



Circular

D3.2 Toolkit for Academics



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Module 1. Introduction to the Circular Model

Unit 1.1. Theoretical framework

The increasing global demand for natural resources driven by the consumption pattern of developed economies, and the industrialization of emerging economies pose a threat to the planet. Living standards in developed economies will continue to rise, and by 2060, GDP per capita in emerging countries is expected to reach OECD levels (OECD, 2019). Different studies have projected that total resource use could more than double by 2050 if these trends continue. Therefore, it is urgent to improve the efficiency with which resources are used maximizing their value and to prevent the increase in globalized demand for resources from leading to a shortage of supply that would lead to an increase in input costs.

In this context, the challenge of sustainable development has become increasingly important. The United Nations Brundtland Commission defined sustainability as “meeting the needs of the present without compromising the ability of future generations to meet their own needs.” (WCED, 1987). In 2015, the United Nations presented 17 sustainable development goals (SDGs) in the Agenda 2030 for this challenge. The circular economy (CE) model is presented in this program as one of the key components to move the world closer to sustainability and help achieve the proposed goals. According to the definition of the United Nations Environment Assembly CE model refers to: “one of the current sustainable economic models, in which products and materials are designed in such a way that they can be reduced, reused, recycled or repaired (4-R) and thus maintained in the economy for as long as possible, along with the resources of which they are made, and the generation of waste, especially hazardous waste, is avoided or minimized, and greenhouse gas emissions are prevented or reduced”. Opposed to the traditional linear model, which is based on a 'take-make-consume-throw away' pattern, that is, raw materials are extracted, goods are produced, consumed and discarded. The circular economy seeks to close the life cycle of products, minimizing waste and maximizing resource efficiency, through reusing, repairing, refurbishing, and recycling existing materials and products.

CE can contribute to meeting the SDGs but it is important to understand the different dimensions of sustainability to analyse whether the CE is an effective instrument to achieve sustainable development. The concept of sustainability is a holistic approach that includes three fundamental pillars: environmental, social and economic dimensions. In this sense, the definition of CE proposed by Kirchherr et al. (2017, p. 229) is appropriate: “an economic system that replaces the ‘end-of-life’ concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes. It operates at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, thus simultaneously creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations. It is enabled by novel business models and responsible consumers”.

Several studies have already demonstrated the positive impacts of the circular economy into the three dimensions of sustainability such as generating economic growth, creating jobs, and improving environmental performance (Ellen Macarthur Foundation, 2015-a). First, in economic terms, the circular economy seeks to create



value through the optimization of resources and the reduction of costs associated with the extraction and processing of raw materials. When the reuse and recycling of materials is fostered, new business opportunities are generated and innovation in production processes is stimulated. Second, from a social perspective, the circular economy seeks to promote equity, inclusion and participation of all actors involved in economic processes. This involves guaranteeing fair working conditions, promoting equal opportunities, and promoting social cohesion in communities. Finally, from an environmental perspective, the circular economy seeks to minimize the negative impact of human activities on the environment, reducing waste generation, controlling pollution, and preserving natural resources for future generations.

In recent years, a large number of authors have defined the concept of CE. While there is still no consensus on a clearly accepted definition, The Circle Economy Foundation developed the Key Elements (KE) Framework highlighting and classifying the elements of the CE into two groups (Circle Economy, 2021):

Core Elements: activities directly handling product or material flows. The main objectives are to extend the useful life of resources, prioritize regenerative resources, and use waste as a resource.

Enabling Elements: actions that remove obstacles for core actors. For instance, the design focused on stretch the lifetime; rethink the business model towards regenerative models that provide well-being for society; work together throughout the entire supply chain, within stakeholders to rise transparency and create value; foster innovation networks and research development, structure; and include digital technology that provides information to track and optimize resource usage, strengthen connections between supply chain participants, and enable the implementation of CE models.

This framework can be translated into three principles proposed by The Ellen MacArthur Foundation:

Principle 1. Preserve and enhance natural resources by controlling finite stocks and balancing renewable resource flows.

Principle 2. Optimize resources efficiency following circular production models, maximizing the utility of components and materials in both technical and biological cycles.

Principle 3. Foster production effectiveness systems by revealing and eliminating negative externalities.

In turn, these three principles can be translated into six concrete actions to move towards the circular economy. Figure 1 introduces and explain the ReSOLVE framework:

Figure 1. The ReSOLVE framework: six action areas

ACTION	DESCRIPTION
REGENERATE	A series of actions aimed at preserving and improving the biological capacity of the Earth. That requires the shift to renewable energy and materials; reclaim land, retain, and regenerate health of ecosystems and return recovered biological resources to the biosphere, through composting for example.





SHARE	Sharing products among different users (peer -to-peer sharing of privately owned products or public sharing of a pool of products), maximize the use out of goods and eliminates waste and duplication through maintenance, repair, and design for durability. It also includes reusing products through their entire technical lifetime (second hand).
OPTIMISE	Improve performance of products; remove waste in the entire supply chain (from sourcing and logistics, to production, use phase, end-of-use collection, etc.) encouraging investment in technological innovations that optimize processes.
LOOP	The essence of the circular model is based on the idea of a loop: resources are processed, circulated, and returned to the economy, rather than being lost to landfills.
VIRTUALISE	This concept means making use of virtual tools when they can improve the productivity of resources.
EXCHANGE	Replace old ways of doing things applying new technologies (e.g. 3D printing or electric engines) and choose new products/services (e.g. multimodal transport).

SOURCE: Own elaboration based on Ellen MacArthur Foundation (2015-b).

When comparing linear and cyclical economic approaches, Braungart et al. (2008) distinguish between “cradle to grave” material flows and “cradle to cradle” cyclical flows. Aligned with other common frameworks, a commonly adopted taxonomy encompasses four resource flows which provides a holistic, regenerative and resource-efficient CE system: Regenerate, Narrow, Slow and Close (Bocken et al., 2016).

Regenerate. Regenerate resource flows, prioritizing the use of renewable energy sources, minimizing reliance on fossil fuels, and eliminating the use of toxic materials in the different stages of life cycle management.

Narrow. Reduce the number of materials used in production processes, optimizing material and energy use, and reducing greenhouse gas emissions. This can be achieved by transitioning towards circular business models. In this sense, the best way to reduce flows is to stop using unnecessary goods or services, such as fast fashion clothing.

Slow. Using resources for longer optimizes the use of resources. At this stage it is important to focus on the design with durable materials, and service circuits that extend the useful life of the product, such as repair, maintenance, refurbish, and remanufacture.

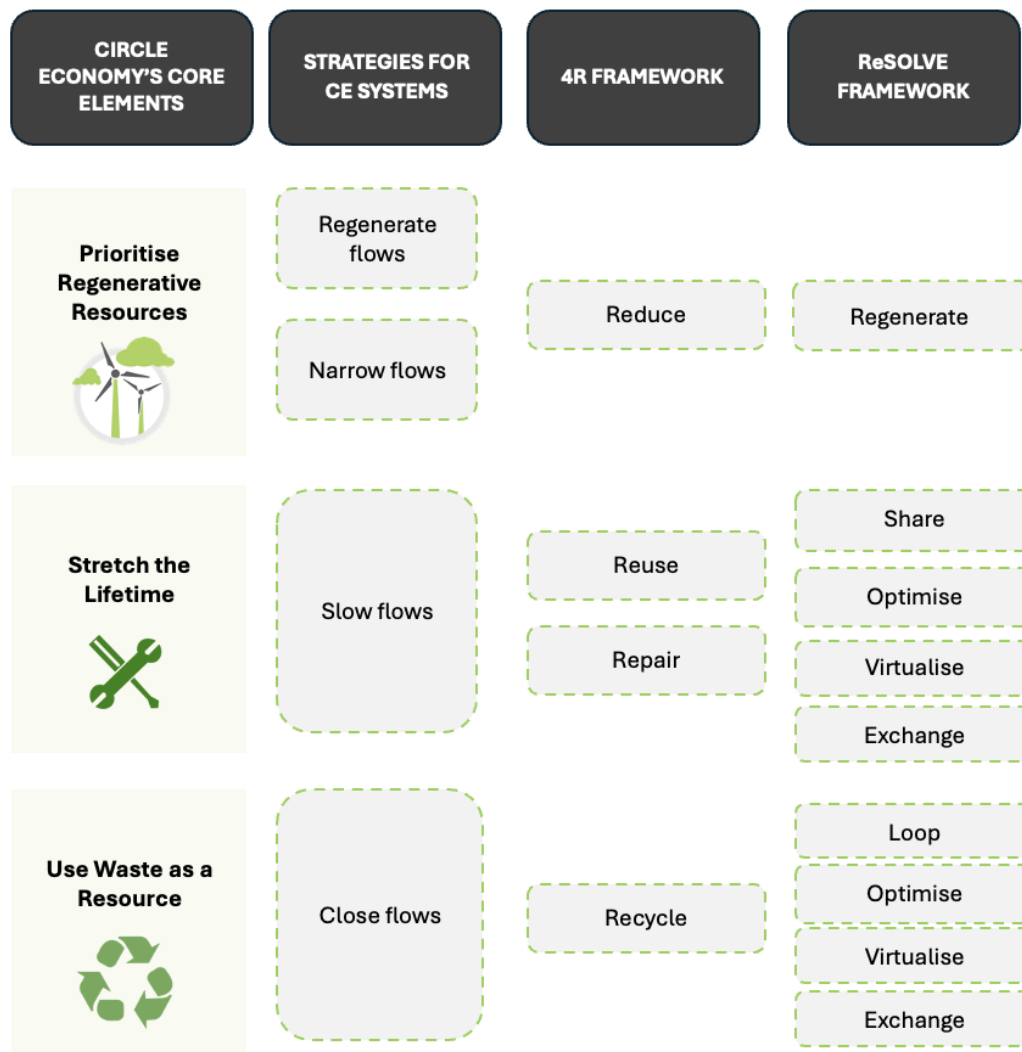
Close. Includes actions that aim to close production and waste loops. This implies make the most of resources at their end-of-life stage by creating circular flows; improve the collection and reprocessing of materials; upcycle rather than downcycle; and design products for recyclability and for disassembly.

In summary, in the figure 2 we show the link between the key core elements and the frameworks mentioned in this section commonly applied in circular economy literature.





Figure 2. Links between principles and frameworks of CE models



SOURCE: Own elaboration based on Circle Economy (2021).

Despite the growing interest and development of policies aimed at the transition towards a circular economy, there are still obstacles to its implementation. The main barriers are the economic incentives provided by traditional and linear production models. The following figure represents the obstacles that may arise in each challenge and proposes an action plan to address each issue.





