Integrating Life Cycle Assessment and Circularity Metrics in Sector-Specific Sustainability Models for Materials

Summary

This PhD project focuses on advancing circular economy (CE) practices in the engineered wood products and electronics sectors to support EU decarbonization and industrial sustainability goals. The research will develop integrated materials sustainability assessment frameworks using life cycle assessment and circularity indicators. Key questions include how to assess materials' circularity and redesign value chains for improved resource efficiency and resilience. Embedded within a broader European sustainability initiative, the project offers opportunities for industrial collaboration and applied research. The candidate will help operationalize CE strategies, promoting sustainable product design and supporting companies in adopting circular business models aligned with EU policy targets.

Research field:	Environmental, marine and coastal technology
Supervisors:	Viktoria Voronova Niina Dulova
Availability:	This position is available.
Offered by:	School of Engineering Department of Civil Engineering and Architecture
Application deadline:	Applications are accepted between June 01, 2025 00:00 and June 30, 2025 23:59 (Europe/Zurich)

Description

The research

The implementation of a circular economy (CE) in industrial sectors such as engineered wood products (EWP) and electronics is increasingly recognized as a critical strategy for mitigating environmental impacts associated with resource depletion, greenhouse gas emissions, and waste generation. In the electronics industry, the accelerating consumption of finite materials and the rising volumes of e-waste necessitate innovative approaches that promote material recycling, reuse, and product life extension. Similarly, the EWP sector faces sustainability challenges linked to deforestation, biodiversity loss, and resource inefficiency. While existing European frameworks - including the European Green Deal, the Clean Industrial Deal, and sector-specific directives such as WEEE and the Renewable Energy Directive - provide policy direction, practical tools and integrated models for operationalizing CE principles within these industries remain limited. Addressing these gaps is essential for achieving the EU's decarbonization and industrial sustainability targets.

The primary objective of this doctoral research is to accelerate decarbonization and enhance advanced manufacturing capabilities in the EWP and electronics sectors through the development of integrated sectoral sustainability models. These models will utilize life cycle assessment (LCA) methodologies and circularity indicators to support evidence-based decision-making in material selection, product design, and value chain optimization. Specifically, the project aims to:

- Develop and validate sector-specific materials sustainability assessment frameworks.
- Promote circular product design by encouraging the use of recyclable, bio-based, and durable materials.
- Facilitate the development of circular value chains through supply chain mapping, identification of inefficiencies, and sustainability strategy integration.
- Collaborate with industry partners to pilot and refine sustainable and circular product innovations.

The expected outcomes of the doctoral project include a comprehensive materials evaluation framework and a pilot database of primary, substitute, and secondary raw materials for use in the targeted sectors. These tools will assess materials based on CE principles, including recyclability, reusability, repairability, and life cycle extension potential. The research will address key questions such as:

- How can materials sustainability be systematically assessed in the context of CE principles for electronics and EWP?

- What indicators most effectively measure circularity and decarbonization potential in these industries?
- How can value chains be redesigned to optimize resource efficiency, resilience, and profitability within CE frameworks?

The project will contribute to the operationalization of circular economy practices, support companies in achieving stable decarbonization, and promote the adoption of advanced, sustainable manufacturing strategies across EU industry sectors.

Responsibilities and (foreseen) tasks

- Develop and validate sector-specific sustainability assessment frameworks using life cycle assessment (LCA) and circularity indicators for the electronics and engineered wood products (EWP) industries.
- Build a comprehensive materials database covering primary, substitute, and secondary raw materials, evaluated for recyclability, durability, and life cycle extension.
- Analyze and optimize value chains through supply chain mapping, identification of inefficiencies, and integration of circular and decarbonization strategies.
- Collaborate with industry stakeholders to pilot and refine sustainable product innovations and advanced manufacturing practices.
- Propose and evaluate circular product design approaches, emphasizing bio-based, recyclable, and repairable materials and components.
- Contribute to the development of circularity and decarbonization indicators, supporting EU policy goals such as the European Green Deal and Clean Industrial Deal.
- Disseminate research outcomes through academic publications, and participation in conferences and stakeholder workshops.

Applicants should fulfil the following requirements:

- Master's degree (or equivalent) in a relevant field such as environmental engineering, industrial ecology, sustainable manufacturing, materials science, circular economy, or a related discipline.
- Strong interest in LCA, EIA, or sustainability metrics.
- Passionate about data analysis and computational modeling, focusing on materials life cycles.
- Very good proficiency in spoken and written English language.
- Willingness to travel to international and domestic project meetings.

The following experience is beneficial:

- Experience with LCA tools and software (e.g., SimaPro, LCA for Experts, openLCA).
- Familiarity with EIA processes, sustainability indicators, or environmental reporting.
- Previous experience working on international projects
- Proficiency in written and spoken Estonian to communicate effectively with local stakeholders.

We offer:

- A fully funded 4-year PhD position focused on advancing circular economy and sustainability in the electronics and engineered wood products sectors.
- Joint supervision by two leading departments at TalTech – the Department of Civil Engineering and Architecture (Environmental Engineering focus) and the Department of Materials and Environmental Technology.
- Opportunity to work in an interdisciplinary research environment, combining engineering, materials science, and environmental sustainability.
- Participation in a collaborative international research project funded by the INTERREG Baltic Sea Region (BSR) Programme, with opportunities for regional networking and impact.

About the department(s)

This PhD project involves cooperation between two departments at TalTech: the Department of Civil Engineering and Architecture, and the Department of Materials and Environmental Technology.

The Department of Civil Engineering and Architecture, within the School of Engineering covers research and education in the fields of architecture, building structures, construction processes, near zero energy buildings, structural and fluid mechanics, road construction, geodesy and water and environmental engineering. Within the Department,

the Water and Environmental Engineering (WEE) research group performs research on life cycle assessment (LCA), impacts of climate change, water quality and treatment of municipal and industrial waste and waste waters. The WEE research group has long-term experience in conducting life cycle assessments and calculating the carbon footprint of various products and materials. The WEE laboratory offers the capability to measure the physical and chemical parameters of wastewater and assess the biodegradability of various bioplastics. The research group has developed several educational materials on LCA and sustainability topics in waste management. The research group actively participates in national and European Union research projects, including Horizon Europe, Interreg, Erasmus+, LIFE, and EuropeAid.

The Department of Materials and Environmental Technology is a national leader in high-level, internationally recognized teaching, research, and development in materials and environmental technology. Within the department, the Laboratory of Environmental Technology (LET) focuses on applied sustainability and environmental research, addressing key topics such as:

- Water and wastewater treatment
- Contaminated soil remediation
- Air pollution abatement
- Abatement of emerging contaminants
- Valorization, processing, and recycling of solid waste
- Life cycle assessment and carbon footprint calculation
- Circular management of industrial and municipal waste

LET has extensive experience in managing and participating in national and international projects, including BSR/Central Baltic INTERREG, ERA-MIN, Erasmus+, and LIFE programmes, with a strong emphasis on advanced environmental matrices treatment, sustainable waste management, circular economy, and ESG solutions.

Additional information

For further information, please contact:

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