs. At the same time, the cost of building waste management has increased, as well as the awareness of recycling and more sustainable materials management in the construction sector. Consequently, performance-based business models, that are more affordable because costs are spread out in time, remove operational hassles, and address the end-of-life phase of building related assets, have a clear advantage over traditional sales-only models.

Source: Eionet Report - ETC/WMGE 2021/2 19

Repairing and reselling electronics: capturing value ignored by others

In the electronics sector, the high speed of innovation and product renewal has created major opportunities for circular business model innovation by actors outside the value chain. Reuse shops and online platforms for smartphones and tablets have been stepping into the value gap created by consumers buying new products while their old ones are still functional. They capture the value that still resides in older electronics, often after some repair or refurbishment, and share it with their customers. A particular example of such a gap-exploiter model is the model used by a reuse company in Sweden that offers smartphone repair and replacement services to insurance companies (Whalen et al., 2018). The insurance companies used to provide a new product without even checking the customer's claim because doing so was too expensive for them. Now, all insurance claims are handled by the reuse company; they check whether the claim is real, and if so, they repair the smartphone if possible. The customer can opt to receive a refurbished phone immediately instead of waiting for the repair of their own product. This model has resulted in fewer insurance claims, providing a direct cost saving to the insurance companies while the reuse company captures additional revenues from selling refurbished models that were not claimed by their original owners.

Source: Eionet Report - ETC/WMGE 2021/2 19

Circular business models can be defined (Geissdoerfer et al., 2020) as "business models that are cycling, extending, intensifying, and/or dematerializing material and energy loops to reduce the resource inputs into and the waste and emission leakage out of an organizational system. This comprises recycling measures (cycling), use phase extensions (extending), a more intense use phase (intensifying), and the substitution of products by service and software solutions (dematerializing)".

According to this definition we may have four generic strategies for circular business models:

Cycling: Includes the implementation of several end-of-use strategies, such as reuse, repair and remanufacturing being the materials and energy recycled within the system. Taking back is a key element of the value proposition.

Example of Cycling

Decommissioned industrial robots can be reused in small and medium enterprises (SMEs), where their reduced purchasing cost enables a viable way to increase productivity through automatization.

Source: Geissdoerfer et al., 2020

Extending: aims at keeping the product in use to the highest extent possible, through long-lasting and timeless design, marketing that encourages long use phases, maintenance, and repair. The implementation of this strategy lead to reduced need for producing new products.

Example of Extending

Patek Philip builds upmarket mechanical watches that last for a long time and have a timeless design that has not changed considerably over the past decades. A marketing campaign supports this with the slogan "you never actually own [this watch]. You merely look after it for the next generation".

Source: Geissdoerfer et al., 2020

Intensifying: leads to the implementation of new value propositions around sharing models, being enabled by capacity management, digital capabilities, and customer relationship management. The use phase of the product is intensified through solutions such as sharing economy or public transport.

Example of Intensifying

Car sharing can reduce idle times of cars and driven mileage per user significantly compared to a conventional ownership-based system.

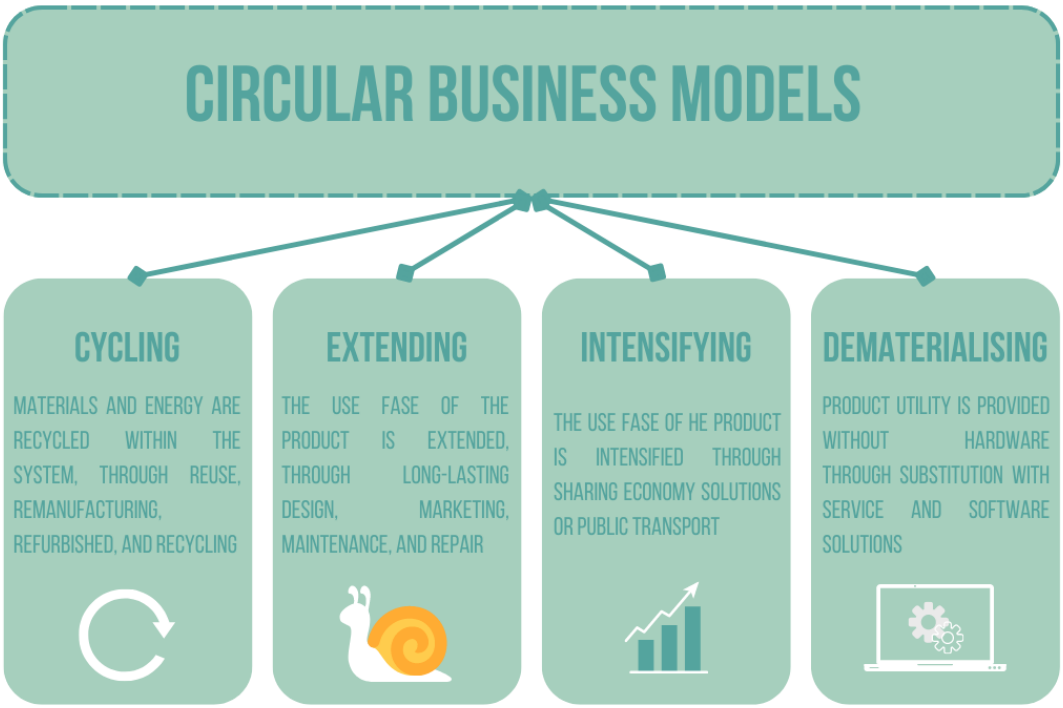
Source: Geissdoerfer et al., 2020

Dematerializing: decreases the use of physical resources by enhancing the value created by intangible solutions, such as services and software.

Example of Dematerializing

Offering services or product service systems instead of physical products to fulfil the same function for the user can reduce the number of produced products while enhancing the customer experience at the same time. A simple example of product dematerialization is the transition from physical CDs and DVDs to digital MP3s and streaming platforms.

Source: Geissdoerfer et al., 2020 (adapted)



Circular Business Models (Adapted from: Geissdoerfer et al., 2020)

Circular business model innovation incorporates principles or practices from circular economy as guidelines for business model design, and can change the way how an organization works, redirecting their business models into a more sustainable or circular direction. By creating circular business models, the organization can combine the creation of economic value with the narrowing, slowing, or closing of resource loops.

5.2 Best practice cases

Best Practice Case # 1

R8 Project: The Cork Food Box

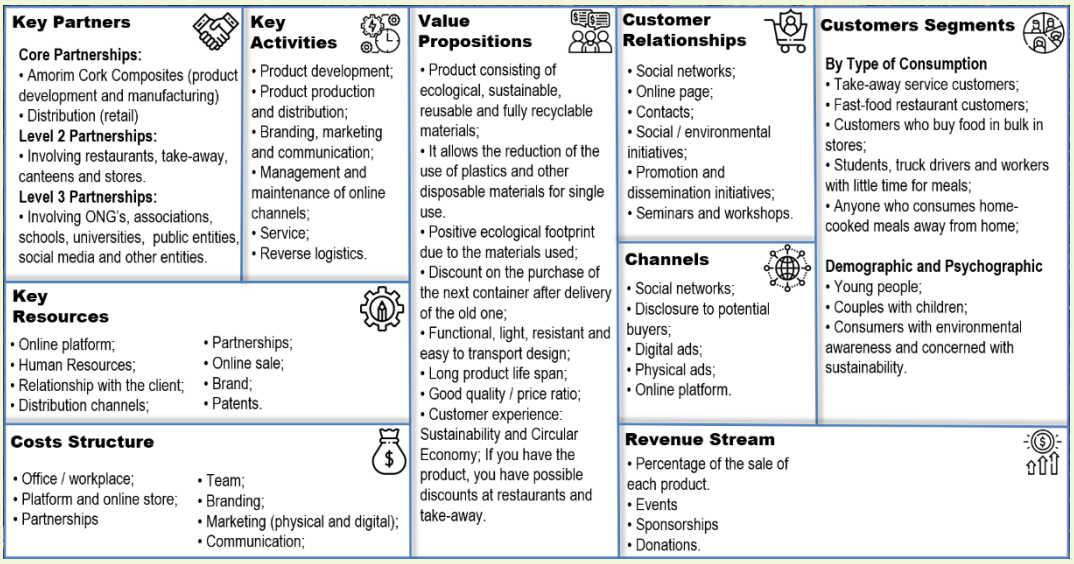
"Reducing Plastic Containers and Single Use Materials with Cork Polymer Compounds"

A group of students from the Master's in Chemical Engineering at University of Coimbra, Portugal, mentored by a teacher, started in 2020 an entrepreneurial project based in a circular business model. The "R8 Project: The Cork Food Box", aims to develop, produce, and commercialize a set of containers of different dimensions, for transport and consumption of food, drinks, and coffee, made by a cork polymer compound (CPC) based in a combination of cork with a biopolymer.