Figure 3. Challenges, barriers and action plan for the transition to the circular model

	CHALLENGE	BARRIER ADDRESSED	ACTION PLAN
CORE ELEMENTS	Prioritize Regenerative Resources	The cost to shift: the transition requires a significant investment of time, knowledge, and resources.	Design regulatory frameworks adaptable, scalable, and flexible to address the complex challenges facing different industries.
	Stretch the Lifetime	Profitability of short life cycle products	Encourage investment in production models that support sustainable consumption. Fiscal support , e.g., tax
	Use Waste as a Resource	Lack of innovation and development to recover value from waste and reuse materials.	Promote the development and application of new knowledge and technologies to encourage innovation in processes, products, services and business models.
ENABLING ELEMENTS	Design for the Future	Lack of skills to recover or reuse components due to lack of knowledge or legislation.	Foster public-private collaboration.
	Rethink the Business Model	Absence of shared interest among supply chain participants. Fear of disruption of existing business model system or value chain.	Favoring business investment in R&D&I (e.g. subsidies). Funding for training, research, and development.
	Strengthen and Advance Knowledge	Asymmetric information and disaggregated and unstructured knowledge.	Awareness raising of stakeholders (e.g. education) Disseminate and transfer findings with integrity.
	Incorporated Digital Technology	The lack of information systems on the location and status of assets leads to the impossibility of optimizing the use of resources.	Encourage investment in digital platforms and technologies that provide insights to track, strengthen connections between supply chain actors, and enable the transition towards CE models.
	Team up to Create Joint Value	Conflict of interests and misaligned objectives between stakeholders in the value chain could obstruct progress and/or generates wasted resources.	Work together throughout the entire supply chain, within stakeholders to rise transparency and create joint value.

SOURCE: Own elaboration based on Circle Economy (2021).

These challenges require **specific, measurable, assignable, realistic, and time-related goals** to provide a framework with clear direction and maximize the benefits of monitoring and evaluation. The policies and actions directed at each level must be closely intertwined and aimed at the same commitment to the transition to the circular economy. All areas of society are important in the transition towards circular models, among others, finance and investments; industry and commerce; energy;



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agricultural and food systems; public health; social affairs and employment; education, science and technology; and finally, digitalization. In addition, governments should establish guarantees that this is a lasting commitment with both short- and long-term actions. Furthermore, there is ample space for peer learning, the exchange of experiences and the transfer of knowledge from the most advanced countries in circular models to countries in which linear production systems predominate.

Unit 1.2. Stakeholder engagement and Living lab design

The commitment made by nations regarding the Sustainable Development Goals and the 2030 Agenda has propelled the transition of economies towards increasingly sustainable models, knowledge-intensive based, where innovation is a key driver. In order to face the transition to sustainable economies, policy measures supported innovation and strategic knowledge assets based on sustainable, trans-disciplinary and hybridized approaches. The initial triple helix model, composed of governments, universities, and businesses, has evolved into a quadruple helix model where the participation of civil society becomes highly relevant, in this way, concepts such as social robustness, inclusivity, and sustainability are included in innovation ecosystems. Living labs are, in this context, platforms for quadruple helix innovation, which offers opportunities for testing, validation, development and co-creation at all stages of a design and commercialization process by synchronizing the innovation processes among the actors of the QHM (Compagnucci et al., 2021).

There are many perspectives on LLs definitions in the context of the CIRCULAR project, where academics and researchers play a leading role, we can approach LLs as the definition of the European Commission(2009): “a user-driven open innovation ecosystem based on a business-citizens-government partnership which enables users to take active part in the research, development and innovation process”; LL are “user-centred, open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings. They act as intermediaries between citizens, research organizations, companies, cities and regions for joint value co-creation, rapid prototyping or validation to scale up innovation and businesses. LLs operate as an open and dynamic research and innovation ecosystem involving solution developers contributing with technology, research labs and universities contributing knowledge and technology, local authorities and policy makers contributing inclusion and social wealth, and user communities seeking applications.

In the CIRCULAR project, universities will act as enablers and providers institutions, to promote research and knowledge creation. The network forms around a provider organization (e.g. university), but information is collected and used together, and knowledge is co-created in the network¹; knowledge is utilized in the network to help the user community. It is important to highlight the role of Universities participating in CIRCULAR to guarantee that LL acts as a bridge between open innovation and user innovation within the QHM. LLs are able to develop the iterative process of experimenting and learning from year to year. This means that they are able to provide a coherent basis for action over time.

To do this, LLs must involve the creative and innovative potential of users, so as to gain better insights into the possibilities, opportunities and restrictions of innovations. Users are not anymore “consumers” with the role of observed subjects for testing products





or services but are co-creators. User knowledge offers a valuable resource for innovation because it fosters understanding of real-life situations where products and services are involved.

A good example of how users act as co-creators and knowledge providers is the Living Labs of the Circular Bioeconomy Alliance in the Amazonia with the aim of combining modern innovation with ancient wisdom: “learning from indigenous communities how to translate our science into generating wiser decisions, into a wiser humanity”. The project aims to accelerate rainforest restoration while creating new forest-based value chains around cocoa, vanilla, medicinal plants and eco-tourism.

Given the importance of involving the users, we should consider how to foster its participation in the living labs, considering a range of methods and tools such as:

- Focus groups,
- Workshops,
- Platforms,
- Online and or face to face questionnaires,
- Laboratories on entrepreneurship and innovation,
- Business ideas contests

The involvement of users in the LL can be difficult considering different degrees of commitment, getting stakeholders interested in participating can be an easy task but achieving a higher degree of commitment can be difficult.

The role of universities as enablers and providers would facilitate the identification and engagement of stakeholders to varying degrees. For instance, among the reasons for businesses to facilitate their engagement with the LL is to meet different set of needs:

- Business plan development
- Funding opportunities for innovation activities
- Ideation events
- Development of products and services
- Access to innovations,
- Access Technologies,
- Internationalization
- Talent recruiting.

Governments and public bodies generally look on the LLs as a support mechanism to implement practices in the LL's domain. The guidelines proposed by the policy document of the United Nations Economic Commission for Europe (UNECE, 2022) introduces three essential levels of collaboration to achieve a successful transition to a CE:



- Collaboration across policy areas: the circular economy requires a transdisciplinary approach involving multiple policy areas, including, but not limited to, the ministries of environment and economy.
- Collaboration across policy layers: national, regional and municipal governments play an important role in implementing countries' circular economy. Given economic globalization, international cooperation is essential, for example, to exchange information between value chains and facilitate mutual learning and capacity-building.

Universities play a significant role in Living Labs as they have access to a young population, for example. Activities that attract students and young people to commit in LL are for example organises.

- Industrial and innovative
- Ph.D. courses,
- Supports student ideas
- Involving undergraduate students in multidisciplinary research teams
- Promoting employment opportunities,
- Entrepreneurship competitions for young people

The inclusion of senior citizens in LL is interesting to include traditional and ancient knowledge and practices. This group of population brings interesting perspectives on sustainability issues that can be applied together with advanced technologies and new processes. Finally digital tools are essential to facilitate communication and data management. The access to scientific databases, technologies, sustainable practices, innovation projects, patents and processes is needed to build-up the knowledge-intensive based open innovation ecosystem.

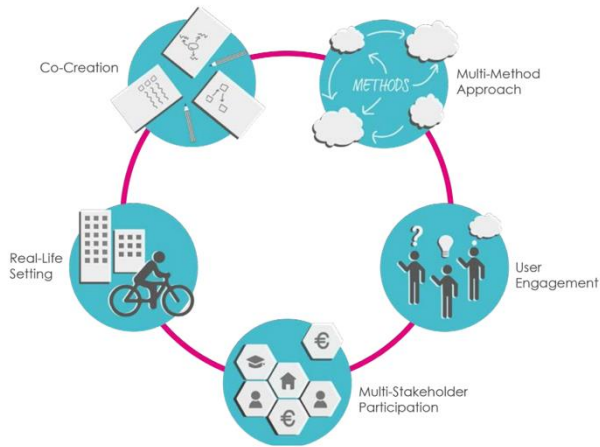
The Living Lab approach follows a cyclical approach, where different scenarios, the possible 'future states' are tested in a real-world context, and solutions evolve through multiple iteration rounds in a participatory process (Figure 4.). The Living Lab approach helps to improve the pivotal multi-stakeholder collaboration within CE ecosystems. These collaborations involve scientists, companies, cities and other public authorities and policymakers, as well as civil society (a.k.a. citizens and various types of consumers) and third-sector organizations contributing to the joint knowledge, innovation and value creation processes. As a result, the Living Lab approach is considered to be an open innovation development approach in which in-house and external resources are combined to deliver novel solutions. The Living Labs engage diverse actors and stakeholders across the CE process starting from the identification and definition of a challenge, the concept or prototype design and the experimentation, towards the pre- and post-launch of a novel CE solution.

While Living Labs can be described in many ways and serve several purposes, the following five key elements described in Figure 4 are forming the foundation for Living Lab activities (EnoLL, 2017).





Figure 4. Key elements in Living Labs implementation (ENoLL, 2017)



Real world context: Living Lab activities are occurring in simulated or in real-world contexts. In practice this means that the various solution alternatives for the new product and service ideas are co-created, tested and validated from early on in the development process, by their potential users in their natural usage-environments.

Multi-stakeholder participation: A wide ecosystem of actors, consisting of all relevant stakeholders from end-users to employees and value chain partners, are involved throughout the innovation process. The harmonized participation of all the main stakeholder groups includes the following four main stakeholder groups, which each are able to benefit from the Living lab process in different ways.

1. **Business / Companies** such as manufacturing and services within the value chain, primary sectors, financial sector, creative industries, social sector, large companies, SMEs, cluster and business organizations, business driven associations, etc.
2. **Research and education (Academia)** including public and private research bodies, primary schools, universities, public and private education and training, science and technology centres, technology transfer officers, etc.
3. **Public Sector** including government, EU regulators, municipalities, public procurement officers, incubators.
4. **Civil society and consumers** including NGOs, citizens and users related to the three circular economy business models, as well as current and possible future customers of the demonstrating companies.

User-engagement: Living Labs seek to identify user-centric solutions, opportunities and challenges. Involving the users already in the beginning of the development activities and across the whole innovation process is a key element of the Living Lab process.

Multi-method approach: As all Living Labs are unique, there isn't a single Living Lab methodology that can be replicated and applied. This means that co-creation methods that best fit their purpose are selected and implemented during the different Living Lab phases, as the requirements and solutions evolve during multiple iterative development rounds.





Co-creation: Co-creation is identified as the central process of the Living Lab approach. It can be defined as a cooperation between different actors or stakeholders who share the same overall objective or goal. It is about planning, developing and innovating new solutions through a specific iterative development process while utilizing various methods, techniques and tools. Through a co-creation approach, diverse teams together with end-users can collaboratively identify needs, ideas, experiences and opportunities and generate fast prototypes to be tested and validated by the real users and other relevant stakeholders.

