

Master of Science in Circular Innovation and Sustainability

Overview of thematic fields and modules

Basics	0.1	Introduction to circular economy (3 ECTS)						
	0.2	Bridging technology (6 ECTS)						
	0.3	Bridging life sciences (6 ECTS)						
	0.4	Bridging economics and management (6 ECTS)						
	1. Circular product- and process-innovation		2. Circular business models		3. Institutional environment		4. Methods	
Basics	1.1	Technological cycle: materials and processes (3 ECTS)	2.1	Circular business models (3 ECTS)	3.1	Society and technology (3 ECTS)	4.1	Scientific methods 1 (3 ECTS)
	1.2	Biological cycle: environmental systems (3 ECTS)	2.2	Circular supply chain (3 ECTS)	3.2	Society and the environment (3 ECTS)	4.2	Scientific methods 2 (3 ECTS)
							4.3	Scientific methods 3 (3 ECTS)
Focus	1.3	Pathways to net zero GHG emissions in the energy and chemical sector (3 ECTS)	2.3	Social entrepreneurship (3 ECTS)	3.3	Innovation and the Circular Economy in a Spatial Context (3 ECTS)	4.4	Impact assessment (3 ECTS)
	1.4	Pathways to net zero GHG emissions in the mobility sector (3 ECTS)						
	1.5	Pathways to net zero GHG emissions in the food sector (3 ECTS)	2.4	Digitalization and sustainability (3 ECTS)	3.4	Corporate social responsibility (3 ECTS)	4.5	Circular design (3 ECTS)
	1.6	Cities and infrastructure (3 ECTS)						
	1.7	Circular use of materials (3 ECTS)						
Cases	1.8	Expansion of personal competences: products (6 ECTS)	2.5	Expansion of personal competences: business (6 ECTS)	3.5	Expansion of personal competences: inter- and transdisciplinary project (6 ECTS)		
Master's Thesis (30 ECTS)								

Figure 1 : overview of all modules

Circular product and process innovation:

Basic knowledge of biological as well as technological cycles build the fundament to understand the idea of circular innovation. The circular use of raw materials and their implications to different sectors play a key component in transforming the future.

This knowledge is taught in the thematic area of competence "Circular product and process innovation". This area of competence is based on seven modules:

- **Technological cycle:** This module deals with recycling and remanufacturing in the areas of household, building materials, composites, biogenic materials and packaging. Students learn to understand materials, principles and technologies suitable for recycling, and its production chains and necessary stakeholders.
- **Biological cycle:** This module focuses on the availability of raw materials, material flows and the strain on important environmental resources. Students will learn how to assess and evaluate the sustainable potential of renewable raw materials and a bio-based circular economy moreover they will understand aspects of environmental pollution.
- **Pathways to Net Zero GHG emissions in the energy and chemical sector:** In this module the students will gain the knowledge to distinguish between decarbonization of the energy sector and defossilization of the chemicals/plastics sector. The different renewable energy supply processes will be looked at in detail, compared and contrasted in terms of rapid implementability.
- **Pathways to Net Zero GHG emissions in the mobility sector:** A well-functioning global mobility system is central to the economy and the well-being of society. However, the movement of people and goods requires space, infrastructure, and energy resources, and has a negative impact on the environment, especially as fossil fuels continue to dominate the mobility sector. This module will address various measures to improve the sustainability of transportation and mobility.



- **Pathways to Net Zero GHG emissions in the food sector:** Food systems have important environmental, social and economic interactions. This module focuses on analysing and applying the potential of new production technologies with reference to circular economy.
- **Cities and infrastructure:** Cities with their infrastructure, including the urbanized landscape and the "in-between city", form the context and drivers of any sustainable and resilient circular economy and society in transition and vice versa. This module focuses on the challenges of global urban megatrends that require sustainable circular innovation.
- **Circular use of materials:** Due to their complexity or toxicity, many products and building materials are not easy to recycle, reuse or eliminate. This module will focus on the development of innovative materials (consumables and building materials) with the aim to substitute existing products, providing high quality and a lower or negligible environmental impact.

Circular business models:

Innovations can only have a significant effect on sustainable development if they are also used by end consumers. The transformation to a circular economy therefore requires not only knowledge in the development of innovations, but also knowledge of possible business models. This knowledge is taught in the thematic area of competence "Circular business models". This area of competence is based on four modules:

- **Circular business models:** This module deals with how the business model must be adapted in order to be able to continue to work in a cost-covering manner despite the specific conditions of a circular economy. The focus is on concepts such as product as a service, sharing platforms or leasing/rental.
- **Circular supply chain:** This module deals with the management of the supply chain and how it must be adapted to the circular economy. The focus is particularly on the concept of "reverse logistics".
- **Social entrepreneurship:** With this module we want to awaken the entrepreneurial spirit in you. It is particularly about innovation techniques and the development of sustainable business models and their financing.
- **Digitalisation and sustainability:** Digitalisation is becoming increasingly important in our society. This module is about how digital transformation can contribute to more sustainability and how sustainable development influences digitalisation.

Institutional environment

In order to fully grasp the understanding of circular innovations a broader context is needed. It is important to get to know the political, societal and economic drivers of sustainable system transition and to learn how it affects production methods, industrial structures and market dynamics. This knowledge is taught in the thematic area of competence "Institutional environment". This area of competence is based on five modules:

- **Society and technology:** With this module students will learn to systematically analyse the impacts of technical innovations on society in a transdisciplinary setting with special consideration of relevant social science approaches.

- **Society and the environment:** The overarching topic of this module is the understanding of the complex and dynamic process of human-environment interaction based on the inseparability of social and natural systems. The module is thus concerned with aspects of global change, development and globalisation, with social/environmental justice, individual responsibility and framework conditions, with environmental governance and policy as well as with societal transformation towards sustainability and sustainable development.
- **Innovation and the circular economy in a spatial context:** Circular economy and its networks happen in certain physical places. Hence, place matters for companies – even in our digitalized world. This module focuses on the key terms and concepts related to entrepreneurial ecosystems, regional innovation systems and spatial factors for innovation.
- **Corporate social responsibility:** Companies are increasingly incorporating environmental, social and ethical aspects into their business practices. This module focuses on the possibilities and limits of applied business ethics and CSR in companies, learn about the essential approaches to ethics, and apply them to various problems, dilemmas, and risks that arise in everyday business.

Methods:

Further to the three thematic area of competence, methodological competences are taught:

- **Scientific methods I** Social science research constitutes one of the primary pillars of economy and society. To understand, and investigate, the changes needed for establishing a circular economy, it is a pre-requisite to understand the principles, methods and practices of social science research.
- **Scientific methods II:** The module offers an application-oriented approach to the analysis of quantitative data. Students will learn why quantitative methods have become more important in recent years and where they can be applied. Inferential statistics is introduced and additional applications of data storytelling, cluster analysis, and further machine learning methods will be discussed. For the module the open source software R-Studio is used.
- **Scientific methods III:** Multi-perspective solutions become more and more important to shape a sustainable future. This module focuses on various transdisciplinary methods. Students will learn when and how they can be used in a meaningful way and can explain and discuss the challenges and opportunities that they bring along in specific projects.
- **Impact assessment:** Starting from the ecological sustainability dimension this module focuses on quantitatively assessing the environmental impact of products and services along their life cycle using life cycle assessment (LCA). Students will conduct an LCA on a case study using common LCA software and inventory databases and acquire a profound understanding on how to interpret the results.
- **Circular design:** Starting from an introduction of the history of eco-design students will learn step-by-step the methodology of circular-design and apply it to their own project for an increased circularity.