The Cork Food Box consists of a versatile and multipurpose concept making the lunch box suitable for everyday use, take-away services, quick meals and even at festivals and events, replacing the plastic containers (disposables and non-disposables), and other single-use materials for the transportation and consumption of food.

Built under eco-design principles, the product was designed to have a lifelong period of usage, and to be recovered at the end of their life cycle, giving to the consumer an advantage in purchasing a new set. The delivered ones will be incorporated in the production of flooring, totally reusing them in a new product.

The Business Model Canvas developed by the project team is shown in the next picture:



See here a video pitch, presenting the **R8 project.**

Best Practice Case # 2

GET GROVER

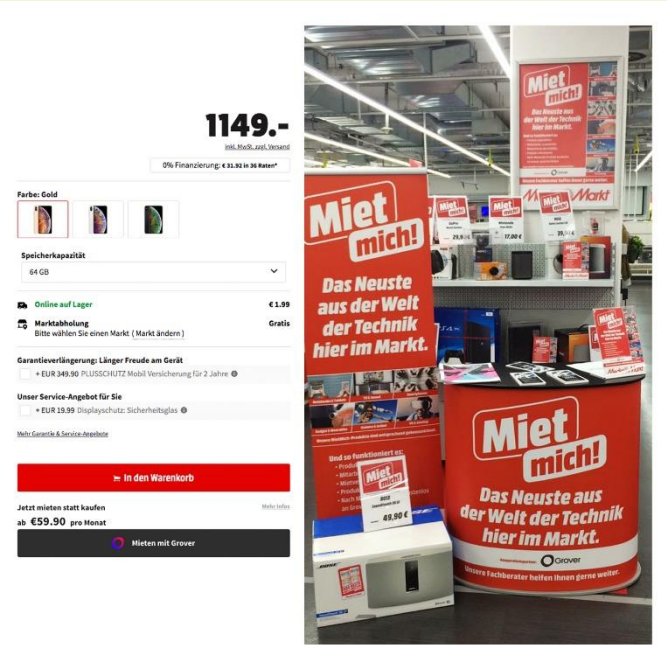
"Less products… more experience"

Grover is German start-up, based in Berlin, that offers a subscription / "rental" platform for various technological products: mobile phones, smartphones, tablets, consoles, cameras, etc.

Grover's motto is "reinvention of consumption", moving from purchase to simple product rental. Using the platform is simple, after registering on the website, the desired product can be rented and at the end of the rental period it can be exchanged, or returned, as needed by the customer.

The service makes products available for flexible periods of time, without any obligation and without the initial capital impact that these products imply.
This start-up established partnerships with retailers, like Media Markt in Germany, where the "Rental with Grover" option is available in more than 500 products, on the Media Markt website.

This business model is an example of the dematerialization of the economy and the growing potential of providing services instead of products.



Sources:
https://getgrover.com/de-en/
https://eco.nomia.pt/

Best Practice Case # 3

ResQ

Rescuing leftovers from restaurants, coffee shops and grocery stores

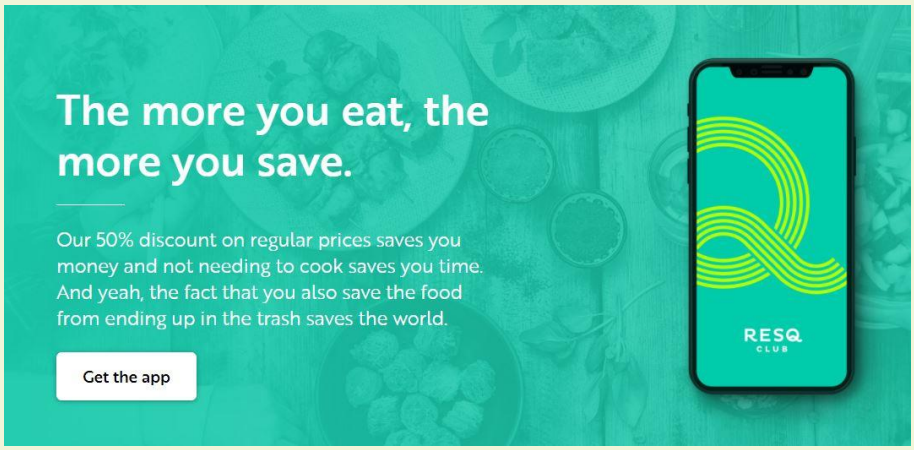
Currently, approximately one fifth of the meals prepared by Finnish restaurants go to waste. This corresponds to about 80 million kilos of food per year.
The start-up ResQ Club has developed an online service to respond to the challenge of food waste, bringing together about 200 restaurants, coffee shops and grocery stores in Finland in the provision of a new service. The idea is to provide the left-over meals that would otherwise go to waste, at lower prices.

The application developed by the company shows, in real time, the best opportunities, usually after the hours of higher turnover (lunch, dinner, etc.), with the location of the participating restaurants, what they offer and their prices. The customer chooses what he/she wants, later collecting the meal at the restaurant.

According to the company data, the service saves monthly more than 200.000 portions from being thrown away - an equivalent to 500 tons of CO_2 emissions saved every month.

The company was launched in 2016 in Finland and is expanding internationally to Sweden, Germany, and Poland.

Similar business models have also been developed in other countries in Europe and the United States of America.



Sources:
https://www.resq-club.com/
https://eco.nomia.pt/

Best Practice Case # 4

MUSGO Design

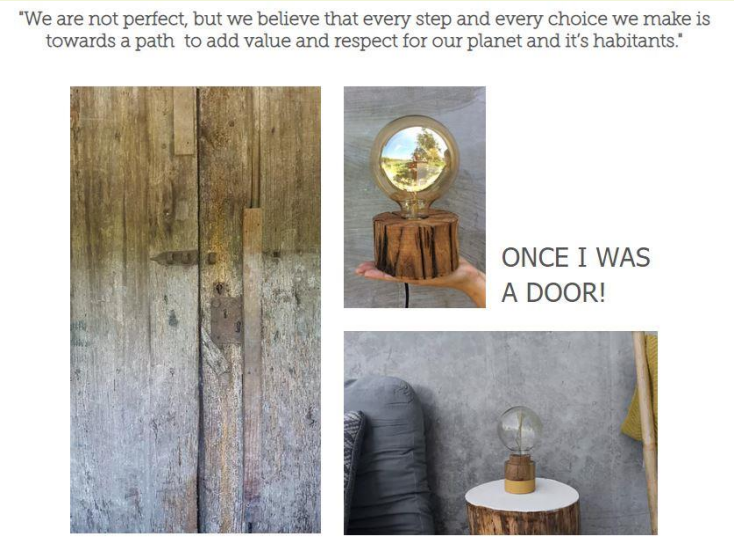
Upcycling: Transforming wood from old homes in design pieces

After three years living in Rio de Janeiro, Margarida and Rui return to Portugal in 2016, and create MUSGO.
In their studio, housed in an old dairy, which has since been restored, they design various pieces of furniture, with the lamps standing out.

In its execution they resort to the reuse of wood furniture, doors, floors, and structures of old Portuguese houses that have been restored, giving them a new life. In addition to the care in the selection of the materials used, including biological varnishes, they also boost local production (small-scale and family businesses), the manual nature and the subsistence of professions that are falling into disuse. On the other hand, the manufacturing process is done consciously and respecting the ecosystem, without polluting the environment.

"Through creativity and respect for the material's characteristics, we create practical design solutions, based on sustainability and simplicity."

"We are increasingly aware of the planet's vulnerability, of how we have and should slow down our work pace. If we think about it, many of our choices are made spontaneously or because we don't have time because it is easy and fast or simply because it is cheaper. All these attitudes lead to countless consequences, such as the purchase of low-quality products, which last a short time, and which lead to the practice of disposables and banality and lack of originality. At Musgo Design, we combine all efforts to counteract this pace of life and consumption."



Source:
https://www.musgodesign.pt/

Best Practice Case # 5

Splosh

How re-thinking the business model for cleaning products can influence design

Angus Grahame set up Splosh in 2012 with the idea that there must be an opportunity to sell household cleaning products outside of the supermarkets using a 'one time sale' model.