There exist three main building blocks within Living Lab projects, following the innovation development phases (Figure 5):

- *Figure 5. Open innovation phases (ENoLL, 2017)*



- 1. Exploration:** getting to know the 'current state' and designing possible 'future states'
- 2. Experimentation:** real-life testing of one or more proposed 'future states'
- 3. Evaluation:** assessing the impact of the experiment with regards to the 'current state' in order to iterate the 'future state' In the following chapters, the different stages are represented and the impact of these is described on the nature of the user activities taking place at each stage

Exploration:

The first phase within an innovation project, following the Living Lab approach, can be labelled as 'exploration'. In terms of the New Product Development (NPD) process, this consists of moving from idea towards concept or prototype of the solution. In the language of entrepreneurs, this is the 'problem-solution fit' stage, as you identify the problem and fit your solution as good as possible with the problem. The main goal of this stage is to understand the 'current state'. This means getting an overview of the current habits and practices of users you want to target. A specific focus is put on the current problems they still face, taking into account the specific contexts in which these problems occur. This is done by means of methods and techniques like observation, participation and in-depth interviews.

After understanding the users and their context, one engages in the process of discovering latent needs and wants of the users. Here sensitizing techniques are used to dig into the users' deeper levels of knowledge, uncovering tacit and latent needs and wants. This leads to the definition of opportunities for improvement of the users' 'current state'. These materialize in possible 'future states' that are thought of. This is





done by means of brainstorming, ideation and co-creation techniques. All the ideas and options are then materialized into concrete concepts that can be co-designed.

In terms of Open Innovation, this phase can be labelled as involving mainly 'exploration' processes. Exploration is defined as purposive inflows of knowledge or technology, aimed at capturing and benefiting from external sources of knowledge to enhance current technological developments. First, exploration is used to understand the current solutions people use, the current habits they display and the current context in which people use these solutions and have developed these habits. Subsequently, exploration is used to develop and share ideas for solutions to these needs, in order to come to concrete innovation concepts.

This exploration stage also provides you with a certain benchmark of the 'current state'. This is important, as it allows the measurement of potential impacts and effects of the experimentation stage in order to measure the effects of the innovation. Therefore, this stage also can be considered as the 'pre-measurement' before the intervention, which takes place in the experimentation stage.

Experimentation

The second stage within an innovation development process can be labelled as 'experimentation'. In the previous stage a certain solution or 'future state' materialized into a concept, this stage puts it to the test by developing and experimenting with a prototype. Specific for a Living Lab approach is the 'real life' setting in which the testing takes place. The degree in which 'real-life' can be attained is linked to the maturity of the design. Prototypes can take on many forms, from tangible MVPs (Minimum Viable Products) to intangible services or experience design prototypes, but their main goal is to facilitate testing of the possible 'future state'. In the experimentation stage, the innovation itself is presented as a prototype to the users in the form of a new solution, which potentially triggers new habits and new contexts of use.

The goal of this 'intervention' is to understand user reactions and attitudes to the proposed solutions, and to also capture behaviour, which is made possible by having the testing take place in "as-real-life-as-possible" contexts. Depending on the maturity, the interventions can be labelled as proxy technology assessments, User Experience testing, or actual field trials.

When a prototype is stable enough, the experimentation can take the form of an actual field trial. Depending on the possibilities, this testing can be short to longer term, involve a few to large amounts of users, and can include some specific to all aspects of the solution. In terms of techniques, one should focus on unobtrusive techniques to capture the concrete user behaviour with the solution ('doing') and avoid only relying on what people 'say'. Summarizing, the experimentation stage puts the designed solution to the test, as much as possible in a real-life context, and allows a decision to be made on whether to head back to the exploration stage to iterate your solution, or whether to proceed to the evaluation stage.

Evaluation

The third and final stage consists of evaluating the innovation. As the exploration stage provided a benchmark regarding the 'current state' of the end-users, the experimentation stage simulated an envisioned 'future state' by means of an intervention. The evaluation stage enables to generate a 'post-measurement' of the intervention and compare it to the 'pre-measurement' benchmark, illustrating potential impact and added value created by the innovation.





In terms of Open Innovation processes, this stage is aimed at exploitation. Exploitation entails purposive outflows of knowledge or technology, implying innovation activities to leverage existing technological capabilities outside the boundaries of the organization. Related to the entrepreneurship literature, this stage can also be labelled as the 'product-market'-fit.

In the experimentation stage, ideas can be enabled to mature into a tested prototype or design, which can now be mapped into a target market and user population. The goal is to launch and implement the innovation into these target markets, based on a go-to-market strategy. The focus is on understanding the potential market, which can be done through techniques such as market research, user toolkits for customization or conjoint analysis for defining a concrete offering. This also involves preparing a coherent marketing communication and strategy. By combining the pre- and post-measurement of the intervention, it should be possible to quantify your value proposition. A key question at this stage is: what advantages is the 'future state' able to deliver in terms of the 'current state' of your envisioned user population? This also facilitates determining pricing levels, as this is much easier when it is possible to quantify the impact of your solution. This stage can also consist of the post-launch activities, where actual adoption and usage of the innovation is monitored in order to re-design or add new functionalities according to the needs of existing or new market groups.

Unit 1.3. Intercultural competence: set of knowledge and skills necessary to act in an intercultural way in diverse contexts

In an increasingly interconnected world, intercultural competence is no longer a luxury, but a necessity for navigating diverse environments when implementing like living labs. This competence encompasses a set of knowledge and skills that empower us to communicate, work, and build relationships respectfully and effectively with people from various cultural backgrounds (Peng et al., 2016). Throughout this section, we'll delve deeper into the essence of intercultural competence, exploring its significance within living labs and unpacking strategies to cultivate it for successful collaboration in these dynamic settings. Moving beyond simply acknowledging differences, the "diversity advantage" approach actively leverages the richness of a diverse environment to fuel progress. This approach to governance, management, and decision-making recognizes that a variety of perspectives and experiences can lead to better outcomes.

Here's a breakdown of the key aspects of the diversity advantage (Council of Europe, 2024):

- o Intentional Impact: Planning goes beyond just including diverse voices. It involves actively harnessing the strengths of that diversity to achieve positive results.
- o Inclusive Decision-Making: Diversifying decision-making bodies ensures a wider range of viewpoints are considered, leading to more well-rounded solutions.
- o Broader Participation: Encouraging active participation from everyone, regardless of background, fosters a sense of ownership and unlocks the full potential of the group.



- Promoting the Advantage: Building awareness and understanding of the benefits of diversity is crucial for widespread adoption of the approach.
- Global Perspective: An international outlook fosters a broader understanding of issues and opportunities, leading to more effective solutions with a wider reach.

Intercultural cities thrive on interaction – the everyday exchange between people from diverse backgrounds. It's this interaction that fosters understanding, breaks down stereotypes, and unlocks the true potential of a multicultural society. However, simply being in the same space isn't enough. Meaningful interaction requires creating conditions for constructive dialogue across cultural and other differences. This is especially important when prejudice and discrimination can thrive in environments lacking contact and open communication.

Here's how we can cultivate this vital interaction:

- Everyday encounters: Encouraging positive, everyday interactions across differences is the foundation. This can involve community events, cultural exchange programs, or simply promoting spaces where people come together naturally.
- Partnerships: Building bridges requires collaboration. Fostering interaction and working in partnerships between diverse groups strengthens understanding and breaks down barriers.
- Understanding challenges: Recognizing and addressing fears and anxieties people might have about interacting with different cultures is crucial. Open dialogue and addressing concerns pave the way for positive interaction.
- Proactive conflict resolution: Challenges and conflicts are inevitable. Developing strategies to proactively address them fosters open communication and strengthens intercultural bonds.
- Sustained interaction: Creating opportunities for sustained interaction, not just one-off events, is key. Building long-term relationships across cultures deepens understanding and fosters a more inclusive society.

By promoting meaningful interaction and tackling barriers, we can create truly thriving intercultural cities where diversity becomes a source of strength and enrichment. Given the complex web of global relationships, the success of the circular economy hinges on navigating the intricate tapestry of cultural contexts across the globe. Diverse values, social norms, and economic realities influence how people approach consumption, waste management, and resource use. Ignoring these differences can hinder the adoption and effectiveness of circular practices.

To bridge this gap, intercultural competence emerges as a critical skillset. It refers to the ability to effectively interact with individuals and groups from different cultures. This includes:

- Cultural awareness: Understanding the underlying values, beliefs, and traditions that shape cultural behaviours.
- Cultural empathy: Developing empathy and respect for diverse perspectives on resource management and consumption patterns.
- Cultural knowledge: Acquiring specific knowledge about the cultural context where you plan to implement circular initiatives.



- Cultural skills: Skilfully communicating and collaborating across cultures to foster a shared understanding of circularity.

By cultivating intercultural competence, we can build more inclusive and successful circular economy strategies, one that embraces cultural diversity as a source of strength and innovation.

Living Labs are real-world platforms where stakeholders collaborate to test and refine circular solutions. Establishing a culturally-conscious Living Lab requires a deep understanding of the local landscape. This includes:

Cultural Values and Consumption: Research prevailing attitudes towards waste, resource use, and product ownership. Consider factors like:

- Is there a strong emphasis on "newness" or a tradition of repairing and reusing goods?
- Are there cultural beliefs that influence consumption patterns (e.g., religious dietary restrictions)?

Traditional Practices: Identify existing practices that align with circular principles, such as local repair shops or community composting initiatives. These practices can serve as a valuable foundation for building a circular economy.

Cultural Barriers: Acknowledge potential roadblocks to implementing circular practices. These might include:

- Stigma associated with used goods in certain cultures.
- Lack of trust in repair services or second-hand markets.

Digital Landscape Assessment:

Technology plays a crucial role in enabling a circular economy. Analyse the digital access and literacy within the local context:

- Infrastructure: Assess internet availability, mobile phone penetration, and access to digital devices.
- Literacy Levels: Evaluate digital literacy skills of the target population.
- Bridging the Divide: Develop strategies to address the digital divide and ensure inclusive participation in the circular economy. This could involve:
 - Offering workshops on basic digital skills.
 - Utilizing low-tech or offline alternatives for information dissemination.

Collective Brainstorming:

By fostering open dialogue and collaboration, we can identify and address potential challenges arising from cultural differences. Here's how:

- Workshop-style Sessions: Organize workshops where participants can discuss potential challenges like:
 - Communication gaps between stakeholders from different cultural backgrounds.
 - Differing approaches to collaboration and decision-making.
 - Scenario Planning: Explore potential scenarios where cultural variations could impact: Stakeholder engagement strategies.



- o Business model design for circular products.
- o Waste management practices.

