Implementation of a circular economy at universities

33. Implementation of a circular economy at universities

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INTRODUCTION

Universities are key agents for the socio-economic development of regions through knowledge creation (research), knowledge transfer (teaching) and community development (social outreach activities) (OECD 2010). Thus, they play a pivotal role in supporting sustainable development (Ferrer-Balas et al. 2008) because they can facilitate the processes through which sustainability innovations can flourish and thrive (Stephens et al. 2008).

Paradoxically, although universities are recognised as organisations which foster change, they tend to be quite conservative and resistant to change themselves, due to rigid governance structures and conservative mindsets (Elton 2003). However, the shift towards a more resource-efficient and sustainable economy calls for system-level changes in the way organisations operate in order to move away from business-as-usual incremental solutions and to tackle unsustainable practices (Wells 2013).

Teaching, research and social outreach activities entail significant resource consumption, waste generation and environmental impacts. Focusing on the United Kingdom (UK) as an example, the annual energy expenditure by universities amounts to £400 million, resulting in 3.1 Mt of greenhouse gas (GHG) emissions (Carbon Trust 2012). The former is equivalent to the net annual average earnings of around 26 000 people in the European Union (EU) (Eurostat 2018a), whereas the latter equals the annual GHG emissions by more than 1 550 000 EU households (EEA 2014). Likewise, over 322 000 t/year of waste are disposed into landfills by UK universities alone (EAUC 2016), equivalent to the annual municipal waste generation by almost 692 000 people in the EU (Eurostat 2018b).

Accordingly, universities should not be perceived only as sustainability drivers through teaching, research and social outreach activities, but also as organisations that should practise sustainability across campuses in order to lead by example (Stephens et al. 2008). However, little attention has been given in the literature to the analysis of the potential benefits from the implementation of circular economy (CE) principles within strategic sustainability-based decision-making processes as a mechanism for enhancing sustainable resource management of campus operations. This has been recently addressed by Mendoza et al. (2019a, 2019b), in two different ways, considering the University of Manchester as an illustrative example of a university:

1. Exploration of barriers and opportunities for the implementation of CE thinking in campus management through the analysis of the scope of corporate sustainability policies and the engagement of university staff (Mendoza et al. 2019a).

2. Application of a comprehensive action-led approach to help staff make the first steps in building a business case for CE strategy development (Mendoza et al. 2019b).

Based on the above findings, this chapter examines the current reality, including barriers, challenges and opportunities, for the implementation of CE solutions in universities with the aim of achieving more sustainable resource management.

METHODOLOGY

The so-called backcasting and eco-design for circular economy (BECE) framework (Mendoza et al. 2017) was used as a guide to identify gaps and opportunities for driving operational and organisational change towards the implementation of a CE in the University of Manchester. BECE is a generic and flexible action-led framework that was developed to guide product-based and service-oriented organisations in building circular and sustainable business models.

The most relevant features of the BECE framework are:

1. it integrates explicitly CE principles to guide sustainable innovation;
2. it is underpinned by CE actions, each representing a relevant CE opportunity;
3. it focuses on implementation, supporting the integration of CE requirements into business practice;
4. it takes a strategic view of a CE by starting with an ambitious vision, which allows an organisation to define the direction and scope of its future CE activities;
5. it enables selection and modular use of different analytical and decision support tools as needed for specific cases; and
6. by combining backcasting (Vergragt and Quist 2011) and eco-design (Crul and Diehl 2009), the framework bridges the gap between the strategic and operational levels, providing tools for both top-down and bottom-up strategic planning and actions, which is key for a successful realisation of the CE concept (Mendoza et al. 2017).

For these reasons, the BECE framework was considered appropriate to guide the identification, evaluation and prioritisation of opportunities for CE implementation in universities, using Manchester as an illustrative example of a large university wishing to 'go circular' (Mendoza et al. 2019a, 2019b). Figure 33.1 describes how the action-led BECE framework was applied in the university context.