Angus also investigated how these could be sold online but the typical size and weight of the products made this difficult. As a result, he began looking into how these could be completely redesigned for a new e-commerce business model.

With Splosh, instead of buying new bottles filled with product on a weekly basis, customers purchase a one-off 'starter box', containing a range of simply designed bottles. Inside each bottle is a sachet of concentrated liquid – customers just add warm tap water to create cleaning products that Splosh claim clean with comparable effectiveness to competitors. These bottles can be used repeatedly, with refill sachets delivered in boxes through the post.

If the bottle is reused 20 times, it means 95% less packaging waste.

Source:
https://www.ellenmacarthurfoundation.org/case-studies/how-re-thinking-the-business-model-for-cleaning-products-can-influence-design

5.3 Tips for how to best implement the principles into practice in education

Some tips for how to best implement the Circular Business Models and Circular Business Models Innovation subjects into practice in training and education:

Tip #1: First in first present and debate with the students the concepts of business model, value proposition, value creation and delivery and value capture, distinguish a linear business model from a circular business model.

Tip #2: Show to the students how to design and build a business model, using Business Model Canvas tool as example. Perform a Canvas construction exercise to do it.

Tip #3: Present and debate with the students the concept of circular business model innovation, and how this shift can change the way how an organization works, redirecting their business models into a more sustainable or circular direction.

Tip #4: Aware the students to the different lifecycle phases (Materials; Product design; Production and distribution; Use; End-of-life), and the general strategies for circular business models (Cycling, Extending, Intensifying and Dematerializing) to have in mind and consider when thinking about new business models.

Tip #5: Brainstorm with the student's circular business model innovation, relating the value issues with the general strategies for circular business models. For that you may use the matrix tool proposed by Geissdoerfer et al. (2020).

CIRCULAR BUSINESS MODEL TOOL

	VALUE PROPOSITION	VALUE CREATION & DELIVERY	VALUE CAPTURE
	• MAIN PRODUCTS/SERVICES • COSTUMER SEGMENTS/MARKETS • COSTUMER NEEDS/PROBLEMS • HOW DO YOU ADDRESS THEM?	• KEY VALUE CHAIN ELEMENTS • CORE COMPETENCIES • RESOURCES AND CAPABILITIES	• REVENUE STREAMS • COST DRIVERS • REVENUE MODEL, LIKE LEASING, REUSE AND BLADE, PLATFORM FEES, ETC
CYCLING • REUSE • REPAIR • REMANUCFATURING/ REFURBISHING • RECYCLING • DESIGN FOR X/MODULARITY • REVERSE LOGISTICS • INCENTIVES TO RETURN CARES			
EXTENDING • LONG-LASTING PRODUCTS • UPGRADABILITY • TIMELESS DESIGN • MARKETING/CONSUMER EDUCATION ENCOURAGING LONG PRODUCT LIFE • MAINTENANCE/ PRODUCT SUPPORT			
INTENSIFYING • SHARING MODELS • RENTAL/LESSING MODELS • USER COOPERATIVES • OPEN ELEMENTS/ CREATIVE COMMONS • POOLING MODELS			
DEMATERIALISING • SOFTWARE INSTEAD OF HARDWARE • SERVICE INSTEAD OF PRODUCTS • CONSUMER EDUCATION RATIONALISING DEMAND			

ADAPTED FROM: CIRCULAR BUSINESS MODELS. A REVIEW. JOURNAL OF CLEANER PRODUCTION

Tip #6: In a workshop ideate with the students a new circular business model. For that you may use the Canvas Model, or the Business Model Toolkit developed by the Forum for the Future.

The Circular Economy Business Model Toolkit | Forum for the Future

The Forum for the Future, in partnership with Unilever, developed a toolkit identifying 10 circular business model archetypes.
In the toolkit users can find an infographic summarizing the archetypes and a card deck with inspirational case studies. The notes section of every business case also includes more detail on the potential market growth opportunities, the potential to apply the example to brands and the scalability of each case. The user will also find an exercise that can be applied, for example, in workshop situations.

Access to the toolkit

Infographic

Card Deck

Source: Forum for the Future.

5.4 How to motivate students to adapt the right mindset

You can motivate the students to adapt the right mindset by putting in evidence the differences between a linear and circular business model, showing that is possible to create value in a more sustainable way. Use several examples close to the student's daily life and with products and services they may use. If possible, use examples from your own school (cafeteria, school facilities, transportation to school, general usage of electricity, water, plastics, etc.).

5.5 Q&A

Question #1: Is a business idea and a business model the same thing?

Answer #1: No. A business idea is the starting point for the development of a business. The idea arises as an answer to a need. Based on the business idea, the business model describes the way business is done, and consists of a set of assumptions and models by which the organization will work to create value.

Question #2: Is it mandatory to use a specific tool to design a business model?

Answer #2: No. There are several tools available, but as a suggestion we have the "Canvas" Model, which is widely disseminated and tested by the market, providing a good understanding of the business in question. Specifically directed for circular business models we also suggest the Circular Business Model Tool proposed by Geissdoerfer et al. (2020), and the Circular Business Model Toolkit developed by the Forum for the Future.

Question #3: What is the difference between a linear business model and a circular business model?

Answer #3: A linear business model is designed to operate in the linear economy: Extraction – Production – Consumption – Elimination. A circular business model integrates cycling, extending, intensifying, and/or dematerializing material and energy loops to reduce the resource inputs into and the waste and emission leakage out of an organizational system.

Question #4: Can you transform a linear business model into a circular business model?

Answer #4: Yes. This is called Circular business model transformation and describes the modification of an existing business model. While the initial business model can be linear or circular the new business model incorporates circular economy strategies.

Question #5: How can we create value with circular business models?

Answer #5: By creating circular business models the organization can combine the creation of economic value with the narrowing, slowing, or closing of resource loops. The Eionet Report - ETC/WMGE 2021/2 presents the case of materials-as-a-service model, to reduce the volume of new raw materials used and the despite that generate economic value. "An example (…) is the concept of chemical leasing. Traditionally, industries buy large quantities of processing chemicals such as solvents and disinfectants, use them once, and discard them as chemical waste. This generates costs at both ends – buying the chemicals and getting rid of the waste. In a chemical leasing model, the chemical producing company does not sell processing chemicals to its industrial clients, rather, clients buy the performance such chemicals provide, for example, cleaning dirt and rust from metal parts, and return the used chemicals to the raw materials provider, who then regenerates or recycles them for reuse."

Question #6: What does circular business model innovation mean?

Answer #6: Circular business model innovation is the conceptualization and implementation of new circular business models. It incorporates principles or practices from circular economy as guidelines for business model design, and can change the way how an organization works, redirecting their business models into a more sustainable or circular direction.

Question #7: Are all the business models presented as circular indeed circular?

Answer #7: No. Not all. As an example, the Eionet Report - ETC/WMGE 2021/2 brings up a common misrepresentation of circular business models that is labelling existing models as circular: "A prominent example of this is the framing of product-service models as key circular business models. While this business strategy can contribute to the realization of circular value chains in some cases, having a product-service model alone does not guarantee circularity (EEA, 2017; Tukker, 2015). Vending machines in canteens, for example, are often provided through a service-contract: the supplier installs, maintains, and sometimes even refills the machine for a fee. The drinks, however, are in single-use, disposable containers, and the machine itself is neither necessarily refurbished nor recycled at its life end."

5.6 Links to further material

See Additional Case Studies about **New Business Model** at **Ellen MacArthur Foundation Website.**

6. DIGITIZATION

6.1 Introduction

The European Commission's Communication "A new skills agenda for Europe: Working together to strengthen human capital, employability and competitiveness" proposes ways to address the skills challenges that Europe is currently facing. The aim is for everyone to have the key set of competences needed for personal development, social inclusion, active citizenship, and employment. These competences include literacy, numeracy, science, and foreign languages, as well as more transversal skills such as digital competence, entrepreneurship competence, critical thinking, problem solving and learning to learn.

The European Digital Competence Framework for Citizens1, also known as DigComp, offers a tool to improve citizens' digital competence. In the fields of education and training, and employment, there was a need to have a common reference framework of what it means to be digitally savvy in an increasingly globalized and digital world.