Collaborative Solutions: Encourage participants to develop solutions that leverage cultural diversity as a strength. This could involve:

- o Designing culturally relevant communication materials.
- o Adapting business models to local preferences and consumption patterns.

The following real-world examples demonstrate how circular economy initiatives can be adapted and implemented across diverse cultures:

Case Study 1: The Humblemend Project, India

In India, a culture of resourcefulness thrives. The Humblemend Project capitalizes on this by empowering women in underprivileged communities to become skilled repair technicians. They collect and repair discarded clothing, extending product lifespans and creating a sustainable livelihood for women. The project's success hinges on its deep understanding of the local culture's emphasis on resourcefulness and its ability to address the digital divide by providing training in basic repair techniques.

Case Study 2: The Maasai Mara Leather Project (Kenya):

In the Maasai Mara, a region steeped in tradition, a community-based project upcycles discarded leather scraps from tourism into high-value handbags and accessories. This initiative not only generates income but also aligns with the Maasai's long-held respect for resourcefulness and utilization of all parts of an animal.

Key Takeaways:

Cultural emphasis on resourcefulness provided a fertile ground for circular practices. Community ownership and participation ensured the project's cultural relevance.

Case Study 3: The Restart Project (Europe):

The Restart Project extends the life of electronic devices through repair workshops and online resources. This initiative addresses the growing trend of e-waste in developed nations and caters to a cultural shift towards mindful consumption and environmental consciousness.

Across Europe, consumer trends are shifting towards mindful consumption. The Restart Project addresses this by creating online platforms connecting consumers with repair services.



Module 2. Capacity-Building for academics

This module aims to assist in building the capacities of academics to design, organize, and implement collaborative social innovation programs that promote active citizenship among students while simultaneously contributing to solving everyday sustainability and climate change issues. The Capacity Building in Higher Education (CBHE) initiative promotes international collaboration through projects formed by partnerships between organizations active in higher education. Aligned with the Sustainable Development Goals (SDGs) and the Paris Agreement, this training addresses challenges related to socio-economic recovery, growth, and prosperity, while responding to contemporary trends such as economic globalization and the recent decline in human development. It also addresses issues of fragility and growing disparities in the social, economic, and environmental fields.

The module will be developed in three units:

Unit 2.1. Embedding circular economy into teaching

Embedding the circular economy into teaching requires a multifaceted strategy that encompasses principles, practices, and real-world illustrations across diverse educational tiers. This approach ensures comprehensive understanding and application among students. Curriculum development and the creation of extracurricular activities are integral to incorporating the circular economy into education.

Curriculum design

To develop an academic curriculum for higher education, it is essential to consider and remember important elements that will be addressed in this module and integral components of Module 2, being common components to all three units that comprise the module. To start this module and this unit, let's revisit some interwoven elements throughout the curriculum development process for learning and training in circular economy and social innovation.

To craft curricular designs for a course across all levels of teaching, we need to construct a comprehensive program that encompasses the following elements:

1. Duration (Hours/Week/month); 2. Work hours by type of class (theoretical, practical, project, seminar, or other), and 3. Credits. Credits are the volume of learning based on the defined learning outcomes and their associated workload that will define the value of this course in the academic path.

4. Title of the curricular unit.

When crafting a title for an academic course in circular economics, it's crucial to consider several key factors:

Clarity: The title should communicate the focus and content of the course to prospective students and stakeholders. Relevance: It should accurately reflect the subject matter and objectives of the course within the context of circular economics.

Engagement: The title should be compelling and engaging, sparking interest and curiosity among potential learners. Accessibility: Ensure the title is easily understandable and accessible to a diverse audience, including those unfamiliar with the field of circular economics. Accuracy: It should accurately represent the core



themes, principles, and methodologies covered in the course, avoiding misleading or overly broad descriptors. **Innovation:** Incorporate innovative or distinctive elements of the course content or approach to set it apart from similar offerings in the field. **Alignment:** Ensure the title aligns with the overall goals and objectives of the academic institution or program offering the course.

By carefully considering these issues, you can create a title that effectively communicates the essence of the course while attracting and engaging students interested in circular economics.

5. Learning outcomes and their compatibility with the teaching method (knowledge, skills, and competencies to be developed by students).

Aligning learning outcomes with teaching methods means ensuring that the intended goals of a course (the learning outcomes) are effectively facilitated by the instructional strategies and approaches (teaching methods) employed in the teaching and learning process. It involves:

Clarity of Goals: Clearly define what students should know, understand, or be able to do by the end of the course (learning outcomes). **Selection of Appropriate Methods:** Choosing teaching methods and instructional activities that are best suited to help students achieve those learning outcomes. **Integration of Methods and Outcomes:** Ensuring that there is a logical and effective connection between what students are expected to learn and how they are taught. **Adaptation to Student Needs:** Tailoring teaching methods to accommodate students' diverse learning styles, preferences, and abilities to optimize learning outcomes. **Assessment Alignment:** Designing assessment tools that accurately measure the attainment of learning outcomes and reflect the instructional methods used. **Continuous Improvement:** Reflecting on the effectiveness of teaching methods in achieving learning outcomes and adjusting as necessary to enhance students' learning.

In essence, it's about creating a cohesive and purposeful educational experience where the instructional approach is intentionally designed to support the achievement of desired learning outcomes.

6. Syllabus.

In a curriculum or course, a syllabus serves as a structured outline or roadmap that details the topics, content, objectives, assignments, and assessment for the duration of the course. It provides students with essential information about what will be covered, how their progress will be evaluated, and any expectations or requirements they need to fulfil. Essentially, the syllabus acts as a guide to help both students and instructors navigate through the course effectively.

7. Demonstration of the syllabus coherence with the curricular unit's learning objectives.

Demonstration of the syllabus coherence with the curricular unit learning objectives" refers to the process of showing how the content and structure of a syllabus align with the intended learning outcomes of a specific course or unit within a curriculum, *i.e.* it involves ensuring that what is being taught (as outlined in the syllabus) directly supports the goals and objectives set for the course or unit. This demonstration typically involves analysing the syllabus to verify that it covers the necessary topics, skills, and assessment tools needed to achieve the desired learning outcomes.

8. Teaching and learning methodologies specific to the UC associated with the pedagogical model.





Elaborate on the teaching and learning methodologies designed for the specific curricular unit in alignment with the chosen pedagogical model. The type of teaching model for a course on circular economy could vary depending on factors such as educational philosophy, student demographics, and learning objectives. However, some common teaching models that might be effective for a circular economy course include the teaching and learning methodologies to be developed in Unit 2.2. Educational methodologies

9. Assessment.

In a circular economy course linked to social innovation, various types of assessment can be used to evaluate students' academic progress and understanding of the subject matter. Here are some examples: Written Assignments: These can include essays, research papers, case studies, or literature reviews focusing on topics related to circular economy principles, strategies, or case studies. Presentations: Students can deliver presentations individually or in groups on specific aspects of circular economy theory, practices, or case studies. This assessment method allows students to demonstrate their understanding and communication skills. Problem-Solving Exercises: Assignments or in-class exercises can be designed to assess students' ability to apply circular economy principles to solve real-world problems or analyse scenarios. Exams: Traditional exams, whether in the form of multiple-choice questions, short answer questions, or essays, can be used to assess students' knowledge and understanding of key concepts, theories, and principles related to circular economy. Projects: Students can work on individual or group projects that involve designing, implementing, or evaluating circular economy initiatives, strategies, or business models. Projects can be hands-on and practical, allowing students to demonstrate their ability to apply theoretical knowledge to real-world contexts. Peer Review: Incorporating peer review into assignments or projects allows students to provide feedback to their peers and learn from each other's work. This assessment method fosters collaboration, critical thinking, and communication skills. Portfolios: Students can compile portfolios showcasing their work throughout the course, including written assignments, presentations, projects, and reflections. Portfolios provide a comprehensive view of students' learning and development over time. Discussions and Debates: Engaging students in discussions or debates on topics related to circular economy principles, challenges, or controversies can assess their critical thinking, communication skills, and ability to analyse different perspectives.

By using a combination of these assessment methods, instructors can evaluate students' knowledge, skills, and competencies in the field of circular economy effectively. It's essential to align assessment strategies with course objectives and provide clear criteria for evaluation to ensure fairness and transparency.

10. Demonstration of the coherence of teaching and evaluation methodologies with the learning objectives of the curricular unit.

This means ensuring that the methods used to teach a subject and evaluate student understanding align closely with the learning objectives established for that particular course or curriculum. In simpler terms, it's about making sure that what students are taught, how they are taught, and how their understanding is assessed all fit together and support the overall goals of the educational program. For example, if a learning objective is for students to develop problem-solving skills, the teaching methods should involve activities that encourage problem-solving, and the evaluation methods should assess students' ability to solve problems effectively. This coherence helps ensure that students are being taught and assessed in a way that effectively supports their learning goals.



Note: The curriculum for circular economy and social innovation should incorporate essential features of both concepts. These include: Holistic Understanding: Ensuring students grasp the interconnectedness of economic, social, and environmental systems in promoting sustainability. Systems Thinking: Encouraging a mindset that views problems and solutions within the context of complex systems, fostering innovative approaches. Resource Efficiency: Teaching methods to minimize waste and optimize resource use through strategies like recycling, upcycling, and renewable energy. Collaborative Models: Emphasizing collaboration among various stakeholders, including businesses, governments, NGOs, and communities, to drive systemic change. Inclusive Design: Promoting designs and solutions that are accessible, equitable, and considerate of diverse social and economic needs. Regenerative Practices: Highlighting approaches that not only reduce harm but actively contribute to restoring ecosystems and enhancing social well-being. Entrepreneurial Mindset: Developing entrepreneurial skills to identify opportunities for innovation and create sustainable businesses and social enterprises. Ethical Considerations: Addressing ethical dilemmas and ensuring that solutions prioritize fairness, justice, and respect for human rights. Lifelong Learning: Instilling a culture of continuous learning and adaptation to stay responsive to evolving challenges and opportunities. Impact Assessment (IA): Methodology used to evaluate the potential effects of projects, programs, or policies previously they are employed.

By integrating these key features into the curriculum, students can develop the necessary knowledge, skills, and attitudes to drive positive change toward a more circular and socially innovative attitude. To introduce students to the programmatic content of the circular economy, it is essential to integrate the previously mentioned elements. This implies introducing and developing the following concepts.