Building on the findings from a preliminary background analysis (desktop research) and foreground analysis (expert interviews), the framework was developed comprising the following five steps:

● A: Vision definition and analysis of barriers and drivers.
● B: Evaluation of the baseline CE and sustainability performance.
● C: Analysis of feasible circular economy solutions.
● D: Development of a circular economy action plan.
● E: Circular economy strategy implementation and review.
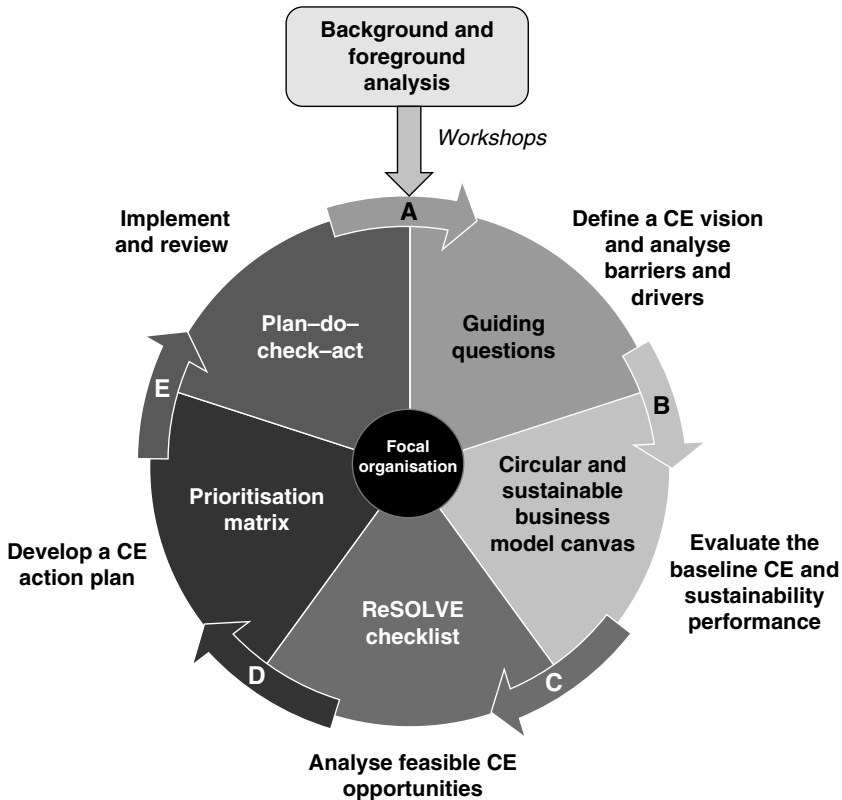
Note: ReSOLVE – regenerate, share, optimise, loop, virtualise, exchange.

Sources: Adapted from Mendoza et al. (2017, 2019a, 2019b).

Figure 33.1 An overview of the BECE framework applied in the research

Steps A–D were developed through two participatory workshops. The first workshop on gaps analysis involved the development of steps A and B by applying backcasting. The second workshop on opportunity assessment entailed the development of steps C and D by applying eco-design thinking. The final step E is the ultimate responsibility of the focal organisation. However, guidelines are provided to facilitate this process.

A brief description of each step is provided in the subsections below. Detailed descriptions of each methodological step, including the process for stakeholder engagement and development of semi-structured interviews, the design of the participatory workshops and the application of the supporting analytical tools, can be found in Mendoza et al. (2019a, 2019b).

Background and Foreground Analysis

A background analysis comprises the evaluation of the scope of the corporate sustainability policies of the focal university to get an overview of the organisation's awareness

of and capabilities in CE and sustainability management. Accordingly, the most relevant corporate sustainability policies of the University of Manchester were analysed, including the Manchester 2020 Strategic Plan (UoM 2015), Campus Masterplan 2012–2022 (UoM 2012), Environmental Sustainability Strategy (UoM 2016), Sustainable Resources Plan (UoM 2017a) and Living Campus Plan (UoM 2017b).

A foreground analysis is aimed at gathering detailed information about the effectiveness of the mechanisms (for example, frameworks, tools and indicators) employed by university staff for identifying, evaluating and monitoring the implementation of sustainability strategies. This is facilitated through engagement and interview of stakeholders with different roles and responsibilities along the governance structure. A team of four sustainability-oriented academics (sustainable chemical engineering, climate change, energy efficiency and environmental governance) and eight technical staff (capital projects, design services, residential services, environmental sustainability coordinator and officer, procurement, technical services, and waste management) from the University of Manchester was engaged to participate in individual semi-structured interviews. As a result of both analyses, the current level of implementation of CE thinking by the university was determined, including the identification of high-level opportunities to drive change.