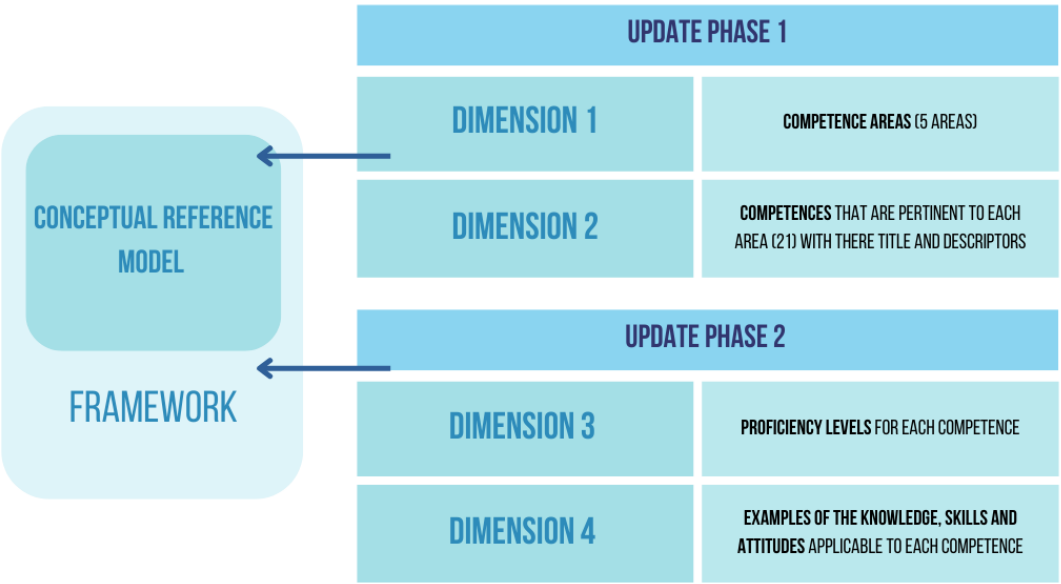
In 2015, almost half (44.5%) of the EU population aged from 16 to 74 had insufficient digital skills to participate in society and economy. In the active labor force (employed and unemployed), this figure is more than a third (37%). 12% of young Europeans aged from 11 to 16 were likely to be exposed to cyberbullying - a number that has increased from 20108. Work, employability, education, leisure, inclusion, and participation in society - all these areas and many others in our society are being transformed by digitalization. Consequently, digital competence – or the confident and critical use of ICT tools in these areas - is vital for participation in today's society and economy (European Parliament and the Council, 2006).

The Digital Competence Framework for Citizens, also known by its acronym DigComp aimed to be a tool to improve citizens' digital competence, to help policymakers to formulate policies that support digital competence building, and to plan education and training initiatives to improve digital competence of specific target groups. DigComp also provided a common language on how to identify and describe the key areas of digital competence and thus offered a common reference at European level.

The Digital Competence Framework for Citizens is structured in four dimensions. Dimensions 1 and 2 represent the DigComp conceptual reference model (see Table 1 – grey background). The process of updating DigComp is advancing in two phases. This document describes Phase 1: the update of the "conceptual reference model" - in other words, updating the competence areas, the competence descriptors, and their titles.

Table – Main dimensions of DigComp 2.0

DIMENSION 1	AREAS IDENTIFIED TO BE PART OF DIGITAL COMPETENCE
DIMENSION 2	COMPETENCE DESCRIPTORS AND TITLES THAT ARE PERTINENTE TO EACH AREA
DIMENSION 3	LEVELS OF PROFICIENCY FOR EACH COMPETENCE
DIMENSION 4	EXAMPLES OF THE KNOWLEDGE, SKILLS AND ATTITUDES APPLICABLE TO EACH COMPETENCE



The two-phase process to update the DigComp Framework to version 2.0

DigComp 2.0 - the Conceptual Reference Model

In this section, we present the updated conceptual reference model for the Digital Competence Framework for Citizens. These changes are explained and discussed in the following section.

Competence areas Dimension 1	Competences Dimension 2
1. Information and data literacy	**1.1 Browsing, searching, and filtering data, information, and digital content** To articulate information needs, to search for data, information, and content in digital environments, to access them and to navigate between them. To create and update personal search strategies. **1.2 Evaluating data, information, and digital content** To analyze, compare and critically evaluate the credibility and reliability of sources of data, information, and digital content. To analyze, interpret and critically evaluate the data, information, and digital content. **1.3 Managing data, information, and digital content** To organize, store and retrieve data, information, and content in digital environments. To organize and process them in a structured environment.
2. Communication and collaboration	**2.1 Interacting through digital technologies** To interact through a variety of digital technologies and to understand appropriate digital communication means for a given context. **2.2 Sharing through digital technologies** To share data, information, and digital content with others through appropriate digital technologies. To act as an intermediary, to know about referencing and attribution practices. **2.3 Engaging in citizenship through digital technologies** To participate in society with public and private digital services. To seek opportunities for self-empowerment and for participatory citizenship through appropriate digital technologies. **2.4 Collaborating through digital technologies** To use digital tools and technologies for collaborative processes, and for co-construction and co-creation of resources and knowledge. **2.5 Netiquette** To be aware of behavioral norms and know-how while using digital technologies and interacting in digital environments. To adapt communication strategies to the specific audience and to be aware of cultural and generational diversity in digital environments. **2.6 Managing digital identity** To create and manage one or multiple digital identities, to be able to protect one's own reputation, to deal with the data that one produces through several digital tools, environments, and services.

3. Digital content creation

3.1 Developing digital content

To create and edit digital content in different formats, to express oneself through digital means.

3.2 Integrating and re-elaborating digital content

To modify, refine, improve, and integrate information and content into an existing body of knowledge to create new, original, and relevant content and knowledge.

3.3 Copyright and licenses

To understand how copyright and licenses apply to data, information, and digital content.

3.4 Programming

To plan and develop a sequence of understandable instructions for a computing system to solve a given problem or perform a specific task.

4. Safety

4.1 Protecting devices

To protect devices and digital content, and to understand risks and threats in digital environments. To know about safety and security measures and to have due regard to reliability and privacy.

4.2 Protecting personal data and privacy

To protect personal data and privacy in digital environments. To understand how to use and share personally identifiable information while being able to protect oneself and others from damages. To understand that digital services use a "Privacy policy" to inform how personal data is used.

4.3 Protecting health and well-being

To be able to avoid health-risks and threats to physical and psychological well-being while using digital technologies. To be able to protect oneself and others from possible dangers in digital environments (e.g., cyber bullying). To be aware of digital technologies for social wellbeing and social inclusion.

4.4 Protecting the environment

To be aware of the environmental impact of digital technologies and their use.

5. Problem solving

5.1 Solving technical problems

To identify technical problems when operating devices and using digital environments, and to solve them (from troubleshooting to solving more complex problems).

5.2 Identifying needs and technological responses

To assess needs and to identify, evaluate, select, and use digital tools and possible technological responses to solve them. To adjust and customize digital environments to personal needs (e.g., accessibility).

5.3 Creatively using digital technologies

To use digital tools and technologies to create knowledge and to innovate processes and products. To engage individually and collectively in cognitive processing to understand and resolve conceptual problems and problem situations in digital environments.

5.4 Identifying digital competence gaps

To understand where one's own digital competence needs to be improved or updated. To be able to support others with their digital competence development. To seek opportunities for self-development and to keep up to date with the digital evolution.

