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CIRCULAR Living Labs Handbook

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Project: 101082209 — CIRCULAR — ERASMUS-EDU-2022-CBHE-STRAND-2

Document Control Information

Document Title:	CIRCULAR Living Labs Handbook
Deliverable Number:	D4.2
Project Title:	CIRCULAR - Circular Economy Living Laboratories supporting Social Innovation in Southeast Asia
Project Number:	101082209
Document Author:	Universiti Malaysia Sarawak (UNIMAS)
Document Version:	Version 1
Date:	08/01/2025
Dissemination Level:	☐ Public ☑ Sensitive

Document History

Version	Date	Change(s)	Created by	Page(s)
V1	30/11/2024	Initial Version	UNIMAS	31
V2	08/01/2025	Final Version	USM	31

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Content

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1. Introduction

CIRCULAR seeks to boost the social innovation ecosystem in Malaysia, Cambodia and Laos by bringing together and reinforcing the links between Teaching, Research, Innovation and Society to design and test innovative solutions in collaboration to mitigate waste management problems, to promote circular economy approaches and improve the quality of life of local communities. CIRCULAR Living Labs include important initiatives in implementing sustainable practices into higher education and community engagement throughout Southeast Asia. The laboratory goes beyond the physical space, growing into a dynamic ecosystem where teaching, research, innovation, and social engagement mix to foster experimental solutions embodied in circular economy principles.

This initiative is a key component of the wider CIRCULAR project, co-funded by the Erasmus+ programme, which is dedicated to sparkle social innovation by connecting educational institutions and local communities. Beside the collaboration aims to address environmental challenges and promote sustainable development. This project brings together a diverse consortium from Malaysia, Cambodia, Laos, Spain, and Portugal, each contributing unique perspectives and strengths to our collective mission.

The project pursues the following specific objectives to establish Living Labs, the practical application of academic knowledge by bridging the gap between educational institutions and societal needs:

- Set-up Living Labs as open innovation ecosystems that integrate education, research, innovation, and regional development to help trigger the adoption of green and more sustainable practices for more efficient use of resources.
- Build the capacities of academics to design, organise and implement collaborative social innovation programmes that promote students' active citizenship and simultaneously contribute to promote everyday sustainability and climate-change problems.
- Build the capacities of researchers on new methodologies and updated strategies to conduct community-based research activities on the topic of circular economy and waste management.
- Empower students and young people to become socially engaged, active climate-conscious citizens and raise the awareness of local communities on the topic of circular economy and sustainable development to promote alternative consumption habits and waste management practices underpinned by knowledge, research and innovation generated by Higher Education Institutions.

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1.1 Purpose of the Handbook

The "CIRCULAR Living Labs Handbook" investigates the implementation of teaching programmes for students about sustainability policies and facilitating hands-on experience through practice, promotion, and dissemination. The work pursues to build an open and inclusive environment involving local communities, social activists, stakeholders, educators and students, both in virtual and physical formats to create opportunities for everyone to be involved. It serves as a guideline for dynamic hubs for experimentation, learning, and innovation, driving us to the transition towards to circular economy.

The Handbook presents a vision of living labs that emphasises new solutions, proposed pathways, and innovative approaches by fostering debates to Identify optimal sustainability models.

This "CIRCULAR Living Labs Handbook" is a part of the project and designed to act as a basic guide to establish and manage Living Labs focused on the circular economy in Southeast Asian Higher Education Institutions (HEIs). And has several purposes:

1) Guide to Setup and Operation: It provides a detailed, step-by-step framework for establishing and running Living Labs, from initial conception through to daily operations, highlighting essential equipment and infrastructure requirements, and operational protocols.

2) Standardisation of Practices: By setting common guidelines and protocols, the handbook aims to standardise operations across various labs, ensuring consistency and quality in their functioning and outputs.

3) Facilitation of Interdisciplinary Collaboration: The handbook promotes a collaborative environment, encouraging interaction among scientists, researchers, students, and community members to foster innovation and integrate diverse expertise in research and development processes.

4) Enhancement of Educational Outcomes: It outlines how Living Labs can be integrated into academic curricula, offering experiential learning opportunities that align theoretical studies with practical, real-world challenges.

5) Promotion of Community Engagement: This document guides the inclusion of local communities in the research process, ensuring that innovations are practical and tailored to local needs.

6) Support for Sustainable Development: The handbook underscores the commitment to sustainable development by detailed investigation of the establishment and operation within labs that prioritise sustainable practices, contributing to environmental conservation, economic stability, and social welfare.

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The document has two main goals as follows:

1. To establish a clear and actionable framework for the setup and operation of CIRCULAR Living Labs.
2. To ensure that CIRCULAR Living Labs function as effective tools for innovation, education, and community engagement.

Through these detailed guidelines and outlined goals, this handbook aims to empower universities and their partners to not only establish but also thrive in their efforts to create effective and sustainable CIRCULAR Living Labs.

1.2 CIRCULAR Living Labs

CIRCULAR Living Labs are dynamic platforms designed to merge educational initiatives, research endeavours, and community engagement into the practical application of the circular economy principles. These labs serve as catalysts for social innovation, where multiple stakeholders come together to develop sustainable solutions that are socially viable and environmentally friendly.
Objectives of CIRCULAR Living Labs:

1. Drive Social Innovation: The labs are set up to encourage the development of innovative solutions that address social and environmental issues effectively, promoting sustainable development at local and regional levels.