Step A: Vision Definition and Analysis of Barriers and Drivers

This step involves envisioning a CE model coherent with the university's core goals and priorities. To facilitate this process in the first workshop, participants were asked: 'What do you think a circular economy model for sustainable campus management would look like in the future?'

Afterwards, a number of guiding questions were asked to initiate a group discussion:

1. What does success look like around this vision?
2. What are we looking to accomplish?
3. What impact do we want to have?
4. What are the potential benefits?
5. How will we know when we get there?

Accordingly, drivers, challenges and opportunities for CE implementation were identified.

Step B: Evaluation of the Circular Economy and Sustainability Performance

The business model canvas (BMC) is a strategic management tool used to facilitate a structured analysis of the performance of an organisation (Osterwalder and Pigneur 2010). However, the traditional BMC is not able to support sustainability-oriented evaluations because it is economically driven for profit generation (Joyce and Paquin 2016). Thus, a circular and sustainable business model canvas (CSBMC) was developed to get an overview of the university's baseline circularity and sustainability performance (Mendoza et al. 2019b). The CSBMC follows the same structure as the traditional BMC but integrates CE- and sustainability-oriented questions with the list

of economic-oriented questions posed to the participants to analyse the performance of the organisation. As a result, gaps for improvement were identified. For further details on the CSBMC and the questions posed to the workshop participants, see Mendoza et al. (2019b).

Step C: Analysis of Feasible Circular Economy Solutions

The ReSOLVE checklist (EMF 2015) was used to structure the analysis of CE solutions for potential implementation in the university context. This checklist consists of six strategic actions – regenerate, share, optimise, loop, virtualise and exchange – that comply with the CE principles of preserving and enhancing natural capital, optimising resource yields, and designing out negative externalities (EMF 2015). According to the EMF (2015), the greatest potential for universities lies in the implementation of the following three ReSOLVE actions:

- virtualise: displacing resource consumption by delivering products and utilities virtually through service provision;
- share: maximising asset utilisation by promoting reuse, maintenance and sharing; and
- optimise: reducing resource consumption per product/service unit and eliminating waste generation in supply chains.

Therefore, only these ReSOLVE actions were considered in the analysis.

Demonstrative case studies gathered from different databases, such as EMF (2017), Circle Economy (2017) and Arup (2016), were grouped into virtualise, share and optimise CE actions. These case studies were used to demonstrate how organisations (outside the university sector) are developing CE actions through business model and product-service innovation. This activity facilitated creative thinking, open dialogue and idea exchange for the prioritisation of CE actions.

Step D: Development of a Circular Economy Action Plan

Based on Crul and Diehl (2009), an opportunity prioritisation matrix was used to group CE solutions based on their potential resource, environmental or social gains compared to their technical or economic feasibility. Consequently, an action plan for CE implementation was developed.

Step E: Circular Economy Strategy Implementation and Review

The most promising CE solutions should be implemented across the campus to maximise overall resource efficiency and sustainability performance. Periodic monitoring and revision of the outcomes should be carried out following the plan–do–check–act approach to ensure continuous improvements.

RESULTS AND DISCUSSION

This section presents a summary of the key findings, including the opportunities to embed CE thinking in sustainable campus management by the University of Manchester.

Key Findings from the Background and Foreground Analyses

Although there is no mention of the CE concept in the university's sustainability policies, there are a number of environmental sustainability strategies in place that resonate with the CE concept. These include the marketplace online platform for the reuse of second-hand products, the university furniture and information technology (IT) reuse centres, trayless dining areas and provision of reusable mugs in food halls, virtualisation of services, recycling facilities and green spaces (UoM 2017a, 2017b).

However, most of these strategies are limited in scope because they concentrate on reducing resource consumption, waste generation and direct carbon emissions rather than rethinking current processes to achieve more sustainable resource management. Indeed, the stakeholder interviews demonstrated that the university's sustainability policies have been developed without incorporating CE thinking, due to a lack of understanding of its practical application in the university context and the uncertainty of the potential benefits. Other key findings from the interviews are summarised in Table 33.1.

Steps A and B: Key Findings from the Workshop on Gaps Analysis

The following subsections present a summary of the most relevant findings from the first workshop used to build a CE vision and analyse current gaps for improvement.