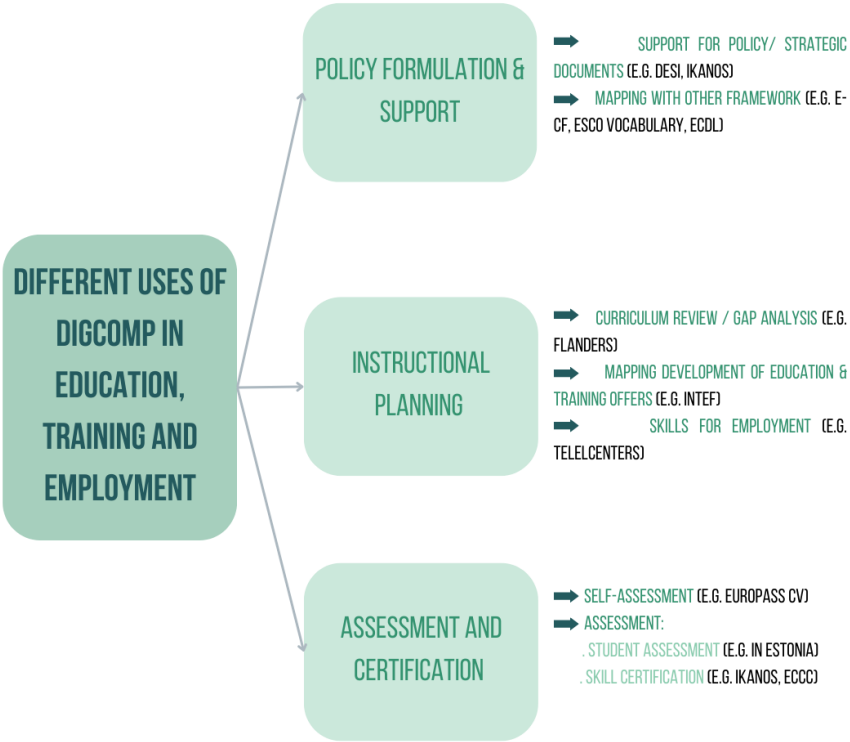
DigComp 2.0: new vocabulary and streamlined descriptors for better scoped competences

Even though the DigComp framework is a rather high-level conceptual reference framework, it has become clear that some vocabulary needed to be updated.

Since its inception, the DigComp framework has been well received and taken up by various stakeholders. This versatile instrument is used for various purposes. In this section, and as illustrated in Figure 2, we categorize three different uses the framework can have in the context of education, training, and employment as follows:

1) Policy formulation and support
2) Instructional planning for education, training, and employment
3) Assessment and certification

The stakeholders range from policy makers, educational and employment authorities at national and regional levels to public and private training institutions and the third sector bodies, which provide education and training opportunities.



Different uses require different types of implementations

To share practices and offer opportunities for peer learning around the implementation of DigComp, in 2015 an "Implementation Gallery" was launched on the JRC Science Hub website[1]. The Implementation Gallery works on the self-reporting principal and presents snapshots of the implementations at a given moment in time. The goal is to display

examples of use across Europe. These should not be regarded, by definition, as best practices. In this section, we will describe a number of these uses by various stakeholders in the three above-mentioned categories (see also the map in Annex 4), without providing an exhaustive overview of DigComp implementations.

Purpose of use: Assessment tool

Tools for assessing one's own digital competence constitute one of the most visible areas of all DigComp implementations. Various stakeholders have operationalized DigComp as a publicly and freely used tool. One of the first implementations is an online test called *Skillage.* It was developed by Telecentre Europe to assess young people's understanding of ICT in an employment setting. The test results in a "Skillage Report" that can be used to help improve skills within the local Telecentre network.

The Europass CV included an online tool for jobseekers to evaluate their own digital competence and include the results in their Curriculum Vitaes. The tool uses the five areas of the DigComp framework with an easy-to-use self-evaluation form. This tool is available in all the official EU languages.

Table - Examples of DigComp as evaluation tool and how the proficiency levels are used

	GIGCOMP AREAS	DIGCOMP COMPETENCES	LEVELS	PROFICIENCY LEVELS COMPAREDTIBILITY
IKANOS	X	X	3 LEVELS: . BASIC . AVERAGE . ADVANCED	LEVELS WITH LOOSE LINK TO DIGCOMP
GUADALINFO	X	X	4 LEVELS: . SIN COMPETENCIA . INICIACIÓN . INTERMEDIO . AVANZADO	LEVELS WITH LOOSE LINK TO DIGCOMP
EUROPASS CV	X		3 LEVELS: . BASIC USER . INDEPENDENT USER . PROFICIENT USER	LEVELS AS IN DIGCOMP
DIGITAL SKILLS INDEX (DESI)	X		4 LEVELS: . NO SKILLS . LOW SKILLS . BASIC SKILLS . ABOVE BASIC SKILLS	LEVELS WITH NO LINK TO DIGCOMP

PRACTICAL EXERCISE: AUTODIAGNÓSTICO DE COMPETENCIAS DIGITALES

Following the European DIGCOMP methodology, several digital skills self-diagnosis tools have been developed. Choose the one you find most appropriate as a basis for your digital skills and perform a DIGITAL SKILLS SELF-ASSESSMENT.

1. IKANOS

Learn more about **IKANOS** here

IKANOS SELF ASSESSMENT TEST PROMOTES REFLECTION WITH MULTIPLE SINGULARITIES:

PERCEPTION QUESTIONS MEASURE THE RESPONDENT'S CONFIDENCE AND KNOWLEDGE IN IMPORTANT DIGITAL TASKS BY ASKING THEM TO CONSIDER DIFFERENT STATEMENTS THAT REFLECT DIFFERENT LEVELS OF COMPETENCE	**AWARENESS** BY FULFILLING THE QUESTIONNAIRE, USERS BECOME AWARE OF ALL ASPECTS OF DIGITAL COMPETENCE FROM A WELL-STRUCTURE FRAMEWORK (DIGCOMP)	**VISUALIZATION** THE DIGITAL PROFILE SHOWS GRAPHICALLY THE ACHIEVEMENTS AND SHORTCOMINGSIN THE VARIOUS DIGITAL SKILLS
PRESCRIPTIVE / MOTIVATIONAL ENCOURAGES MOTIVATION TO IMPROVE SKILLS, PROVIDING USEFUL INFORMATION THAT SHOULD GUIDE THE USER TO SEEK A LEVEL OF PERFORMANCE	**ARCHIVABLE** THE DOWNLOADABLE PDF PROFILE ALLOWS TO SAVE THE RESULTS FOR REVIEW	**SIMPLICITY** THE TOOL IS EASY TO UNDERSTAND IN ANY CONTEXT WITHOUT FURTHER EXPLANATION. THE ITEMS ARE RELATED TO COMMON ACTIONS IN DIGITAL LIFE
COMPREHENSIVE TEST QUESTIONS ARE RELATED TO THE DESCRIPTIONS OF EACH COMPETENCE IN THE DIGITAL DIGCOMP FRAMEWORK, ADDING EXAMPLES OR PLACING THEM IN REALITY OF DIGITAL TECHNOLOGY USE, PROVIDING RELIABLE AND SIGNIFICANT ITEMS OF THE THREE ELEMENTS OF A COMPETENCE: KNOWLEDGE, SKILLS AND ATTITUDE	**SHORT** IT IS POSSIBLE TO COMPLETE THE TEST IN THE TIME FRAME NOT EXCEEDING 20 MINUTES	**NEUTRAL** QUESTIONS CONTAIN ONLY SELF-ASSESSMENT STATEMENTS AND ARE NOT BASED ON TECHNOLOGY SCENARIOS (WINDOWS, ANDROID, ETC.) OR SPECIFIC PROGRAM OR APPLICATION KNOWLEDGE

Visit **IKANOS DIGITAL SKILLS SELFTEST TOOL** here

2. DIGCOMP TEST FOR EDUCATORS

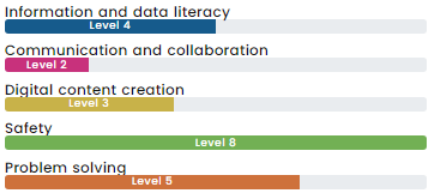
DigComp
Competências Digitais

Learn more about **DigComp** here

Click on the image to answer the self-assessment.

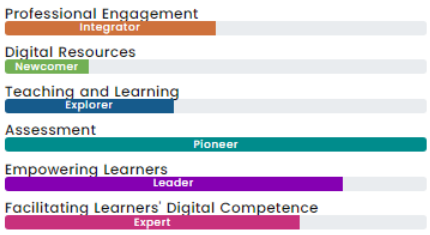
Citizens - DigComp 2.1

DigComp, currently in version 2.1., has become a reference for the development and strategic planning of various initiatives, both at European and Member State level. It contributes to the development of the DESI – Digital Economy & Society Index and to the National Digital Competences Initiative – INCoDe.2030. It is organized in 5 areas and comprises a total of 21 competences. Eight proficiency levels were defined for each competence, following Bloom's taxonomy and inspired by the structure and vocabulary of the European Qualification Framework - EQF: Level 1 and 2 (Basic), Level 3 and 4 (Intermediate), Level 5 and 6 (Advanced) and finally Level 7 and 8 (Highly Specialized). Each level represents a step up in citizens' acquisition of the competence according to its cognitive challenge, the complexity of the tasks they can handle and their autonomy in completing the task.