2. Build Capacity: Through hands-on educational programmes and active community involvement, the labs aim to build the capacity of individuals and communities to engage in and lead sustainability initiatives.

3. Foster Collaborative Networks: By providing a space for collaboration among academia, industry, and communities, the labs help forge strong partnerships that are essential for the widespread adoption of sustainable practices.
4. Promote Scalability and Replication: The ultimate goal is to develop solutions that can be scaled up and replicated in other contexts, amplifying the impact of the innovations developed within the labs.

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By focusing on these broad objectives and maintaining a commitment to social innovation and sustainability, CIRCULAR Living Labs serve as a blueprint for how educational institutions can contribute effectively to societal and environmental well-being. This general framework ensures that the handbook serves as a guide, inspiring stakeholders involved in or looking to establish similar initiatives with following characteristics of CIRCULAR Living Labs.

1. Interdisciplinary Collaboration: The labs facilitate collaboration across various disciplines, drawing on expertise from environmental science, engineering, business, and social sciences to foster innovative solutions to sustainability challenges.

2. Community Engagement: Central to the labs is their focus on community engagement, where local stakeholders actively participate in shaping and testing sustainable solutions, ensuring that these innovations are grounded in local needs and contexts.

3. Practical Application: CIRCULAR Living Labs are committed to implementing theoretical knowledge in real-world settings, effectively bridging the gap between academic research and practical environmental solutions.

4. Educational Enhancement: These labs enrich educational experiences by integrating applied learning opportunities into curricula, helping students and community members alike to develop practical skills and knowledge in sustainability.

5. Sustainability Focus: Every aspect of the labs is designed with sustainability in mind, aiming to promote long-term environmental stewardship and community well-being.

2. Conceptual Framework of CIRCULAR Living Labs

The CIRCULAR Living Labs initiative is built on a conceptual framework that links the principles of the circular economy with the innovative and educational potential of Living Labs. This section provides an overview of these basic concepts, aiming to equip stakeholders with a comprehensive understanding that will support practical applications and laboratory operations.

The Three Pillars of Circular Living labs in Figure 1 illustrates the core elements driving the CIRCULAR Living Labs initiative. These pillars—Education for

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Sustainable Development and Environmental Sustainability, Citizen Science, and Community Engagement—work together to foster an integrated circular economy model, blending educational initiatives, scientific collaboration, and community involvement.

This conceptual framework not only serves as a guide for stakeholders but also emphasises the pivotal role of universities in implementing and driving the success of Circular Living Labs. Universities act as catalysts by integrating sustainability education, public scientific participation, and localised engagement efforts into their missions. Through embedding circular economy principles into curricula, leveraging research capabilities for innovative solutions, and using campuses as testing grounds for sustainable practices, universities create dynamic ecosystems for learning and experimentation. By engaging with communities, fostering partnerships, and building capacity through training and dissemination, they ensure relevance and impact. Institutional support, robust monitoring, and collaboration further solidify their role, transforming universities into hubs of sustainability leadership while addressing local and global challenges. This interconnected framework is detailed further in the chapter below.

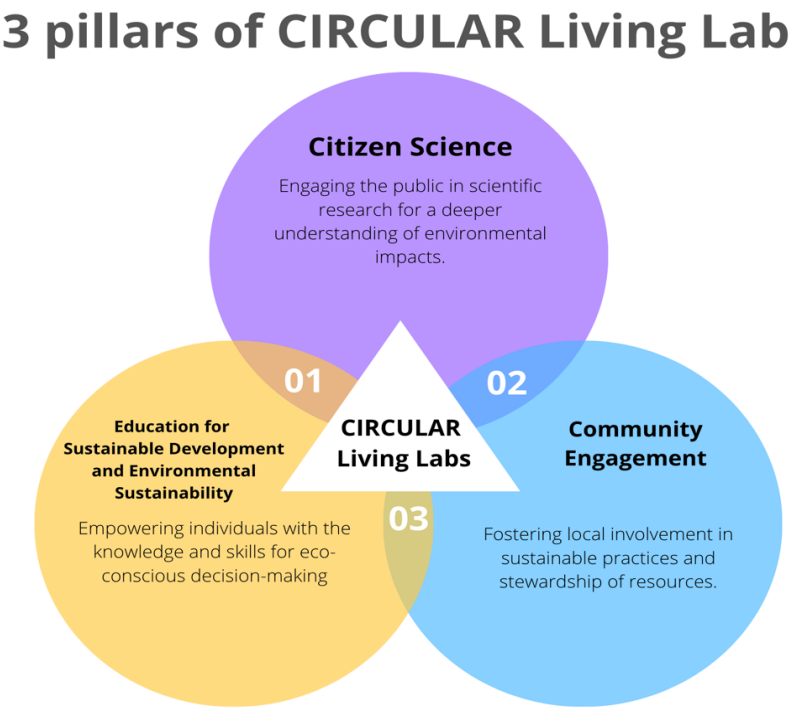

Figure 1. The 3 pillars of CIRCULAR Living Labs

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2.1 Citizen Science

Citizen Science in the context of CIRCULAR Living Labs involves the active participation of non-professionals in scientific research. This approach democratises science, making it accessible and relevant to the broader community. It encourages public involvement in data collection, problem-solving, and innovation, which enhances the social relevance and impact of scientific research.