Key features of a circular economy and social innovation (modulo 1):

Resource Efficiency: Maximizing the use of resources by reducing, reusing, and recycling materials to minimize waste and extract maximum value from resources. Closed-loop Systems: Designing products and processes aimed at creating closed-loop systems where materials are continuously reused or regenerated at the end of their life cycle. Product Life Extension: Extending the lifespan of products through repair, refurbishment, and remanufacturing, thereby reducing the need for new resource extraction and production. Sharing Platforms: Encouraging shared and collaborative consumption of goods and services through platforms such as carpooling, tool libraries, and peer-to-peer rental platforms. Biomimicry: Drawing inspiration from natural systems and processes to design products, processes, and systems that are inherently restorative and regenerative. Digitalization and Innovation: Leveraging digital technologies and innovation to optimize resource use, track material flows, and enable more efficient resource management. Policy Support: Implementing supportive policies and regulations that incentivize circular economy practices, such as extended producer responsibility, eco-design standards, and waste reduction targets.

Overall, the circular economy represents a shift towards a more sustainable and resilient economic system that aims to decouple economic growth from resource consumption and environmental degradation. By adopting circular economy principles, businesses, governments, and individuals can contribute to the transition to a more sustainable and prosperous future.

Circular economy principles can contribute significantly to achieving the Sustainable Development Goals (SDGs) outlined by the United Nations. Here's how the circular economy can help advance progress towards the SDGs: **SDG 1: No Poverty**; **SDG 2:**



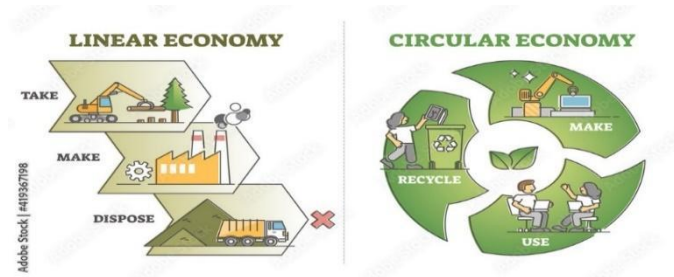
Zero Hunger; **SDG 3:** Good Health and Well-being; **SDG 6:** Clean Water and Sanitation; **SDG 7:** Affordable and Clean Energy; **SDG 9:** **SDG 11:** Sustainable Cities and Communities; **SDG 12:** Responsible Consumption and Production; **SDG 13:** Climate Action; **SDG 14:** Life Below Water and **SDG 15:** Life on Land; **SDG 17:** Partnerships for the Goals.

In general, the circular economy can significantly contribute to advancing progress towards the SDGs. It achieves this by tackling interrelated environmental, social, and economic challenges, and by fostering sustainable development pathways for the future.

Syllabus for Curriculum Design

As previously mentioned, the syllabus plays a key role in academic curriculum development, not only in imparting scientific knowledge but also in developing students' critical thinking skills. Incorporating the differences between linear and circular economies in learning is of utmost importance as this topic is fundamental for curriculum development. The differences between a linear economy and a circular economy are significant and mainly revolve around their approaches to resource usage, waste management, and sustainability. Here's an analysis of the main distinctions. We will introduce some key concepts to consider when distinguishing these two models for curriculum development at all levels of education (Figure 6). The theoretical framework of the circular model theory, which should be incorporated into the curriculum of a course on circular economy integrated with social innovation was developed in Unit 1.1. Some components such as **Waste Management, Economic Model, Environmental Impact, and Long-Term Sustainability** must always be incorporated.

Figure 6 – Linear economy versus circular economy.



Strategies such as eco-design, product life extension, and waste valorisation further contribute to climate change mitigation, biodiversity conservation, and the preservation of natural resources, thereby yielding significant social benefits. These benefits include the creation of new economic opportunities and jobs through the promotion of innovation in product design, remanufacturing, and recycling industries. Additionally, it fosters social inclusion by fostering the development of sharing economies, collaborative consumption models, and community-based initiatives, thereby ensuring access to affordable and durable products for all.

It's crucial now to elaborate on key elements illustrating how each facet of society can impact the fundamental components of the circular economy. Elucidating these aspects will provide insights into effectively addressing each element of the circular economy to foster its integration within society.

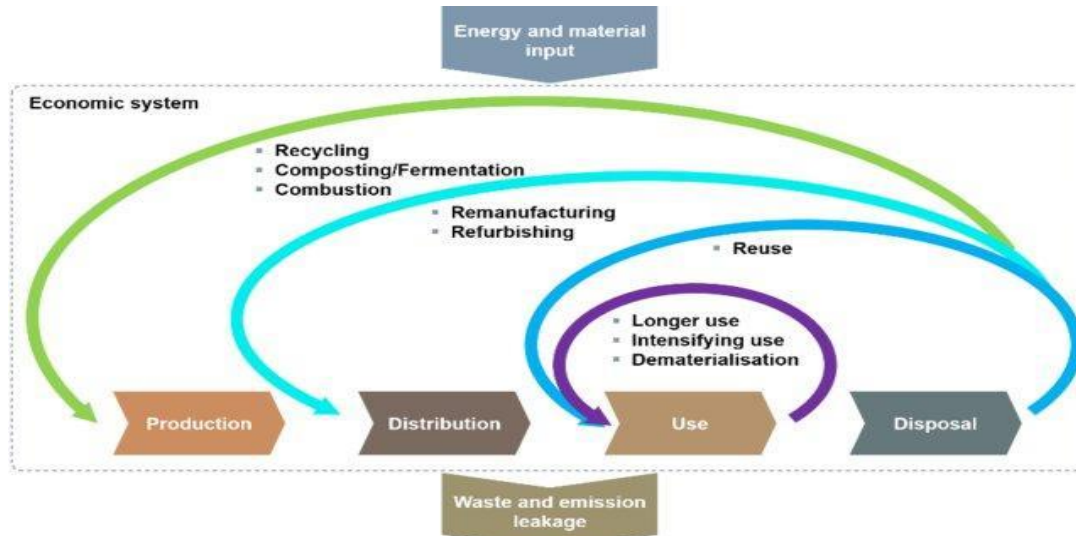
In the context of curriculum development, it's imperative to incorporate the circular model, which revolves around the product life cycle and its associated circular management. While the concept of the product life cycle is typically discussed within





marketing and management disciplines, its integration into the circular economy framework is often overlooked. Hence, it's paramount to infuse this novel perspective of the product life cycle (Figure 7) into educational curricula, especially within higher education programs such as *Design for Longevity; Resource Efficiency; Usage and Maintenance: End-of-Life Management*.

Figure 7 - Circular Economy (Source: Geissdoerfer et al (2020)).



Including lifecycle thinking in product design and decision-making processes helps identify opportunities for innovation and value creation throughout the product lifecycle.

Incorporating the understanding of natural cycles into education is vital for grasping the essence of the circular economy. This connection offers multiple benefits; Contextualization: Linking circular economy principles with natural processes helps students comprehend their origins and rationale within the biosphere; Inspiring Solutions: Nature's intricate cycles serve as inspiration for innovative, sustainable solutions to societal and environmental challenges; Scientific Foundation: Integrating natural cycles provides a solid scientific basis for circular economy concepts, emphasizing their grounded nature; Respect for Nature: Understanding natural cycles fosters a deeper appreciation for conserving resources and biodiversity, promoting responsible resource usage; Efficiency and Resilience: Nature's efficient, resilient utilization of resources underscores the importance of minimizing waste, inspiring similar practices in human economies; Awareness of Interconnection: Recognizing the interdependence between natural and economic systems emphasizes the consequences of human actions on the environment and vice versa; Holistic Approach: By embracing natural cycles, circular economy education adopts a holistic perspective, aligning economic solutions with the capacities and limits of natural systems.

The relationship between natural life cycles and the circular economy lies in the fundamental principles of sustainability and resource efficiency that both concepts embody. Here are some key points of connection: Closed-Loop Systems: Resource Efficiency; Regeneration and Renewal; Resilience; Interconnectedness.

For an educational proposal, the distinction between natural cycles and non-natural cycles is rooted in their origin and functionality. Natural cycles are inherent to ecosystems, evolving over millions of years, while non-natural cycles are human-





created systems, often operating linearly. The role of the circular economy is to bridge this gap by aligning human activities with natural processes and principles.

Here's how it interacts with both types of cycles:

Natural Cycles: Natural cycles like the water, carbon, and nutrient cycles have evolved within Earth's ecosystems over millennia, facilitating the continuous flow and recycling of materials and energy. Operating within closed-loop systems, natural cycles exhibit efficiency, resilience, and regeneration, with waste serving as a resource for other components. Organisms adapt to utilize resources and maintain ecosystem balance.

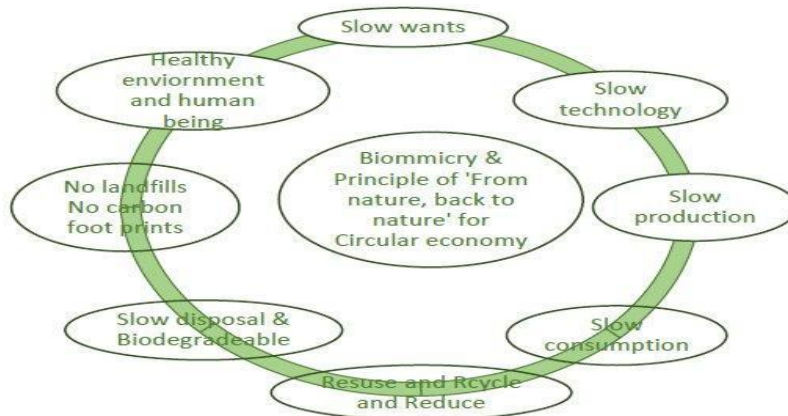
Non-Natural Cycles: Non-natural cycles, also known as linear systems, are human-created and often follow a "take-make-dispose" pattern, leading to resource depletion and environmental degradation. Inefficient and wasteful, non-natural cycles rely on continuous resource extraction and produce significant waste that is not effectively recycled or reused.

Role of Circular Economy: The circular economy aims to transform non-natural cycles into circular systems by redesigning products, processes, and business models. By maximizing resource recovery, reducing waste generation, and promoting innovation, it seeks to create sustainable systems. Drawing inspiration from natural cycles, the circular economy aims to emulate their efficiency and resilience. Through closed-loop resource management, resource efficiency, and regeneration principles, it seeks to minimize human impacts on ecosystems.

When crafting the curriculum courses at the **higher education** and **postgraduate levels**, it is crucial to incorporate the concept of **biomimetics** also known as **biomimicry** which offers a fascinating avenue. Biomimetics, which draws inspiration from nature's designs and processes to solve human problems, presents a compelling framework for exploration. By incorporating biomimetics into our curriculum, we enhance students' comprehension of sustainable practices and foster innovative solutions to current issues. This integration provides ways for research and practical application in the circular economy, aligning with bioeconomic principles. Embracing biomimetics enriches educational experiences and empowers students to effect positive change at the nexus of social economy and innovation. involves emulating nature's solutions to design and innovate human-made technologies, processes, and systems, considering **Nature as a Model; Interdisciplinary Approach; Systems Thinking; Innovation and Creativity; Sustainability Principles; Ethical Considerations**. By integrating these concepts into the curriculum, students will develop a holistic understanding of biomimetics and its applications within the circular economy, preparing them to become innovative and responsible leaders in sustainability-driven fields (Figure 8).