Circular economy vision for the university

The workshop participants agreed on the adoption of a preliminary CE vision that would allow the university to take simple incremental steps towards the implementation of a CE. Although incremental changes are not going to drive the needed fundamental shift from linear to circular thinking, they represent a necessary interim step, aiming to empower the stakeholders and reduce the resistance to change (Lozano 2006).

The workshop participants decided to follow the CE definition provided in EMF (2015) because they all found it meaningful to start driving change: 'A restorative and regenerative university that aims to keep products, components, and materials at their highest utility and value at all times'.

Table 33.2 summarises relevant opportunities, drivers and barriers for CE implementation in the university, as identified by the workshop participants. In addition to these barriers, the participants were aware of the potential benefits that the deployment of a CE could bring. These benefits go beyond a more efficient and sustainable campus to include the development of new academic programmes and redesign of governance structures.

Baseline circularity and sustainability performance of the university

Table 33.3 presents the findings from the application of the CSBMC in the workshop to get an overview of the circularity and sustainability performance of the University of Manchester. As can be seen, although there are some sustainability activities in place

Table 33.1   Summary of key outcomes from stakeholder interviews

Topic	Interview outcomes
CE concept and principles	Important to agree on a CE vision that resonates with the organisation's core goals and priorities in order to encourage CE practice CE criteria should be embedded in sustainability policies to avoid putting too much effort into the development of strategies that would lead to marginal improvements Important to raise CE awareness among staff, students and the stakeholder network
Decision support frameworks and tools	Sustainability-oriented decisions derive mostly from internal meetings where stakeholders share information, propose solutions and agree on actions based on inside knowledge and experience in daily practice Staff should have access to decision support systems that could facilitate the identification of best alternatives through the combination of CE and sustainability criteria Important to obtain buy-in from senior managers and make everybody a sustainability champion to facilitate the implementation of a CE across the university
Key performance indicators (KPIs)	KPIs used to measure and monitor progress on resource efficiency and environmental sustainability are not very informative and meaningful A key barrier to setting meaningful KPIs is the lack of suitable data collection systems Current financial models cannot provide disaggregated data to set robust KPIs and support the development of comprehensive CE and sustainability studies
Allocation of responsibilities and budgets	Schools do not benefit directly from the economic savings related to improvements in resource efficiency because budgets to take such actions and the related savings are handled by the estates department This may discourage school/department managers and staff to pursue CE practices Budget incentives and appropriate KPIs should be developed to facilitate implementation of CE by schools/departments
Creation of joint teams of managers and technical staff	Top-down CE strategies formulated by senior managers may not be practical at the operational level if they lack consideration of technical aspects Staff focused only on operations management may lose track of the organisation's core goals and strategic priorities It is important to create teams combining operational staff and senior managers to develop realistic CE strategies for their effective implementation
Stakeholder engagement and collaboration	The university does not have the capability to develop certain CE- and sustainability-related activities Stakeholder partnership and collaboration are essential for co-creating solutions for CE implementation in the university and its stakeholder network

Table 33.2   *Opportunities, drivers and barriers for CE implementation in the university context*

Opportunities	Reduced material consumption
	Cost reduction
	Lower carbon emissions
	Strategic design and management of innovative buildings and infrastructures
	Creative thinking and innovation
	New educational programmes
	Behavioural change among students and staff
	Stakeholder engagement in sustainability practice
Drivers	Highly skilled staff to realise organisational and operational changes
	Environmental sustainability action plans, programmes and strategies
	University living lab for sustainability and network of sustainability champions
	Extensive stakeholder network of the university, including partners and suppliers
	Integration of CE-related specifications in tender processes (procurement)
	CE-oriented legislation and strategies developed by Manchester City Council and the Greater Manchester regional government
Barriers	People's unawareness and lack of involvement in CE practice
	Budget limitations and time constraints
	Lack of practical frameworks and tools to ensure improved CE performance
	Material-intensive student expectations (value for money)
	Conservative culture and rigid governance structure
	Seasonal changes in campus operations
	Business competing demands, goals and priorities

(UoM 2015), the CE principles are not embedded explicitly in the strategy and operation of the university. These activities can be extended further to make the CE mainstream. The university can also build strong customer relationships (for example, feedback loops) around CE by taking advantage of its engagement mechanisms (for example, living labs) and communication channels (for example, websites). This could lead to the creation of novel user-centric CE services and engagement strategies, such as the setting up of a CE programme for sustainable resource management that could motivate students and staff to co-create innovative solutions for implementation across the campus.