Citizen Science is aimed at designing a system to tackle the challenges of complex waste management and resource scarcity drawing upon a diverse expertise from students, civil society organisations, public authorities, key stakeholders, and individuals from the public with different backgrounds. Integrating knowledge and insights from industry, government, and researchers enables the creation of innovative solutions, such as bio-based materials, recycling models, and solar energy systems. This mentioned acceleration process will provide opportunities for businesses and communities, building a way for sustainability and the zero-waste aim. Besides, by actively engaging the community in this work, a significant opportunity for fostering future collaborative endeavours is presented.

Engaging citizens in scientific endeavours fosters greater public awareness and understanding of scientific issues, particularly those related to sustainability and environmental protection. It also generates diverse, large-scale data that can be vital for the success of environmental initiatives. Through community engagement in Citizen Science, Living Labs can cultivate networks and partnerships that extend beyond the immediate scope of a single project. By actively involving citizens in the research and design of environmental solutions, Citizen Science not only enriches the current work but also lays the groundwork for sustained collaborative endeavours. This fosters a shared commitment to sustainability among businesses, researchers, and the public, and will enhance community resilience and encourage continuous improvement toward circularity goals.

In the context of Citizen Science within Circular Living Labs, universities play a crucial role as facilitators, knowledge hubs, and innovation leaders. Their primary responsibility is to create structured frameworks that integrate citizen participation into scientific research while ensuring methodological rigor and ethical practices. Universities can design and implement training programmes to

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equip citizens with the necessary skills for data collection and problem-solving, fostering an inclusive environment for collaboration. Additionally, they act as intermediaries, connecting public participants with industries, and other stakeholders to amplify the impact of Citizen Science projects.

By leveraging their research expertise, universities can guide the development of innovative solutions as in the experience of the partner universities cases—such as recycling systems, bio-based materials, and renewable energy technologies—while ensuring these efforts align with scientific standards. Furthermore, universities are responsible for documenting and analysing the data collected from citizens, transforming it into actionable insights that address waste management and resource scarcity challenges. They also play a crucial role in disseminating findings through academic publications, workshops, and public engagement initiatives, ensuring transparency and encouraging continued participation.

Through these efforts, universities not only drive the success of Citizen Science projects but also strengthen their role as key players in fostering sustainable practices, building resilient communities, and achieving circularity goals. Their commitment ensures that Citizen Science remains a transformative tool for both immediate problem-solving and long-term societal change.

2.2 Education for Sustainable Development and Environmental Sustainability

The Education for Sustainable Development and Environmental Sustainability pillar within CIRCULAR Living Labs serves as a bridge between current educational practices and a future-oriented vision for sustainability. This teaching component integrates circular economy principles into education, with a focus on active engagement of the students in problem-solving and ecological initiatives that benefit both their immediate communities and the broader environment. By fostering eco-friendly habits, a shift in mindset, and a lifestyle grounded in sustainable practices, this pillar aims to install a legacy of responsibility that future generations will carry forward.

The teaching component of the CIRCULAR Living Lab is aimed at promoting an active participation of students in the process of education, at finding solutions

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and to promote green ecology programmes of the circular economy among stakeholders and the university community.

A general vision of this pillar promotes a change of mindset within promoting new ways of behaviour (eco-friendly habits), work style and lifestyle to all participants. This represents an individual level contribution addressing environment challenges and will be spread globally to face climate change issues daily. Via various training programmes a high priority will be given to the active engagement of the students. It will provide teachers and students with practical guidelines and educational strategies to understand and implement the Circular economy ideas in a variety of fields of education.
As part Education for Sustainable Development and Environment Sustainability pillar of the circular economy encompasses five key components:

- Association of clean and green students.
- Student engagement in circular awareness.
- Learning approach of circular economy.
- A dynamic model that can be adapted to the different needs of each country.
- A practical and participatory approach to the circular economy.

These five key components work together to create an inclusive and adaptable framework that empowers students, fosters sustainable practices, and promotes a circular economy mindset, ultimately contributing to global sustainability efforts among the university community.

As an example, the programme mentioned below not only promotes awareness but also empowers students with the knowledge and tools to take an active role in sustainable development. Two foundational elements—Clean and Green Student Association and Student Engagement in Circular Awareness—are designed to cultivate environmental responsibility and inspire a lifelong commitment to sustainability.

Through these components, students gain firsthand experience with circular economy practices, connecting theoretical learning with practical applications and acquiring values that contribute to a more sustainable future. Each element reinforces the goal of shaping informed, proactive individuals who can advocate

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for and implement Circular Economy principles within their communities and beyond.

1) Clean and Green Student Association

The student association places a high priority on engaging in activities that focus on teaching and learning about the circular economy. Through various initiatives and programmes as in the example below, they aim to educate and raise awareness among students about the principles and benefits of a circular economy.

By emphasising the importance of reducing waste, reusing resources, and recycling materials, the student association aims to foster a sustainable mindset and encourage responsible consumption and production practices.