Figure 8- Biomimetics Principles (Alka et al., 2021)



In the development of courses for higher education, aiming to train students for professional areas unrelated to teaching, it is fundamental to consider several important issues. Firstly, it is essential to analyse the demands and trends of the job market, identifying the skills and competencies necessary for professionals to succeed in their respective fields. This includes understanding technological changes, regulatory requirements, and employer demands. By addressing these inquiries, it becomes feasible to devise impactful courses that foster a profound comprehension of circular economy and social innovation, empowering students to **Complexity; Research and Innovation; Specialization and Professional Focus; Integration of Business Practices; and Access to Advanced Resources.**

In preschool and school education, we must also consider the following items: **Simplicity and Clarity; Emphasis on Fundamental Concepts; Practical and Experiential Activities; Integration with School Curriculum; and Development of Critical Awareness.**

In summary, while higher education courses tend to be more advanced, specialized, and geared towards research and professional practice, courses for mandatory education should be more accessible, focused on fundamental concepts, and integrated into the existing school curriculum, with an emphasis on practical activities and development of critical awareness.

Designing the curriculum for preschool and school-level education entails addressing various issues, that will be addressed in the next topic.

Curriculum design for preschool and school-level

Environmental Education and social enrolment begin at home, yet schools play a crucial role in fostering community engagement and behaviour change. Youth are not just the future; they are already here and should participate in finding solutions and decision-making processes. Schools must go beyond transmitting academic knowledge and prioritize shaping young people into responsible citizens, ready to address societal challenges. Over time, Environmental Education has evolved from a focus on natural sciences to a broader social and political context, covering topics like responsible consumption, climate change, and the circular economy across various education levels.





Preschool level: Children at preschool level (normally up to six years old) begin to learn about the different dimensions of the planet and deepen their environmental awareness in “Knowledge of the World”. The objective is to learn to value and respect the environment.

Primary and secondary education: Through the Citizenship and Development component, Environmental Education is present in all years of primary and secondary education. Topics such as recycling, biodiversity, sustainability, and responsible consumption are covered in a practical and theoretical way.

The depth in which Environmental Education topics are covered varies, but many subjects are transversal to pre-school, basic, and secondary levels.

Some of the areas covered in the teaching path are: Raising awareness of ethics and citizenship: students become aware that their actions influence the environment and learning to adopt an environmental sustainability stance, bearing in mind the impact of their actions on future generations; Encouraging responsible production and consumption: how to reduce waste production and adopt responsible consumption behaviours are lessons that become part of students' daily lives. Here, reusing and recycling are key concepts; Explain biodiversity: students develop the view that man is not the centre of the universe and understand the importance of biodiversity and ecosystems; Teach about the importance of energy and water: students diversify their knowledge about the energy sources that can be used. By understanding the consequences of the current model, they recognize the need to change towards energy efficiency.

Extracurricular activities

Extracurricular activities are essential for students' holistic development, serving to enhance the academic curriculum and equip them with the skills needed to navigate the complexities of the real world. To develop extracurricular activities within an academic curriculum, we must consider some important questions, such as: **Development of Complementary Skills, Exploration of Interests and Passions, Experiential and Practical Learning; Development of Networking; Differentiation in Selection Processes; Well-being and Mental Health.**

The development of curricular activities will depend on the level of education. Let's develop a set of activities for higher education and basic and secondary education. Here are examples of real activities that can be organized for higher studies.

1. Higher education extra Extracurricular activities

Seminars and Conferences: Organize seminars featuring guest speakers from academia, industry, and government to discuss topics related to the circular economy, such as sustainable design, waste management, and circular business models. Host conferences that bring together students, professionals, and experts to exchange ideas, showcase innovative projects, and explore opportunities for collaboration in advancing circular economy initiatives.

Dual Scholarships: Partner with organizations, companies, or government agencies to offer dual scholarships that support students pursuing studies related to the circular economy while gaining practical experience through internships or research projects. Provide financial support and mentorship to students engaged in dual-degree programs that combine academic coursework with hands-on learning opportunities in circular economy-related fields.



Company Internships: Facilitate internships with companies and organizations that are implementing circular economy principles in their operations, such as sustainable fashion brands, waste management companies, or renewable energy firms. Connect students with internship opportunities where they can apply their knowledge and skills to real-world projects, gain insights into industry practices, and build professional networks in the circular economy sector.

Professional Development Workshops: Offer workshops on resume building, interview skills, networking strategies, and career planning to help students transition successfully from academia to the professional world.

Master's Programs: Collaborate with universities and educational institutions to develop master's programs or specialized tracks focused on the circular economy, covering topics such as circular design, resource management, and sustainable supply chains. Offer scholarships, grants, or fellowships to support students pursuing advanced degrees in circular economy-related fields and encourage research that contributes to advancing knowledge and innovation in the field.

Mobility Programs: Facilitate international exchange programs or study tours that expose students to global perspectives on the circular economy and provide opportunities to visit innovative projects, research centres, and businesses in different countries. Partner with universities and organizations abroad to offer exchange opportunities for students to study or intern abroad, fostering cross-cultural collaboration and learning in the field of circular economy.

Summer Courses: Develop intensive summer courses or workshops focused on specific aspects of the circular economy, such as biomimicry, circular design thinking, or sustainable entrepreneurship. Invite experts and practitioners to lead hands-on sessions, case studies, and field trips that provide practical skills and knowledge applicable to addressing real-world challenges in the circular economy.

Senior University: Establish a senior university program that offers lifelong learning opportunities for retirees or older adults interested in exploring topics related to the circular economy, sustainability, and environmental stewardship. Provide lectures, workshops, and discussion groups tailored to the interests and needs of senior learners, fostering community engagement and knowledge sharing on circular economy principles and practices.

University Extension Courses: Offer university extension courses or long-life programs to provide professionals with the opportunities to deepen their understanding of the circular economy and acquire new skills relevant to their careers. Design flexible, online courses that cater to diverse learners' needs, allowing participants to access course materials, engage in discussions, and complete assignments at their own pace while balancing work and other commitments.

By offering a diverse range of extracurricular activities, universities can provide students with valuable opportunities to engage with the circular economy, develop practical skills, and contribute to advancing sustainability in their communities and beyond.

In preschool and school education we must consider the development of curriculum activities adapted to this level of schooling. Here are some examples of real activities that can be organized for higher studies. In addition to the theoretical knowledge passed on by educators and teachers, several practical activities can be developed with children and adolescents to develop their environmental awareness. Examples of activities in schools that can also be done at home are given below. We give some





examples of extracurricular activities for different levels at preschool and school levels of education.

2. Preschool and school education extra-curricular activities:

Interdisciplinary Projects: Develop projects that integrate various disciplines, allowing students to explore connections between different areas of knowledge.

Science Fairs: Organize science fairs where students can present experiments, demonstrations, and research projects, promoting interest in scientific inquiry.

Clubs and Study Groups: Facilitate the formation of clubs and study groups focused on specific interests, providing opportunities for discussions, collaboration, and peer learning.

Artistic and Cultural Activities: Promote activities related to art, music, theatre, and literature to encourage creative expression and appreciation for culture.

Field Trips: Organize visits to museums, local businesses, research centres, and other relevant locations to enrich students' learning experiences and contextualize the curriculum content.

Mentorship Programs: Establish mentorship programs where more advanced students can assist peers with academic difficulties, fostering collaboration and mutual support.

Academic Competitions: Encourage participation in academic competitions to stimulate skills development and a healthy competitive spirit.

Practical and Experimental Classes for Environmental Education: Incorporate practical and experimental activities into the curriculum to complement theoretical learning and provide students with hands-on experiences that stimulate curiosity and investigation. Bellow examples are provided:

Preschool: reuse and plant

At the preschool level, awareness of biodiversity and the practice of responsible consumption are two of the main objectives to be achieved in the Environmental Education plan. Thus, children can do activities such as:

- Build fruit trees and other plants using materials such as paper, fabrics, or plastic;
- Germinate a seed;
- Plant a tree and monitor its growth cycles;
- Take advantage of time outside to observe nature: snails, ants, or worms.

1st cycle: recycling and renewable energy

In the 1st cycle, children begin to play a more active role and internalize concepts such as sustainability. At this stage, they can carry out initiatives such as:

- Games to learn how to separate different urban solid waste (plastic, glass, paper);
- Build mini-eco points using buckets or other school containers;
- Build cardboard mills and understand how they work.

2nd cycle: Composting and ecosystem

Relating theoretical information with the practical world and learning through methodologies linked to the arts are good ways of engaging children in the 2nd cycle of basic education with Environmental Education themes. Here are some possible



actions: Learn how to compost; Watch documentaries about the interdependence of species and the connection between different ecosystems, promoting discussion on the topic. A good motto is the life cycle and pollination of bees; Puppet theatre with butterflies, to learn to value the interaction between insects and plants.

3rd cycle: Responsible consumption

The analysis component grows in the 3rd cycle, but challenges like those listed below, which involve the concept of a game, promise to captivate audiences aged 12 to 15: A peddy paper around the city about waste and the possibility of reusing; Games that encourage students to make sustainable choices (An example: which food and beverage should I choose and why?); Analysis task in which students rethink their day and how they could improve water consumption management, from the moment they brush their teeth to bath time.

Secondary Education: Citizenship and Combating Climate Change

In addition to developing critical thinking, students (aged from 15-18) are encouraged to make a difference in the community, both in small everyday acts and from an associative perspective through actions such as: Discussing documentaries, articles, and interviews on the topic of climate change; Learning how to calculate the ecological footprint using digital tools; Make known the work of (and put in contact with) associations and other organizations in the environmental area, encouraging active citizenship. Example of activity: taking care of a river.

It is not just in schools that Environmental Education takes place (Appendix A). Throughout your life, you can participate in volunteer projects and other activities that make you a more responsible citizen.

Unit 2.2. Educational methodologies

In this section, we will explore the principles of active learning as opposed to traditional methodologies, emphasizing their primary benefits for acquiring and enhancing key competencies. Educational approaches in circular economy should be crafted to promote active learning, critical thinking, and the practical application of circular principles. Below are several effective educational methodologies well-suited for teaching concepts of circular economy and social innovation.

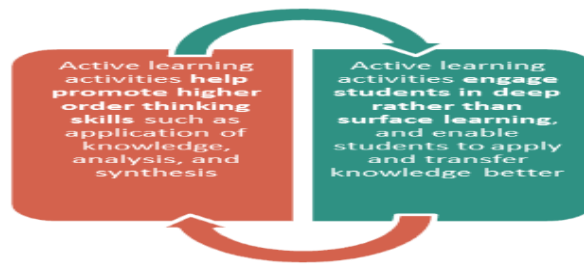
Active methodologies for learning.