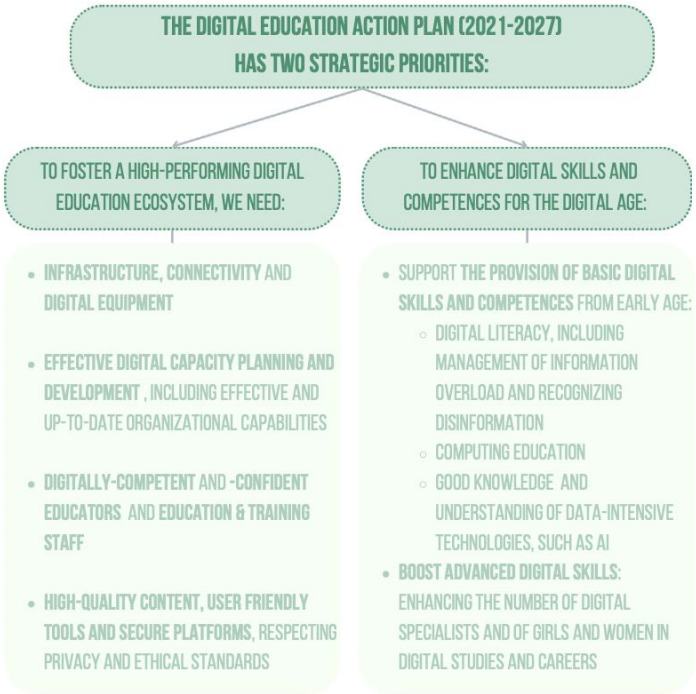


Educators - DigCompEdu

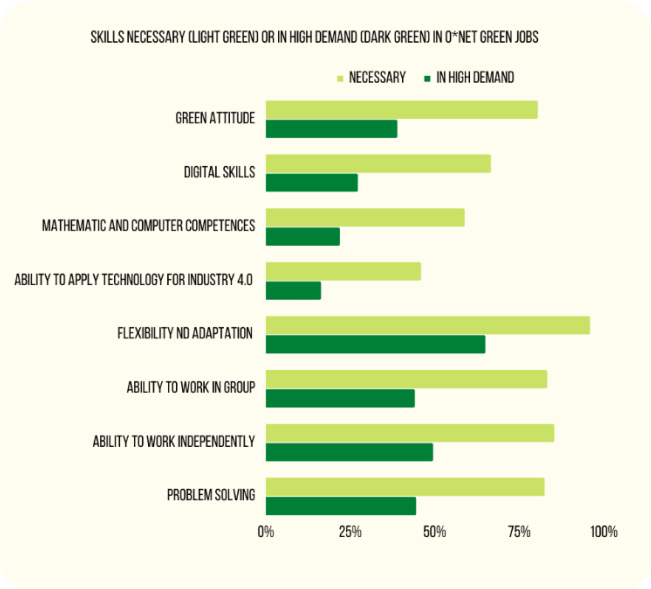
DigCompEdu describes these competences with a focus on supporting and encouraging the use of digital tools in education, as a means of improvement and innovation. It is directed towards educators at all levels of education: from pre-school to vocational, higher education or adult education. It is organized in six areas, with 22 competences, and proposes a progression model with six increasingly complex levels of proficiency to help educators assess and develop their own digital competence. Proficiency levels follow the Common European Framework of Reference for Languages (CEFR): A1 - Newcomer, A2 - Explorer, B1 - Integrator, B2 - Expert, C1 - Leader, and C2 - Pioneer.

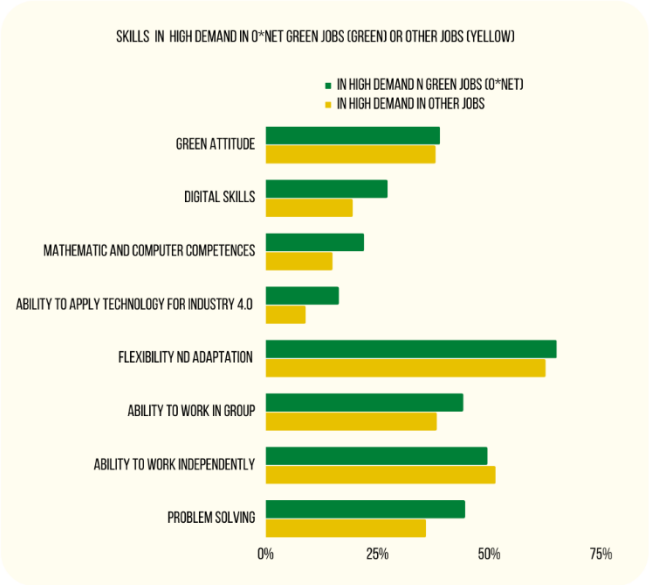


3. CIRCULAR ECONOMY AND DIGITIZATION



Visit the **Digital Education Action Plan** here





Sustainability Competences Report EU

Many of the development aspects of the circular economy are supported by digital developments. For example, creating services around products is one of the ways of immersing in a circular economic system. Transforming products into services means that the product cycle is not exhausted, that it generates employment throughout its consumption phase and that return and therefore reuse and/or recycling is ensured.

European industries are increasing their offer of services around the products they manufacture. In a digital context it is possible to obtain services related to the good maintenance of the product, but they can become a catalogue of services that create a relationship between company-consumer. This is a differentiation of the manufacturer and copes with changing consumer habits.

An example of this can be found in lighting manufacturers. The long life of LED bulbs, which are common among consumers, is causing these manufacturers to offer "after-sales" services and products related to the bulbs.

Educational institutions of all levels should be encouraged to embrace the SDGs as guidance for their activities and supported to become places where skills for sustainability are not only taught, but also actively practiced. Reform and modernization of education systems from building green schools and green campuses to developing new skills for the digital economy should also be addressed.

Enhancing ICT skills and core digital competences, in line with the EU Digital Education Action Plan, and focusing on artificial intelligence should be among the priorities when moving forward. Harnessing the power of the digital transformation to meet the SDGs is a clear priority. The EU is fully committed to develop capacity and expertise in key digital technologies such as connectivity, the 'internet of things', cybersecurity, blockchain or high-performance computing, while simultaneously paying attention to the potential negative externalities of digital infrastructures.

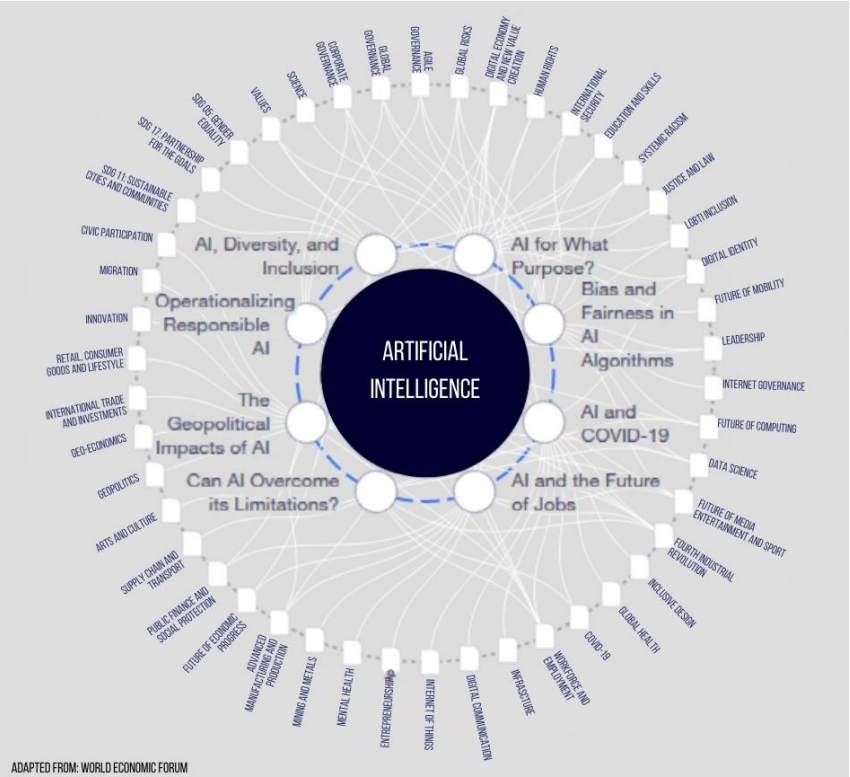
Artificial intelligence is an area where the EU is lagging China and the United States. The EU needs to catch up quickly to reap the economic benefits and at the same time take the lead in shaping the necessary new ethics that should accompany this new technology. This way the EU can help ensure that artificial intelligence is a net benefit to people's lives and work. By being able to process large amounts of data instantaneously, artificial intelligence has the potential to significantly increase productivity in many areas, such as healthcare, energy, agriculture, education, and environmental protection. For instance, in the agricultural sector, researchers currently use artificial intelligence and big data to predict crop yields several months before harvest, thereby potentially helping farmers increase productivity, make informed planting decisions, and ultimately enhance food security.