Table 1 indicates the specific examples and suggestions for initiatives that could be implemented with this student association:

Table 1. Activity suggestions to be implemented by student organisations

	Example of ideas	Implementation
1.	Campus-wide Recycling Programmes	The student association could lead efforts to establish comprehensive recycling systems across campus. This could involve setting up clearly marked recycling bins, educating students about what materials can be recycled, and organizing campus-wide clean-up drives.
2.	Waste Reduction Campaigns	Students can engage in awareness campaigns aimed at reducing single-use plastics and promoting alternatives such as reusable containers and bags. The association could organise workshops and seminars to educate students on the environmental impact of plastic waste and the benefits of the Circular Economy.
3.	Upcycling and Repair Workshops	Hosting hands-on workshops where students can learn how to repair or repurpose items. These workshops could teach practical skills, such as sewing, basic electronics repair, or creative reuse, allowing students to directly participate in the circular economy by extending the life of products.

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4.	Circular Economy Competitions	The student association could organise innovation competitions focused on finding sustainable solutions for local waste management issues. Students could work in teams to develop prototypes or business plans that align with circular economy principles.
5.	Collaborations with Local Businesses for Resource Sharing	The association could collaborate with local businesses to establish programmes for sharing or exchanging resources, such as surplus food or office supplies. A "food rescue" initiative, for example, could help redirect surplus food from restaurants or supermarkets to community kitchens
6.	Sustainable Campus Gardens	Establishing a campus garden using organic waste from food and other materials could offer students practical experience in resource management and permaculture. The garden could also serve as a platform for educating students about the benefits of local, sustainable food production and its role in a circular economy.
7.	Green Certification Programmes	The student association could help create a "Green Certification" programme for departments, buildings, or student organisations on campus. This program could set sustainability criteria related to waste management, energy use, and overall environmental impact. Departments or groups that meet these criteria could be recognised with a certificate or award.
8.	Community Outreach and Education	Extending beyond the campus, the association could partner with local schools, community groups, or NGOs to host educational programs on circular economy principles. Initiatives could include hosting sustainability workshops for local youth, giving presentations on waste reduction, or organising community-wide clean-up and recycling events.

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By initiating and participating in these activities, the student association not only contributes to a more sustainable campus but also fosters a broader cultural shift toward circular economy practices. These efforts provide students with both the theoretical knowledge and practical tools needed to implement circular solutions, preparing them to be sustainability advocates in their professional and personal lives.

2) Student engagement in circular awareness

To prioritise student engagement in the circular economy, one key element is hands-on experiential learning. This involves providing students with opportunities to actively participate in and observe circular practices, such as through field trips to recycling centres or waste management facilities.

Experiential learning helps students connect theoretical knowledge with real-world applications, fosters critical thinking, and cultivates a deeper understanding and commitment to the principles of the circular economy. By prioritising experiential learning, students can develop practical skills, engage with professionals in the field, and become active participants in creating a more sustainable future.

The teaching component of the CIRCULAR Living Lab embodies a forward-thinking approach to education that aligns with global sustainability goals. By encouraging active student participation in the circular economy, this initiative empowers future generations to adopt eco-friendly practices and develop an environmentally conscious mindset. Through a blend of theoretical learning and practical engagement, the Education for Sustainable Development and Environment Sustainability pillar not only strengthens students' understanding of circular economy concepts but also equips them with tools to implement these principles in their personal lives and professional fields. Ultimately, this educational framework cultivates a collaborative, adaptable model that can be shared across diverse contexts, fostering global action toward addressing climate change and promoting sustainable development.

The partner universities play a critical role in the success of the CIRCULAR Living Labs by not only facilitating educational programmes but also actively engaging in initiatives that foster sustainability and promote circular economy principles. Their involvement goes beyond traditional teaching, and they serve as

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key enablers of learning, research, and community-based action. Universities can take on several key responsibilities to promote education for sustainable development within the scope of the CIRCULAR Living Labs:

1. Curriculum Integration and Development
2. Research and Innovation Hub
3. Community and Industry Partnerships
4. Workshops and Awareness Campaigns
5. Global Networks and Knowledge Sharing
6. Sustainability Recognition Programmes

By taking these proactive steps, partner universities play an integral role in fostering a culture of sustainability, ensuring that the CIRCULAR Living Labs serve as both educational platforms and catalysts for real-world change. These initiatives not only promote education for sustainable development but also create a pipeline of future leaders equipped with the knowledge, skills, and experience to drive the global transition to a circular economy.

2.3 Community Engagement

Community engagement in the CIRCULAR Living Labs framework is essential for ensuring that the innovations and solutions developed are deeply rooted in local needs and sustainable development goals. This engagement fosters a sense of ownership among community members, enhancing the relevance and applicability of research outcomes.

Beside the involvement of the citizens in the transition process to the Circular economy concept will demonstrate the process impact and lead to its constant implementation by the community. And the community can result in significant beneficial transformations, including the decrease of waste and the creation of fresh job opportunities through the establishment of local circular enterprises.