Active learning is an approach to instruction that involves actively engaging students with the course material through discussions, problem-solving, case studies, role plays, and other methods. Active learning approaches place a greater degree of responsibility on the learner than passive approaches such as lectures, but instructor guidance is crucial in the active learning classroom. Active learning activities may range in length from a couple of minutes to whole class sections or may take place over multiple sessions (Figure 9).





Figure 9- Active Learning Scheme (Source: <https://staff.ki.se/active-learning>)



Over the last several years, pedagogical research into the effectiveness of active and collaborative learning in the undergraduate and graduate classroom has demonstrated that across all disciplines active learning, relative to traditional lecture format classes, increases student test scores, comprehension, and/or self-efficacy relative to traditional lecture format classes. Let's develop some of the methodologies that incorporate critical and creative thinking, fostering continuous and immersive learning from both individual skills and group perspectives.

Problem-Based Learning (PBL): PBL engages students in solving real-world problems related to the circular economy. Students work collaboratively to identify, analyse, and develop solutions for specific challenges, applying circular principles in the process. This approach encourages critical thinking, creativity, and teamwork.

Example Activity: Provide students with a case study of a company struggling with waste management issues. Task them with investigating the company's processes, identifying opportunities for waste reduction and resource optimization, and proposing a circular economy-inspired solution to address the problem.

Project-Based Learning (PBL): Similar to PBL, project-based learning involves students working on extended projects that address circular economy issues. Students design and implement projects, such as waste reduction initiatives, sustainable product designs, or circular business models, gaining hands-on experience and practical skills in the process.

Example Activity: Assign students to design a product using principles of the circular economy. They must consider factors such as material selection, product life cycle, and end-of-life management.

Case Studies: Case studies provide students with real-world examples of circular economy initiatives, challenges, and best practices. Students analyse and discuss case studies from various industries and contexts, exploring the application of circular principles and evaluating the outcomes and impacts of different approaches. The case study is accompanied by a list of questions that asks students to reflect on the information and formulate a response to it. This is an extremely flexible active learning approach because of the range of possibilities that a case study can take. Cases are frequently used in Business, Health Sciences, Education, or Sociology. Good case studies do not have an obvious answer and require students to gather additional information or ask critical questions to understand the needs and perspectives of the participants involved in the case. It is important to give students enough time to read the case study so that they fully understand the content before moving on to the questions. The first time a case study is introduced to the class, breaking the activities up into manageable chunks of work and time should be considered. The success of a case study depends on the facilitator's ability to pull the "big picture" out of the details.





Example Activity: Present students with case studies of companies that have successfully implemented circular economy strategies. Facilitate group discussions on the key principles and strategies employed, as well as the challenges faced, and lessons learned.

Experiential Learning: Experiential learning methods, such as field trips, site visits, and hands-on activities, immerse students in practical experiences related to the circular economy and offer invaluable opportunities for students to engage with the principles and practices of the circular economy firsthand. Visiting recycling facilities, sustainable businesses, or ecological restoration sites allows students to observe circular principles in action and deepen their understanding of sustainability issues. Through experiential learning in the circular economy, students not only gain theoretical knowledge but also cultivate critical thinking, problem-solving abilities, and a sense of environmental responsibility.

Simulation Games: Simulation games, such as role-playing exercises or interactive simulations, simulate complex systems and decision-making processes related to the circular economy. Students play different roles, such as consumers, policymakers, or business owners, and make decisions that affect resource use, waste generation, and environmental impacts, gaining insights into the interconnectedness of circular systems.

Design Thinking: Design thinking approaches encourage students to adopt a human-centred perspective to problem-solving in the circular economy. Through empathizing with stakeholders, defining problems, ideating solutions, prototyping designs, and testing iterations, students develop innovative and user-centric solutions that address real-world needs and challenges. By integrating Design Thinking as a learning methodology in the curriculum for circular economy and social innovation, educators can empower students to become creative problem solvers and changemakers who are capable of driving positive impact in a rapidly changing world. Through hands-on experiences and collaborative projects, students develop the skills, mindset, and confidence needed to tackle complex sustainability challenges and contribute to building a more resilient, equitable, and sustainable future.

Interdisciplinary Collaboration: Encourage interdisciplinary collaboration by bringing together students from different disciplines, such as engineering, business, design, and environmental science, to explore circular economy concepts from diverse perspectives. Collaborative projects and discussions foster cross-disciplinary learning and creativity, reflecting the holistic nature of circular systems. Interdisciplinary promotes collaborative teamwork and interdisciplinary cooperation among students hailing from diverse backgrounds and possessing varied areas of expertise. Encourage students to leverage their unique skills and perspectives to co-create innovative solutions that integrate principles of circular economy and social innovation.

Action Research: Action research involves students conducting research projects that contribute to advancing knowledge and practice in the field of circular economy. Students identify research questions, collect data, analyse findings, and propose recommendations for implementing circular solutions in real-world contexts, promoting experiential learning and applied scholarship.

Online Learning Platforms: Online learning platforms offer flexible and accessible resources for teaching circular economy concepts, including interactive modules, multimedia content, and virtual labs. These platforms provide students with



opportunities for self-paced learning, online discussions, and collaborative projects, catering to diverse learning styles and preferences.

By incorporating these educational methodologies into teaching practices, educators can engage students in meaningful learning experiences that empower them to become active participants and leaders in advancing the transition to a circular economy.

Think Pair Share

Think	Pair	Share
Students think independently about the question that has been posed. Students must be given time to form an idea or answer.	Students are grouped in pairs to discuss their thoughts. This step allows students to articulate their ideas and consider other perspectives.	Student pairs share their ideas with a larger group. Students are more comfortable presenting ideas to a group with the support of a partner

For applying this methodology, it is important to avoid asking simple/recall-type questions: this activity works best when students are challenged to think through a more complex idea. The benefits of the three-step process are two-fold: first, students are generally more confident presenting ideas with a partner; second, students' ideas become more refined through this process.

Unit 2.3. Teaching-learning resources

This section offers a categorization of diverse teaching-learning resources, exploring their distinctive attributes, to present a range of tools applicable within educational settings. The creation of a circular guide will be explored. Teaching-learning material (TLM) is also called Instructional material or Teaching Aids.

Types of Teaching-Learning Resources

The creation and utilization of effective teaching-learning resources to support education in circular economy and social innovation is crucial. As educators strive to equip students with the knowledge and skills needed to address complex sustainability challenges, the development of high-quality resources becomes essential. This segment, provides a classification of various teaching-learning resources, examining their unique characteristics, to present a spectrum of tools applicable within educational settings.

The development and utilization of effective teaching-learning resources to bolster education in circular economy and social innovation are paramount. As educators' endeavour to equip students with the requisite knowledge and skills to tackle intricate sustainability challenges, the creation of high-calibre resources becomes indispensable. In addition to reinforcing the elements previously mentioned, this chapter highlights the importance of considering some key elements to develop teaching-learning resources such as **Curriculum Development; Pedagogical Approaches; Digital and Multimedia Resources; Open Educational Resources (OER); Experiential Learning Tools; Assessment and Evaluation.**





By investing in the development of high-quality teaching-learning resources, educators can enhance the quality and effectiveness of education in circular economy and social innovation, empower students to become agents of positive change, and contribute to the transition towards a more sustainable and equitable future.

When developing teaching resources for **preschool and school-age children**, it is crucial to consider their specific characteristics and needs. Here are some important considerations: **Cognitive development and motor skills; Learning diversity; Inclusion; Contextualization and relevance; Playful approach; Proper progression; Feedback and assessment** (Appendix A)

By utilizing Teaching Learning Materials, teachers turn amicable; a cordial environment is constructed which significantly helps in learning. Below are definitions of Material Types to be selected according to students' age and teaching-learning goals.

Animation: Successive drawings that create an illusion of movement when shown in sequence. The animations visually and dynamically present concepts, models, processes, and/or phenomena in space or time. Users can control their pace and movement through the material typically, but they cannot determine and/or influence the initial conditions or their outcomes/results. Animations typically do not contain real people, places, or things in movement.

Assignment: Activities or lesson plans designed to enable students to learn skills and knowledge.

Drill and Practice: Requires users to respond repeatedly to questions or stimuli presented in a variety of sequences. Users practice on their own, at their own pace, to develop their ability to reliably perform and demonstrate the target knowledge and skills.

Illustration/Graphic: Visual concepts, models, and/or processes (that are not photographic images) that visually present concepts, models, and/or processes that enable students to learn skills or knowledge. These can be diagrams, illustrations, graphics, or infographics in any file format including Photoshop, Illustrator, and other similar file types.

Photographic Image – Instructional: Photos or images of real people, places, or things that visually present concepts, processes, and/or phenomena that enable students to learn skills or knowledge. These can be photographs, images, or stock photography.

Quiz/Test: Any assessment device intended to evaluate the knowledge and/or skills of learners.

Teaching-learning resources should be appealing to children and young students. Size, shading (multicolour or splendid or engaging shading blend), development (like moving toys), and in a few cases the smell and/or taste or sound are a portion of the properties of the materials that allure students.

Circular design guide

The Circular Design Guide is a pivotal component in fostering understanding and practical application of circular economy principles. It serves as a roadmap for creating activities, projects, and initiatives that embody circularity and sustainability. Developing a guide is important, but it is a task that presents difficulties.





The development of a guide for Circular Design faces a series of challenges arising from the complexity and scope of the circular economy concept, such as the: **Conceptual Complexity:** The circular economy encompasses a variety of interconnected concepts. The definition and understanding of these concepts may vary among different contexts and stakeholders, making it challenging to create a guide that is comprehensive and accessible to all audiences; **Multidisciplinary:** Integrating different disciplinary perspectives and approaches into a cohesive guide can be difficult, especially when it comes to translating technical and theoretical concepts into practical and actionable guidelines; **Adaptation to Specific Contexts:** A generic guide may not be suitable for all situations, requiring adaptations and customizations to meet the specific needs and realities of different contexts; **Continuous Updating;** Keeping a guide up-to-date and relevant requires continuous effort to monitor trends, review literature, and update content to reflect the latest information and developments in the field; **Engagement and Dissemination;** Ensuring that the guide reaches its target audience and is effectively utilized requires effective engagement, outreach, and capacity-building strategies.

Although they face significant challenges, creating a guide for Circular Design is essential to promote the adoption of sustainable practices and drive the transition to a more circular and regenerative economy.