They also allow us to save money. The EU and its Member States could focus on financing breakthrough and disruptive technologies and innovative companies that have the potential to become EU and global market leaders in the sustainability transition, as well as on the effective and timely uptake of these innovations. Particular attention should be paid to sustainable and innovative farming and food systems, clean technology, human and animal health, ecosystem solutions and resource-efficient

products and production methods. Additionally, a supportive regulatory framework to stimulate the effective uptake of innovation for sustainable development is required.

Green Economy

The United Nations defines the Green Economy as one that "results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcity". This brings together the three concepts of sustainability: social, economic, and environmental. A value-based approach to nature, the environment, human well-being, and economic development. Green economy is one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcity.



The fourth industrial revolution will change the way we live, work, and relate to each other. It will bring with it new opportunities for social transformation, a revolution driven by the internet of things, artificial intelligence, and the use of autonomous vehicles.

At present, almost all entrepreneurial projects tend to be closely linked to digital tools, whether in customer service or in the management of the company itself, or even implicitly in the product itself.

Circular and digital economy

Many of the development aspects of the circular economy are supported by digital developments. For example, creating services around products is one of the ways of immersing in a circular economic system. Transforming products into services means that the product cycle is not exhausted, that it generates employment throughout its consumption phase and that return and therefore reuse and/or recycling is ensured.

European industries are increasing their offer of services around the products they manufacture. In a digital context it is possible to obtain services related to the good maintenance of the product, but they can become a catalogue of services that create a business-consumer relationship. This is a differentiation of the manufacturer and copes with changing consumer habits. An example of this can be found in lighting manufacturers. The long life of LED bulbs, which are common among consumers, is causing these manufacturers to offer "after-sales" services and products related to the bulbs.

Information and Communication Technologies (ICT) represent a major technological breakthrough that has revolutionized the market and the current economic model. Digitalization has a great dematerializing potential, although it is often accompanied by a tendency towards the proliferation of electronic devices (which also quickly become obsolete). Virtual reality, augmented reality, web platforms, mobile, means of payment, customer contact, big data.... They are an integral part of a process of change in the economic model.

6.2 Best practice cases

Best Practice Case # 1

Nice to eat you – Encantado de comerte
Reducing food wastage

Paraphrasing the well-known Anglo-Saxon greeting Nice to meet you, Nice to Eat You is a young initiative whose aim is to channel and recover, through a web application available for mobile devices, the huge amount of food in good condition that ends up in the rubbish bin daily. The aim is to create a network of sustainable businesses that promote responsible consumption.

Reading an article about the amount of food that is thrown away globally, I was shocked by the figure and thought about how this could be corrected. That's how we came up with the idea of using technology to connect businesses, restaurants, and supermarkets that waste food with potential users. Gabriel Ramas, one of the promoters, acknowledges that they were keen to develop a food reuse project, without knowing that what they were dreaming of could be included in what is called the circular economy. "Without technology, it would not have been possible to come up with an idea like this one. Finally, the Nice to eat you web-app took off in December 2018 with around 40 collaborating businesses in Madrid. From there, it has generated a community of 4,000 registered users, with a presence also in Zaragoza. Since then, one ton of food has been saved, which has prevented the emission of 700 kilograms of CO2 into the atmosphere, according to those responsible.

Click on the image to open the video.

Learn more about **Encantado de Comerte**

Best Practice Case # 2

Surus inversa

Surus Inversa is a company that offers sustainable solutions to manage the international sale of goods and assets discarded by other companies - equipment, industrial machinery, disused facilities, complete plants, surplus production, demolitions, waste, etc. - through a digital auction platform, which can be accessed from anywhere in the world. A website for "second chances" because anything that is no longer of use to someone else, there is always a buyer who might be interested in it. A new piece of equipment may not be affordable, but a second-hand one is. SCRAPALIA's second chances website makes its catalogue of reusable goods available to the secondary market.

escrapalia

Click on the image to open the Website.

Also learn more about **Surus**

Best Practice Case # 3

InnoWEEE Project

A second life for electronic equipment

The collection of waste electrical and electronic equipment (WEEE) currently takes place through a complex chain that can leave space for illegal parallel channels. It is therefore necessary to improve the traceability of material flows and support cultural change through a reward system for virtuous behavior. The InnoWEEE project intends to boost the collection of such waste through appropriate awareness and operative campaigns. It will help develop new business models for municipalities and retailers to improve the collection of WEEE in cities, for example through smart bins.

Click on the image to open the video.

Learn more about **InnoWEEE Project**

Best Practice Case # 4

RECIRCULAR

What is the Impact Measurement Methodology?

"The Methodology for Impact Measurement of recircle is the tool that we have developed to measure the value that our users generate with the recovery of residues carried out. It is a tool that calculates indicators such as the reduction of carbon footprint, water footprint, cumulative energy demand and increased life expectancy. This has already been integrated into our online platform.

On the one hand, we measure the impact achieved through the recovery of resources (waste, by-products, production residues), that is, by preventing these resources from ending up in the landfill or being incinerated. Landfill and incineration are options outside the circular economy and generate negative effects such as soil and groundwater contamination or greenhouse gas emissions, among others. By giving a second life to these resources we avoid these types of pollution, but we also contribute to reducing the consumption of virgin raw materials. Therefore, the methodology also measures the impact of replacing the virgin raw materials needed for production, which no longer must be extracted and processed, with the recovered resources." **www.recircular.com**

Click on the image to open the video.

Learn more about **Recircular**

6.3 Tips for how to best implement the principles into practice in education

Some tips for how to best implement the principles of Digitalization into practice in training and education:

Tip #1: First ask the students what DIGITALISATION is. It can range from functions performed by computers to applications, social networks, websites etc.

Tip #2: Analyses any stage of the circular economy process (reuse, recycling, packaging....) and identifies parts that can be digitally realized or improved with digital applications.

Tip #3: Find examples of apps that in a circular economy process are especially useful for reducing paper use, resources, reuse, etc.

Tip #4: Create specific activities in their school life where digitalization or the introduction of apps boost the school's circular economy (websites for resale of used items, exchange of products, sharing of means of transport, etc.).

Tip #5: Bring some digitization activity to the school's neighborhood. Design an app where neighbors share used clothes, traders sell their surplus products more cheaply, or exchange recycled products. Have a social impact.

6.4 Links to further material

http://www.telecentre-europe.org/wp-content/uploads/2016/02/TE-Guidelines-on-the-adoption-of-DIGCOMP_Dec2015.pdf
http://www.digcomp.andaluciaesdigital.es/
http://www.paneeinternet.it/index.php

https://publications.jrc.ec.europa.eu/repository/handle/JRC106281

https://ec.europa.eu/jrc/en/digcompedu

https://ec.europa.eu/jrc/en/digcomporg

https://ec.europa.eu/jrc/en/research-topic/learning-and-skills

http://ikanos.encuesta.euskadi.net/index.php/566697/lang-e

https://europass.cedefop.europa.eu/editors/en/cv/compose

http://www.digcomp.andaluciaesdigital.es/

http://www.dcds-project.eu/dcds-platform/

https://publications.jrc.ec.europa.eu/repository/handle/JRC123624

7. COLLABORATION AND CHANGES IN HUMAN BEHAVIOR

7.1 Introduction

The transition towards a circular economy cannot be achieved by any single actor it requires collaborative efforts across the value chain, involving individuals, the private sector, different levels of government and civil society. It also requires the change in thinking, elaborating new circular solutions and of behavior of companies and especially individuals.

Municipalities and policy makers need to put down the foundations to make change possible, by providing the necessary infrastructure, creating a political environment and regulations that incentivize innovation for change.

7.2 Learning Material

Workshop 1 - Discussion

Introduction:
A discussion about the linear and circular economic in an easy-to-understand way, discussing the pros and cons as well as the impact on the environment, our individual lives, and the society. Students should be inspired to think about the different economical models and their pros and cons

Objective:
In the following, an example is taken how to raise students' awareness for the transition from linear economy to a circular economy, based on the recycling system.
At the beginning a comparative analysis is made in the classroom of the Linear Economy Model and the Circular Economy Model and pros and cons are being discussed, with a special focus on benefits of the later.