Therefore, to build a strategy of the work for this pillar we need insightful information about local community needs and their priority so the main concept of the CIRCULAR Living Lab in the region will be based on the interest of the local communities. After the clarification we can start to analyse the coming data and possible challenges during the work. There are several approaches on how to

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analyse the needs and interests of the local communities. In the example below by:

- Conducting a regular survey of community members' opinions and actions about the principle of the 3Rs.
- Organising community meetings to compile perceptions on the current environmental issues, waste management practices, and potential solutions.
- Conduct site visits to waste management facilities and recycling sites to understand better the current issues and infrastructure.
- Using various social media, both online and offline, facilitates local community members to share information about implementing the circular economy and other relevant activities.

Moreover, you can find additional suggestions which were made under the scope of WP2 CIRCULAR Living Labs work analyses.

In this workbook the aim of this pillar is to seek ways to actively engage the community and potential audience. Hence it emphasises the community's role in shaping the circular economy policy, the advantage of collaboration by encouraging individuals from different fields and backgrounds to work together for the comprehensive understanding of the CIRCULAR Economy and to raise their awareness about sustainable zero waste development.

There are many ways to raise communities' awareness, namely organising community workshops, seminars, and events. Community members can be motivated to act via constantly highlighting the importance of reducing, reusing, and recycling waste within the context of the circular economy.

3. Institutional Setup

The institutional setup of CIRCULAR Living Labs is designed to support their operation as dynamic environments where sustainable practices are developed and tested. This section outlines the organisational structure, facilities, and key partnerships that underpin the functionality and success of the labs.

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3.1 Organisational Structure

The organisational structure of CIRCULAR Living Labs is designed to ensure efficient management and operation across different universities in Southeast Asia. Each university hosts its Living Lab, tailored to leverage local expertise and resources while aligning with the overarching goals of the CIRCULAR project. Here, we detail the structure for a specific example at Universiti Malaysia Sarawak (UNIMAS) and outline general organisational principles that can be adapted to other institutions in Malaysia, Laos, and Cambodia.

Circular Living Labs in Southeast Asian Higher Education Institutions (HEIs) are innovative platforms where academic institutions collaborate with industries, communities, and governments to address pressing environmental challenges. These labs focus on applying circular economy principles, fostering sustainable practices, and experimenting with real-world solutions. From waste management and renewable energy to sustainable agriculture and green technologies, these labs serve as hubs for research, innovation, and capacity building. By involving students, faculty, and stakeholders, Circular Living Labs promote interdisciplinary learning, empower communities, and contribute to the region's sustainability goals while driving impactful change.

As an example to other universities, the first partner universities will carry out a series of impactful activities under their Circular Living Lab programmes, showcasing innovative approaches to sustainability education and community engagement. Universiti Sains Malaysia (USM) will focus on raising awareness among students on campus and in schools across Penang, employing problem-based learning, community-based participatory research, and co-curricular activities facilitated by Kampus Sejahtera and local NGOs. Universiti Malaysia Sarawak (UNIMAS) will conduct workshops and training sessions aimed at enhancing awareness and communication skills related to sustainable practices, fostering a deeper understanding of circular economy principles.

At the Royal University of Phnom Penh (RUPP), the Clean and Green Team will lead initiatives in solid waste management, campus cleanups, awareness campaigns, and student gatherings to inspire environmental stewardship. Svay Rieng University (SRU) will integrate circular economy concepts into their teaching modules and organise training programmes for students to promote

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sustainable practices. The National University of Laos (NUOL) will emphasise community participatory research and provide training, consultation, and educational sessions led by faculty and student volunteers. Lastly, Savannakhet University (SKU) will develop programmes focused on circular agriculture and environmental management, engaging students in practical, hands-on learning experiences.

These activities set a strong foundation for the Circular Living Labs, serving as a blueprint for other universities to replicate and adapt, fostering widespread adoption of circular economy practices across the region.

Table 2: CIRCULAR Living Labs

Partner	Location	Contact details	Activities
USM	School of Humanities, Universiti Sains Malaysia	Associate Prof. Dr. Asyirah Abdul Rahim Email: asyirah@usm.my	Awareness program, Problem Based Learning to university students, community based participatory research and co-curricular activities at partner schools.
UNIMAS	Faculty of Education, Language & Communication	Associate Prof. Dr. Zaimuariffudin Shukri Nordin Email: nzaim@unimas.my	Awareness program, Student association policy for Circular Economy, Co-curriculum activities. Case study workshops Research projects for Circular Economy
RUPP	MSc in Climate Change Program/Clean and Green Team	Prof. Dr. Seak Sophat Email: seak.sophat@rupp.edu.kh	Solid waste management, campus cleanup, awareness raising, student gathering
SRU	Faculty of Business Administration	Asst. Prof. Mom Ket Email: momket@mail.sru.edu.kh	Teaching and training
NUOL	Faculty of Environmental	Dr. Vattanamixay Chansomphou,	Provide education and

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	Sciences, Student Activity Room, Dong Dok Campus	Department of Environmental Sciences, Faculty of Environmental Sciences, Dong Dok Campus, Email: v.chansomphou@nuol.edu.la, mobile: 020 5858 0344	promote community participatory research, including training, research and consultation
SKU	Faculty of Agriculture and Environment	Mr. Chittakone Insixiengmai Email: lay_sku@yahoo.com	Teaching and training

Example: Universiti Malaysia Sarawak (UNIMAS)
Location: The Living Lab at UNIMAS is strategically placed within the Faculty of Social Sciences and Humanities and the Faculty of Education, Language, and Communication. This placement facilitates interdisciplinary collaboration and ensures that the lab benefits from a wide range of academic insights and pedagogical approaches.
Operational Teams:

1. Research and Development Team: Focuses on developing and implementing research projects that align with the principles of the circular economy. This team is multidisciplinary, including researchers from environmental science, engineering, sociology, and more.