However, it is crucial first to build a meaningful business case showing the benefits that the university could achieve by 'going circular'. This includes the analysis of the return on investment and the implementation of measures to overcome risks. It is also important to analyse if the deployment of a CE across the campus (for example, through product life extension and virtualisation) could affect the well-being of the maintenance staff through potential job losses.

A cost–benefit analysis should also include a comparison of alternative scenarios and pathways, such as access to services versus purchase of circular products. The implementation of these CE alternatives would require a redesign of current procurement mechanisms, including the integration of CE criteria in procurement processes, the enhancement of the current stakeholder network by bringing new strategic partners into place and the reorientation of campus management policies and protocols.

Table 33.3   *An overview of the university based on the application of the circular and sustainable business model canvas (CSBMC)*

Value proposition	Service offering	Campus operations that create opportunities for an efficient use of resources, including financial savings and social well-being enhancement
Value creation	Key partners Key resources	8000+ suppliers, constructors, utility providers, consultancies 12 000 staff, 229 buildings, 270 hectares, equipment, infrastructure
	Key activities	Teaching, research, campus management and social outreach
		Annual campus operations consume a significant amount of resources (247 GWh of energy + 742 000 m^3 of water) that lead to environmental impacts (72 000 t of Scope 1 CO_2 emissions) and waste generation (7000 t, only 30% recycled)
		Key activities to enhance campus environmental sustainability include: energy, water and waste management, encouragement of sustainable travel, development of green spaces, sharing of research equipment, sustainable construction, responsible purchasing, sustainable catering
Value delivery	Customer segments	Main customer segment: students (40 000+ undergraduate and postgraduate students from 160 countries); others: industry, hospitals, government, charities, local communities, society
	Customer relationships	Students' Union, social media, mentorship and counselling, marketing, student and staff engagement programmes (green impact teams, sustainability champions and living labs)
	Channels	Websites, public events, staff promoters, research beacons, advisors, publications, conferences, experimentation, Manchester corridor
Value capture	Cost structure	£943 million annually: ten-year capital investment programme from 2012 to 2022 (£1.75 billion), utilities (£50 000/day for energy), goods and services (£383M annually), maintenance, security, staff, fixed costs
	Revenue streams	Annual income £943 million: fees (£424 million), grants (£276 million), councils (£128 million), other (£158 million). Total economic output generated throughout the UK equals £2.3 billion due to 'knock-on' effects

Steps C and D: Key Findings from the Workshop on Opportunity Assessment

Building on the outcomes from the previous two steps, a second workshop was focused on the evaluation and prioritisation of strategic CE actions as discussed below.

Table 33.4   Outcomes from the evaluation of circular economy opportunities by the workshop participants

CE opportunities	Workshop participants' suggestions
Virtualise	Access to all-inclusive leasing contracts based on 'pay-per-use': lighting, office equipment and buildings
	Sensor networks could be used to monitor and collect real-time data to improve the university's performance (e.g., internet of things, preventative maintenance)
	Greater control of campus operations (e.g., products usage)
	More comfortable built environment (e.g., lighting in buildings)
	Novel value-capture mechanisms (e.g., students personalised fees)
	Engagement of staff and students in sustainable resource use (e.g., data-gathering and analysis)
Share	The design of flexible spaces and seasonal renting of spare space to optimise space usage (current utilisation rate: 20%)
	A centralised security and administrative management system in collaboration with neighbouring universities could optimise resource use further
	Reusable food containers for students can reduce waste generation
Optimise	Optimise the management of packaging materials and mattresses from students' residences
	Implement take-back systems (e.g., reverse vending machines) for the collection of drinks packaging

Evaluation of CE opportunities for implementation in the university

The findings from the analysis of CE case studies related to the three ReSOLVE actions considered here (virtualisation, sharing and optimisation) are summarised in Table 33.4. These three actions share a number of common challenges, including the need to change governance structures, procurement mechanisms, conservative mindsets and behaviour, cultural barriers and allocation of resources between university units. Also, it is important to evaluate risk and safety issues to ensure an appropriate management of CE solutions. Likewise, cost-effectiveness analysis was highlighted as a key requirement.