By overcoming the challenges mentioned above and collaborating collaboratively and multidisciplinary, professionals can develop effective guides that empower individuals and organizations to integrate circular design principles into their activities and processes. Developing the Circular Design Guide theme involves:

1. Introduction: Explain circular design principles' importance in sustainability, aiming to minimize waste and promote environmental and social benefits.
2. Phases: Outline circular design process phases like ideation and prototyping, offering practical guidance for integration.
3. Case Studies: Showcase real-world examples of successful circular design applications across various industries.
4. Guidelines: Provide actionable advice on material selection, waste reduction, and stakeholder engagement.
5. Resources: Offer tools like design thinking frameworks and lifecycle assessment tools to support circular design implementation.
6. Interactive Activities: Engage readers with hands-on learning through workshops and collaborative projects.
7. Feedback Loop: Encourage user feedback to continuously improve the Circular Design Guide. By creating an accessible guide, stakeholders can embrace circularity and drive sustainable change effectively.



Additional material for self-study time and reflection

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Appendix A

Tips for classroom: circular economy.

Reflection on the circular economy can encompass studies of contemporary themes such as financial education, consumer education and environmental education

Addressing circular economy is a way of introducing content from different components and themes into the classroom. It is related to financial education, consumer education and environmental education.

There are 15 themes that relate to students' daily lives and must be worked on in a transversal way. In this text, we will show 5 tips for approaching the circular economy in classrooms and working on these topics together.

What is circular economy?

The circular economy is an economic model that seeks to minimize resource waste and reduce environmental impact. In this system, products are designed to be durable, repairable and upgradeable, so that the time they can be used is extended as much as possible.

Another characteristic of the circular economy is the reuse of materials. When a product reaches the end of its useful life, the materials that make it up are recovered and reintroduced into the production chain. This is done through recycling, remanufacturing (reconditioning) or composting. This way, resources are kept in circulation for longer.

This brings two main benefits:

1. Prevents excessive extraction of virgin raw materials;
2. reduces the amount of waste sent to landfills or disposed of inappropriately.

Reflection on the circular economy stimulates students' critical thinking, helping them understand the environmental and financial challenges faced by today's society. By reflecting on the subject, students learn about financial planning, consumption and consumerism, which can encourage them to adopt more sustainable financial behaviours," she says.

5 tips to promote the circular economy in classroom for mandatory class

They can also be part of a class project, which allows for more meaningful learning.

Reduce consumption. The first, and perhaps most important, way to promote the circular economy is to reduce the consumption of disposable products. Furthermore, it is important to raise awareness about consumption versus consumerism. Before purchasing a new item, a person should ask themselves whether they really need it. And consider whether you can opt for a more durable and sustainable alternative.

Reuse and repair Old or broken items can be of great value. Students should be encouraged to explore ways to reuse or repair them. Clothes can be customized, and objects can be transformed into crafts.

Recycle materials correctly. First of all, you need to understand which materials are recyclable and which are not. This may vary from region to region, depending on selective collection. Students can be encouraged to separate waste, establishing a selective collection system at home and at school. And you can even encourage



family and friends to do the same thing. If the school does not yet make such a separation, a project tip is to study how to implement this system.

Share and/or exchange. One idea to propose to students is to explore sharing and exchange options, instead of making new purchases. Activities can be organized at school, such as book, toy or clothing exchange events. Activities of this type help to extend the useful life of items and reduce waste.

Cultivate a vegetable garden at home. Having a vegetable garden or participating in community gardening projects is a practical form of circular economy. In addition to growing fresh food, people can use food scraps for composting, transforming them into natural fertilizer for the garden. And it is another proposed activity that students can carry out.

Source : A BEI Educação. <https://beieducacao.com.br/economia-circular-na-escola/> , 2023.

Study Case: Private company: Vertical integration and Circular Economy

Source: https://bcsdportugal.org/wp-content/uploads/2022/06/Casos-de-estudo_Economia-Circular_Soja-de-Portuga_LVF.pdf



CHARACTERIZATION OF THE COMPANY AND PROJECT

Soja de Portugal Group

The Soja de Portugal Group has been in the market since 1943, in the agri-food industry sector and currently operates in three main areas: **Animal nutrition; Poultry meat; Collection, treatment, and valorisation of animal by-products.**

Encompassing some of the most relevant companies in the Portuguese agro-industrial sector, such as SORGAL, AVICASAL, and SAVINOR, Soja de Portugal has factories and facilities in various parts of the country, including the sites of Trofa, Ovar, Pinheiro de Lafões, São Pedro do Sul, Vouzela, Pinhel, and Torres Novas, which, based on a policy of innovation and continuous improvement, have allowed it to achieve



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leadership positions in the national market and gain market share in the external market.

Thematic Area of the Case Study: Circular: Economy.

Case Study Title: Application of the circular economy model in the Soja de Portugal.

Group Execution Location: Portugal.

Execution Duration: The Circular Economy model is continuously applied in the companies of the Soja de Portugal Group.

Team Involved: All business units of the Soja de Portugal Group.

Publication Date: June 2022

BACKGROUND ON THE SELECTED THEMATIC AREA:

Circular economy consists of a model based on the reduction, reuse, recovery, and recycling of materials and energy, being seen as a key element to promote the dissociation between economic growth and the increase in resource consumption. Current trends of population growth, increasing demand, and consequent pressure on natural resources have highlighted the need for modern societies to move towards a more sustainable paradigm, a greener economy that ensures economic development, improvement of living and employment conditions, as well as the regeneration of "natural capital". In the field of animal nutrition, the increase in food utilization efficiency aims not only at zootechnical production efficiency but also at reducing pollutant emissions into the environment. On the other hand, the business area of valorisation of animal by-products is based on the assumptions of the circular economy and the removal from the environment of potentially polluting compounds, which are reused by transformation into ingredients for animal nutrition. The application of the circular economy concept contributes to achieving the objectives for sustainable development, allowing the integration of processes capable of reducing carbon emissions, thus respecting the Paris Agreement.

Soja de Portugal's circular economy model is based on the concept of valuing co-products resulting from industries producing food of animal origin (meat and fish), co-products that would otherwise not be valued, and would therefore be waste. These are thus reintroduced in the form of raw materials, after their collection and treatment, valorizing them, contributing to a lower dependency of the group on certain raw materials and increasing its quality control over them, thus promoting a reduction in the environmental footprint of the group of companies.

PROBLEM: IDENTIFICATION AND ITS RELEVANCE FOR THE COMPANY

With a view to preserving and increasing natural capital with stock control, balancing thus the flows of renewable resources and circulating products and materials in the field of animal nutrition, the acquisition of SAVINOR by the Soja de Portugal Group in 2006 emerged. SAVINOR S.A. has two synergistic business areas: the production and slaughter of poultry (SAVINOR) and the collection, treatment, and valorization of by-products (SAVINOR UTS).

These by-products would normally have other destinations; however, through the circular economy process used by the company, they have become efficiently used to produce compound feed. With the primary objective of preserving and increasing natural capital by controlling finite stocks, balancing the flows of renewable resources and circulating products and materials, raw materials produced by the by-products valorization units belonging to the Soja de Portugal Group are used in the animal nutrition sector. In this way, the Group's business areas act in perfect synergy.

RESOLUTION: ACTIONS, STAGES, PARTNERSHIPS





The production of poultry meat (AVICASAL and SAVINOR) is carried out under a vertical integration regime, with in-house production and contracting of producers. The birds housed in pavilions with the highest technology are fed with feed produced by the SORGAL brand and slaughtered in the slaughterhouses of AVICASAL and SAVINOR. The by-products generated in the slaughter and dressing process are immediately processed in the transformation units of SAVINOR UTS, converted into ingredients for animal feed, namely poultry meal and fat. Additionally, other ingredients of animal origin are produced from by-products of the agri-food industry that are collected and valorized in the SAVINOR UTS unit.

The services provided by SAVINOR UTS are recognized as public utility services by local and community entities. This business area is responsible for collecting and treating by-products from the agri-food industry from over 250 locations in Portugal and Spain, in addition to the sustainable treatment of by-products generated by in-house production and poultry slaughter, as mentioned earlier.

MAIN CHALLENGES

Reduction of the environmental footprint inherent to the industrial process; Promotion of management adapted to reality in the use of global resources; Improve efficiency in the use of global resources, promoting their sustainable management; Manage and reduce waste, reducing, recycling, and reusing raw materials; Validity of raw materials; Adoption of practices that enhance the sustainability of products produced and marketed by the group.

RESULTS

Valorization of by-products resulting from the production and slaughter of poultry: In 2020, 60,000 tons were valorized, more than 5% compared to 2019;

Optimization of the use of raw materials and energy efficiency, as a way to contribute to the conservation of natural resources;

Reduction of carbon and water footprint, resulting in better environmental performance, through efficient use of water and reduction of energy consumption, for example;

Valorization of steam production whenever possible with renewable energy sources (biomass) or cleaner sources (such as natural gas): In 2020, 6,000 tons of biomass were used in the production of green energy;

Treatment and reuse of water, whenever technically possible, and in all processes that allow it;

Recovery and use of heat sources generated in thermal or refrigeration processes for heating production waters or washing,

Installation of photovoltaic panels at SORGAL and plans for installations at other units, allowing for an annual savings of €150,000. In 2021, SORGAL managed to avoid 355,000 kg of CO₂ emissions into the atmosphere, equivalent to 16,136 trees, through its installed photovoltaic system.

Installation of automatic remote online monitoring systems in all sectors and energy and water-consuming companies, aiming for consumption optimization. In 2020, energy consumption was 74,161 GJ, 27% less than in 2019 for electricity;

Conversion of a fuel oil boiler to a natural gas boiler at SAVINOR Trofa;

Investment in LED technology at all Group industrial sites, with full replacement of lamps with LED technology;

Construction of a new WWTP (waste water treatment plant) with a treatment capacity equivalent to a city of 50,000 inhabitants at the SAVINOR Trofa industrial site;

Through the use of a chlorine filtration and disinfection system, the Group has been reusing wastewater by about 20%. This reused water is intended for irrigation, street cleaning, floor washing, workshops, among others;





Better control over the origin and quality of products as a result of reduced exposure to external suppliers; ·

Sensitization of employees and the community to the importance of the circular economy model in process sustainability and positive environmental impact;

Development and implementation of new technologies to improve environmental performance;

Reduce, reuse, and promote recycling of generated waste.

RECOMMENDATIONS

According to the European Commission, the circular economy should be seen as an opportunity to catalyze innovation and promote the efficient use of various resources simultaneously. Soja de Portugal considers the circular economy an extremely useful tool for companies to increase their efficiency, using fewer natural resources and having the least possible waste.

As a consequence of the group's strong commitment to this methodology, all business areas are managed sustainably, both synergistically among the various business areas and independently. LEARN MORE <http://www.sojadeportugal.pt/> <http://www.savinoruts.pt/> Savinor UTS video on the circular economy process: https://www.youtube.com/watch?v=Pb2vOs0e9RU&list=PLSereLkpHEehlipHguEHGtm42_Y5XRkR