2. Education and Outreach Team: Manages the integration of lab activities into university curricula and oversees community outreach programs. This team works closely with faculty to develop educational content and with community organisers to set up workshops and seminars.

3. Technical Support Team: Ensures that all lab facilities and equipment are maintained in optimal condition. This team also provides technical support to research projects and educational activities.

Adaptation for Other Universities
For universities in Laos, Cambodia, and other parts of Malaysia, the organisational structure can be adapted based on local needs, available resources, and specific sustainability challenges. Key considerations include:

1. Local Relevance: Ensure that the focus areas of each Living Lab align with the local environmental and societal challenges to maximise impact.

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2. Collaborative Frameworks: Establish partnerships with local industries and government agencies to enhance resource sharing and increase the practical impact of research and education programmes.
3. Community Integration: Design operational strategies that facilitate deep community involvement, turning residents into active participants in both defining and solving sustainability challenges.

This structured yet flexible organisational approach ensures that CIRCULAR Living Labs operate efficiently and effectively, fostering environments where academic knowledge meets practical application to address real-world challenges. Each lab, while unique in its specific setup and focus, shares the common goal of advancing sustainability through education, research, and community engagement.

3.2 Facilities and Infrastructure

The facilities and infrastructure of CIRCULAR Living Labs are strategically designed to support a broad spectrum of activities, encompassing research, education, and community engagement. Central to this infrastructure is the adaptability to local conditions and the incorporation of essential technologies like SimaPro, which plays a critical role in the research and educational components of the labs.
Requirements for Facilities:

1. Collaborative Workspaces: Essential for interdisciplinary collaboration, this space facilitates teamwork among researchers, students, and community members. The design should support various activities such as workshops, team meetings, and brainstorming sessions, without requiring sophisticated architectural elements.
2. Research Areas: Dedicated research spaces equipped with necessary laboratory equipment and computing facilities, including access to SimaPro software. This setup supports both individual and collaborative research efforts, allowing for comprehensive life cycle assessments and environmental impact studies.
3. Educational Facilities: Areas designed to accommodate educational activities, from traditional lectures to practical training sessions, should include technological setups that facilitate the use of SimaPro in the curriculum. This integration enhances the practical learning experience by allowing students to apply theoretical knowledge to real-world scenarios.
4. Community Engagement Zones: Open and accessible spaces that encourage community involvement in lab activities. These zones are designed to host community events, collaborative projects, and educational workshops, promoting active participation and inclusivity.

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5. Administrative Offices: Well-equipped offices to support the administrative functions of the labs, ensuring efficient planning, coordination, and management of daily operations.
6. Technical Support Areas: Spaces dedicated to technical support are crucial for the maintenance and operation of lab equipment, including the computers and systems running SimaPro. These areas ensure that technical staff are available to assist with software issues, equipment setups, and general troubleshooting.

To support the effective implementation of the CIRCULAR Living Lab initiatives, the following specific equipment will be purchased to facilitate research, education, and practical applications related to the circular economy:

- Incorporation of SimaPro:

SimaPro is a leading software for life cycle assessment (LCA) and environmental impact analysis, widely used by researchers and educators to evaluate the sustainability of products, processes, and systems. Within the Circular Living Labs, SimaPro will play a critical role in assessing the environmental impact of various circular economy initiatives, such as waste-to-resource systems, recycling models, and renewable energy solutions.

1. SimaPro Deployment: As a vital tool for teaching and research within the Living Labs, SimaPro software should be readily accessible across research and educational facilities. The labs should ensure that adequate licenses and training are available to maximise the software's utility.
2. Training and Support: Regular training sessions on SimaPro should be provided for all lab users to ensure proficiency in utilising the software for environmental impact assessments. Support staff should also be trained to assist users with technical issues related to SimaPro.

- Separate waste bins:

Separate waste bins are a convenient way to organise waste sorting, promoting an environmentally responsible lifestyle among students. They are typically divided into sections for different types of waste

1. Paper – for magazines, newspapers, and cardboard packaging.
2. Plastic – for bottles, containers, and product packaging.
3. Glass – for jars and bottles.
4. Metal – for aluminium cans.
5. Organic waste – for food scraps that can be composted.

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- Circular Economy flipchart

Circular Economy flipchart as a practical tool for visualising the principles of resource efficiency, waste reduction, and sustainable design. It can be used to map out the circular flow of materials, highlight the 3Rs (Reduce, Reuse, Recycle), and brainstorm solutions for transitioning from a linear to a circular system. With its interactive format, flipchart encourages collaborative discussions, making it ideal for workshops, educational sessions, or strategic planning meetings focused on sustainability.

This framework ensures that each CIRCULAR Living Lab can tailor its setup to meet specific operational needs and local conditions, fostering environments that are conducive to innovation, learning, and community engagement while fully leveraging the capabilities of SimaPro software.