Action plan to start building the case for CE implementation

Based on the findings from Table 33.4, the workshop participants chose a number of CE solutions that they considered a priority for developing a business case for the implementation of a CE within the university (Table 33.5). These solutions are related to the virtualise and share actions. The participants did not find it a priority to implement the optimise action in the short term. The selected CE solutions were mostly aimed at responding to students' needs and expectations in a more efficient and sustainable way as they are the most relevant customer segment for the university.

Step E: Circular Economy Implementation and Review

The proposed action plan was then used by the Environmental Sustainability Team to initiate the development of a CE programme to help achieve the goals and targets of

Table 33.5   Circular economy action plan proposed by the workshop participants

Action plan	Workshop participants' suggestions
Circular furniture	Refurbish the large existing stock and get access to remanufactured products through leasing contracts
	Develop a dynamic monitoring system to inventory, track and check the location, condition and availability of the furniture across the campus
	Create a responsible team and allocate space to undertake refurbishments
	Integrate CE criteria in new tender processes focusing on service provision through full life cycle management of remanufactured furniture or brand new products with a buy-back offer
Circular mugs and food containers	Offer students the possibility to purchase reusable food containers and mugs
	Implement take-back systems to clean and distribute reusable products
	Raise awareness and engage students and staff by offering discounts and special deals, such as an express 'green line' to purchase food
Circular appliances	Deliver fridges and vacuum cleaners in student residences as service through pay-per-use contracts
	Gather data on product performance over time (e.g., energy consumption) through digital technologies as a vehicle to offer students a better service (e.g., personalised solutions) and raise their CE and sustainability awareness
	Analyse risk and safety issues related to service delivery and the required changes in students' behaviour and expectations
Circular lighting	Enable access to pay-per-lux contracts to avoid purchasing and maintaining lighting equipment and installations
	Design mechanisms for charging students personalised fees based on their energy use in residences
	Deploy a network of sensors and create a software to monitor energy use in buildings across the campus
	Analyse first the potential energy and cost savings for the university, including the implications for the maintenance staff

the university's Sustainable Resources Plan (UoM 2017a). This is an important first step towards making the CE mainstream. However, the implementation of CE actions requires continuous organisational learning and operational change. Likewise, the development of robust analytical tools and meaningful KPIs is crucial for measuring the sustainability implications of different CE solutions and improving the action plans over time.

CONCLUSIONS AND RECOMMENDATIONS

The use of the proposed action-led CE framework has shown it to be a useful and effective tool for identifying, evaluating and prioritising the implementation of CE solutions

in universities, as demonstrated by the example of the University of Manchester. The framework enabled identification of gaps in current sustainability policies, strategies and decision-making processes of the university. These included the lack of comprehensive sustainability decision support tools, data-gathering systems and KPIs as well as the need for better allocation of competences and budgets and stakeholder engagement. This analysis revealed that environmental sustainability strategies already in place were limited in scope and not specifically related to CE.

Nevertheless, the university has a number of actions in place that can be extended further and/or redesigned to facilitate CE implementation, including how it creates, delivers and captures value from customers. The workshop participants agreed on a CE action plan containing four priority solutions where the university can make a difference in the way resources are managed across the campus to improve the sustainability performance substantially, compared to the implementation of conventional (linear) eco-efficiency solutions.

However, it is crucial first to build a practical and meaningful business case showing the benefits that the university could achieve by 'going circular'. In this process, it is also important to involve students actively in the development of CE solutions and to provide feedback on the effectiveness of CE strategies from a bottom-up perspective (for example, based on customer needs and experience). This can be facilitated by taking advantage of the customer engagement mechanisms in place, such as the Students' Union, social media, green impact teams and living labs. Access to such a robust CE business case would facilitate 'buy-in' from senior managers and, ultimately, the operational staff. Likewise, it would encourage the university's suppliers, partners and students to collaborate in the co-creation of CE solutions.

This chapter has illustrated the first steps that need to be taken to build a CE business case. Future research should focus on quantifying the sustainability implications of implementing a CE in universities. This includes the definition of meaningful KPIs, development of suitable data-gathering systems, the use of systems-based tools, stakeholder engagement and the use of university living labs as places for experimentation towards CE implementation. These research activities could lead to the development of innovative CE policies, standards and reporting frameworks for universities, helping to monitor and communicate CE progress as well as to benchmark them on their circularity and sustainability performance.

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