The following charts and questions[i] can be used to generate discussion:

Task 1:

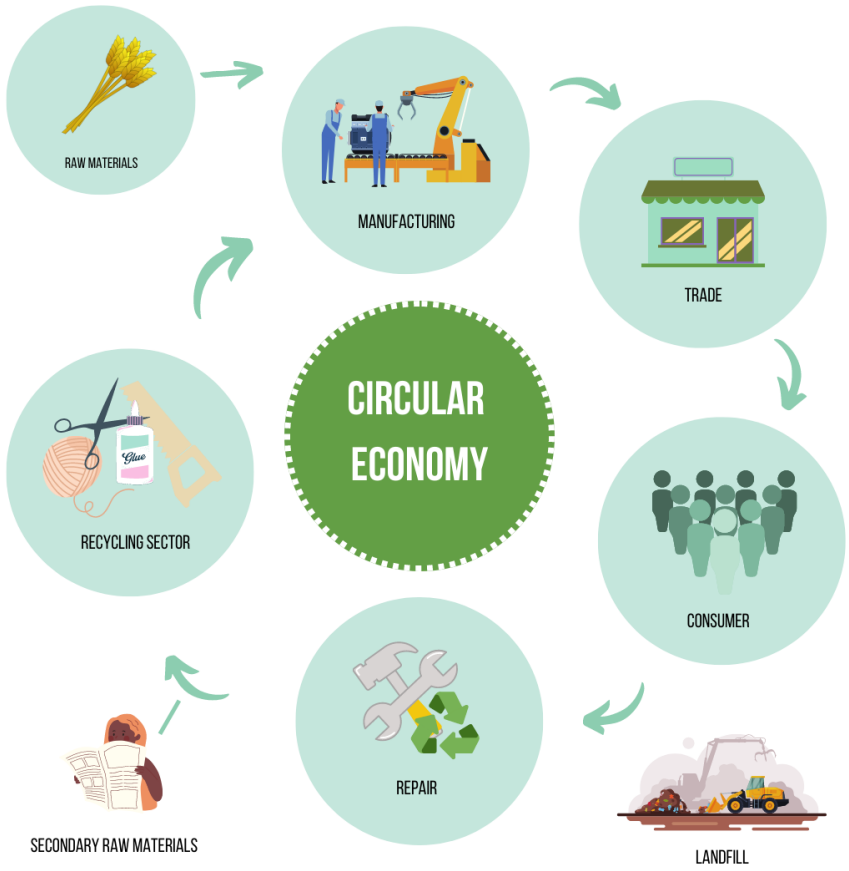
Q: Describe in your own words, what is shown in the chart. Can you imagine that this form of economy is beneficiary to the environment and for a better future? Why or why not?

A: No, because of wasting resources and having a negative imprint on the environment etc.

Task 2:

Q: Describe in your own words, what is shown in the chart. Which difference can you see? Think about why circular economy might be better for the future and environment?

A: recycling, reuse of material etc. and yes, it's better for the future …



Task 3:

Following this introductory part, the focus can be shifted from a general perspective to a more individual perspective, meaning from a "we need to" to I "I need to / I can do" approach in everyday life situations, taking waste management as an example, because everyone is involved in producing waste every day.

A discussion can be triggered by asking the following questions:

Q: Looking at a typical day, in what situations are you producing waste? Name a few products and their components, which are thrown away after usage.

A: exemplified answer

Situation	Products	Components/material
Morning toilet	Makeup products, (electric) toothbrush, toothpaste, soap, shampoo, toilet paper, deodorant etc.	Chemicals, plastic, paper, glass, aluminum etc.
Breakfast	Coffee, jam, eggs, bakery products, cereals, milk bottle/carton, juice bottle/carton	Ground coffee, paper, plastics, glass,
Cleaning/Washing	Glass cleaner, dishwasher taps, soap, cloth, washing powder/liquid, vacuum cleaner etc.	Chemicals, paper, plastic, textile, batteries, electrical components (metals) etc.
Reading/listening to music	Books, music player (iPod, MP3), magazines, newspapers	Paper, batteries etc.
Candlelight dinner	Food wrappers and packaging, plates, glasses, silverware, candles, LED lamps, wine bottles, presents	Plastics, paper, glass, cork, wax, wrapping paper, metal etc.

7.3 Further Informational Material

Taken from the German Recycling system, waste is separated and sorted into different categories and collected. Several symbols help the consumer to recognize the used materials and give guidance




1 **2** **3** **4**

1 – Green Dot (Grüner Punkt)

Can be found on products, when the producer already paid a fee for the recycling of packing according to the EU guideline 94/62/CE from 1997 and does not have to take the used or empty packaging back himself. This system was developed by the Duales System Deutschland GmbH.

More information: www.gruener-punkt.de

2 – Crossed out bin

Can be found on any electrical device according to the WEEE-guidelines (Waste of Electrical and Electronic Equipment). It shows the consumer, that these devices cannot be disposed with the usual household waste.

More information: https://eur-lex.europa.eu/legal content/DE/TXT/?uri=CELEX:32012L0019

3 – One way deposit symbol

Can be found on one-way packaging of drinks, like cartons, cans, PET, and some glass bottles. Since 2003, the consumer in Germany pays a deposit for products carrying this symbol and when returned to the shop, the deposit will be refunded.

More information: https://www.verbraucherzentrale.de/wissen/umwelt-haushalt/abfall/fragen-und-antworten-zum-einwegpfand-dosenpfand-11505

4 – The Blue Angel (Der Blaue Engel)

Can be found on products and services being especially environmentally friendly. Anyone (producer, consumer) can recommend a product or service to Federal Environment Agency in Germany to award the symbol. The symbol is not certifying an entire harmlessness, just indicates that the product or service is more environmentally friendly than others in that product category.

More information: www.blauer-engel.de

Worksheet 1 – My personal contribution to a circular economy

To support changes in the behavior of individuals, the following task can be used to further raise awareness - what kind of simple to apply contribution everyone can make in everyday situations.

Introduction:
For a functioning circular economy, it is crucial that everyone sorts their waste correctly.

Task1: (individual)
Have a look at the following things and sort them into the different categories

Coffee Filters – CD – yoghurt cup – paper towel – wall paper left overs – glass ashtray – beer bottle – wrapping paper – tea bag – photograph – tin foil – small pet litter – magazine – button battery – wine bottle – Styrofoam – cat litter – old printer - milk carton – tin can – flower left overs – old laptop - egg shells – broken vacuum cleaner – tea cup – washing powder carton – spray can – jam jar – carton – shampoo bottle – non-refillable lighter – LED lamp – egg carton – old armchair – bottle caps – newspaper – neon tube light – energy saving bulb- old pen

Glass	Degradable biomaterial	Plastics/ Metal/ composite materials	Paper	Electronic Waste	Residual waste

Task 2: (group)
Check your choices with a partner and discuss your differences.

Task 3: (group)
Discussion: In comparison to the waste management system (Germany) mentioned above, what are the similarities and differences to the system in place in your country and/or community?

Workshop 2 – Thematic Discussion

Introduction:
Linear versus circular economy (see above)

"Unless we go to Circular it's game over for the planet; it's game over for society"
quote from documentary

Objectives:
Initiate a discussion about the necessity of circular economy and the link between environmental issues and economy in general and the potential of circular economy and individual behavior to change things to the better.

Task 1

Watch the documentary "Closing the Loop" and pay special attention to why "going circular" is a necessity for shaping a better future.

Click on the image to open the video.

Task 2 – Discussion

To trigger a discussion about circular economy with a focus on behavioral changes of individuals, economy, politics, and society, the following questions can be used:

- What is the downside of linear economy, regarding our environment?
- What are the opportunities of circular economy and the impact on society and our environment?
- What needs to be done to become "circular"?
- What is circular thinking?
- Name the 5 R: s of going circular (reduce, reuse, recycle, renew, reinvent)
- Name a few benefits of a circular economy?

Task 3

Q: Do you want to be part of the problem or part of the solution?

Discuss: What can you do as an individual to support the change towards a more circular and sustainable economy, preserving the environment, our lives, and societies?

[1] Based on Stadt Münster: Koordinierungsstelle für Klima und Energie
KLIMAschutz macht SCHULE – Unterrichtsmodell „Abfall"

Partners