3.3 Partners and Stakeholders

Engaging a diverse array of partners and stakeholders is fundamental to the success of CIRCULAR Living Labs. By involving various groups from the outset, Living Labs ensures that the innovations they foster are well-rounded, practical, and aligned with the needs of all parties involved. This section outlines the key strategies for effective stakeholder engagement:

1. Identification and Inclusion

Stakeholder engagement plays a pivotal role in the success of CIRCULAR Living Labs, ensuring their initiatives are collaborative, innovative, and impactful. While a general framework for stakeholder engagement is crucial, this project has already taken significant strides in this area through the stakeholder consultations carried out during WP2. These consultations laid the foundation for identifying, involving, and integrating stakeholders into the project, providing valuable insights into their needs and expectations.

The mapping process during WP2 involved identifying key stakeholders such as academics, industry professionals, government representatives, local communities, and end users. Stakeholder consultations were conducted through targeted interviews, and surveys, ensuring that a wide range of voices were heard. This process allowed for the establishment of a strong collaborative framework tailored to the unique contexts of each partner university and their local communities.

In specific cases, participatory design sessions were organised, enabling stakeholders to actively shape the lab's objectives and operational strategies. For example, community members were involved in defining local circular economy

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challenges, while industry representatives provided expertise on practical solutions. These efforts were supported by regular updates and feedback sessions, creating open communication channels that fostered trust and collaboration.

The stakeholder engagement strategies implemented during WP2 not only enhanced the inclusivity of the project but also ensured that the solutions developed were relevant, practical, and widely accepted. Building on this foundation, the CIRCULAR Living Labs will continue to refine their engagement approaches, incorporating stakeholder feedback into ongoing initiatives and maintaining long-term partnerships that support sustainability and innovation. This iterative process underscores the project's commitment to collaboration and its role as a dynamic platform for advancing circular economy practices.

Table 3 Areas of stakeholder engagement

Action Area	Key Actions	Activities
Mapping Stakeholders	- Identify key stakeholders: academics, industry professionals, government, communities, and end users.	- Conducted targeted consultations (workshops, interviews, surveys) to gather stakeholder insights.
	- Define stakeholder roles and contributions.	- Used feedback to identify local circular economy challenges and prioritise engagement strategies.
Inclusion Strategies	- Include stakeholders from planning to implementation phases.	- Involved stakeholders in defining lab objectives and operational strategies.
	- Organise participatory design sessions and advisory boards.	- Facilitated workshops where stakeholders shaped specific lab activities.
	- Schedule regular stakeholder meetings to maintain collaboration.	- Established trust and commitment through open dialogue and iterative feedback.
Communication and Collaboration	- Create open communication channels via platforms, workshops, and regular updates.	- Provided consistent updates to stakeholders during WP2 consultations, ensuring engagement.

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	- Develop frameworks encouraging joint decision-making and resource sharing.	- Established collaborative frameworks tailored to each university and community.
Participatory Design and Development	- Host co-creation workshops to integrate diverse perspectives.	- Facilitated participatory sessions where stakeholders contributed directly to project design.
	- Actively involve stakeholders in decision-making during design and implementation phases.	- Incorporated stakeholder feedback into defining project priorities and solutions.
	- Regularly refine solutions based on stakeholder input.	- Iterative refinement of objectives and strategies based on WP2 insights.
Building Long-Term Relationships	- Develop long-term engagement strategies, including incentives and recognition of contributions.	- Created mechanisms for ongoing stakeholder involvement and addressed specific needs identified in WP2.
	- Celebrate successes to strengthen partnerships.	- Highlighted achievements during consultations to build stakeholder confidence and trust.
	- Monitor and evaluate engagement strategies for continuous improvement.	- Used feedback mechanisms in WP2 to inform adjustments to future engagement processes.

By systematically engaging with partners and stakeholders through these strategies, CIRCULAR Living Labs can ensure that their initiatives are robust, relevant, and supported by a broad spectrum of societal actors. This collaborative approach not only fosters innovation but also enhances the acceptance and sustainability of the solutions developed within the Living Labs.

4. CIRCULAR in Teaching and Learning

CIRCULAR Living Labs places a strong emphasis on integrating the principles of the Circular Economy to both formal and informal educational frameworks. By doing so, they aim to advance sustainability literacy and provide practical skills that students and community members can apply to real-world environmental challenges.

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4.1 Formal Curriculum

The formal curriculum in CIRCULAR Living Labs is carefully designed to embed Circular Economy (CE) elements across various academic disciplines, providing a comprehensive education that equips students with both theoretical knowledge and practical applications.

1. Curriculum Integration:

- Coursework: Courses specifically developed to include Circular Economy (CE) concepts are integrated across faculties such as engineering, business, environmental science, and social sciences. These courses are structured to offer a balanced view that encompasses both the challenges and potential solutions within the circular economy, encouraging students to think critically and innovatively.

- Interdisciplinary Modules: These modules are crafted to intersect insights from different disciplines, providing students with a holistic understanding of how various aspects of the circular economy interact and can be applied to solve complex sustainability issues.

2. Highlighted Courses:

- Environmental Economics: Focuses on economic policies and strategies that support sustainable development.

- Sustainable Design: Teaches principles of designing products and systems with minimal environmental impact.
- Waste Management and Resource Recovery: Explores techniques and strategies for reducing waste and recovering resources in industrial and municipal contexts.

4.2 Informal Curriculum

The informal curriculum at CIRCULAR Living Labs facilitates experiential learning through various projects and initiatives that directly involve the community and local industry in sustainability efforts.

1. Workshops and Seminars:

- Skill-Building Workshops: Target specific skills related to Circular Economy, such as sustainable design principles, waste management techniques, and the use of SimaPro for lifecycle assessments. These workshops are practical and designed to enhance the capabilities of participants, preparing them for impactful roles in sustainability.

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- Guest Lectures and Seminars: Feature experts from academia, industry, and government who share insights on the latest trends and innovations in sustainability. These sessions not only provide learning opportunities but also facilitate networking and foster collaborations.

2. Experiential Learning and Fieldwork:
- Project-Based Learning: Engages students in real-world projects that challenge them to apply their classroom learning to develop viable solutions to environmental issues. Examples include designing sustainable products or improving recycling systems within the community.

- Field Trips: Organise field trips to local industries, waste management facilities, and eco-friendly organisations to observe and learn from real-world applications of circular economy principles.

3. Capstone Projects and Internships:
- Capstone Projects: Encourage students to undertake comprehensive capstone projects that require them to develop and implement solutions to real challenges. These projects are often done in collaboration with local businesses or community organisations.

- Internship Programmes: Establish partnerships with companies and NGOs to offer internships focused on sustainability, providing students with professional experience and industry exposure.

4. Community Education and Outreach:
- Public Workshops: Offer workshops and courses to community members on sustainable practices such as home composting, recycling, and energy conservation. These initiatives aim to extend the impact of the Living Labs beyond the academic community.

- Youth Programmes: Implement programmes aimed at engaging school children and youth in sustainability education, fostering early awareness and involvement in environmental stewardship

Educational programmes at CIRCULAR Living Labs are designed to significantly improve sustainability literacy, ensuring that both students and the wider community understand and can engage with critical sustainability issues and circular economy principles. By providing a comprehensive educational initiative, the lab aims to equip participants with the skills needed to innovate and lead in the field of sustainability.

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This preparation sets the foundation for an impactful career and active civic participation. Additionally, the programme goes beyond academic settings to empower community members, allowing them to take an active role in fostering a sustainable future for their environment. Through such outreach, Living Labs not only educate but also mobilise community resources and energy towards building a more sustainable world. This holistic approach ensures that the benefits of the lab's educational efforts will result in meaningful and lasting change.

5. CIRCULAR in Research

CIRCULAR Living Labs prioritise Research and Development (R&D) as a core element of their mission to drive innovation and develop sustainable solutions for environmental challenges. The labs serve as a nexus for scientific inquiry, practical application, and collaborative exploration within the framework of the circular economy.

Core Aspects of Research and Development:

1. Interdisciplinary Research:
   - The Living Labs champion interdisciplinary research by integrating expertise from environmental science, engineering, economics, and social sciences. This diverse input allows for a holistic examination of sustainability challenges, enhancing the development of robust and comprehensive solutions that are both innovative and practical.

   - Community-Based Research: Incorporating community insights and needs into research projects ensures that the outcomes are directly applicable and beneficial to local stakeholders. This approach also fosters a stronger connection between the labs and the community, promoting mutual learning and engagement.

2. Innovation Projects:
   - Focused on creating new technologies, systems, and methods, innovation projects within the labs tackle key areas like resource efficiency, waste management, and the integration of renewable energy solutions. These projects are designed to advance the practical applications of circular economy principles, leading to tangible environmental improvements.

   - Service Learning: Projects often include service-learning components, where students and researchers apply their skills to real-world

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problems, gaining hands-on experience while contributing to community development.

3. Partnerships and Collaborations:
   - Strong partnerships with industry leaders, government bodies, and other educational institutions are vital for expanding the reach and impact of the labs' research. These collaborations provide essential resources, such as advanced technologies, funding, and unique expertise, facilitating more extensive and impactful research projects.

   - Action Research: Engaging with partners in iterative processes of action research allows for continuous refinement of technologies and methodologies, ensuring that innovations are well-suited to market needs and sustainability goals.

4. Grant and Funding Opportunities:
   The pursuit of grants and other funding opportunities is critical for supporting ambitious research initiatives. Securing financial backing enables the labs to undertake significant projects that have the potential not only to advance scientific understanding but also to achieve commercial viability.

Planning for Research:

- Identifying Research Problems: The process begins with identifying pertinent environmental and sustainability challenges that align with the goals of the circular economy.
- Setting Research Objectives: Clearly defined objectives guide the research, focusing on creating measurable impacts in terms of resource sustainability, economic viability, and social equity.
- Developing Methodologies: Methodologies are designed to be rigorous yet adaptable, capable of addressing the dynamic aspects of environmental challenges while incorporating stakeholder feedback and evolving based on project findings.

Social Innovation Focus:

- Social innovation is embedded in all research activities, with a strong emphasis on developing solutions that not only address technical issues but also foster social change and community empowerment. This dual focus ensures that the innovations developed are sustainable and have the potential for broad societal acceptance and impact.

The research initiatives at CIRCULAR Living Labs are designed to not just contribute to the academic field but also make a real-world impact, embodying the principles of the circular economy in ways that improve environmental

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outcomes, enhance community well-being, and drive sustainable economic growth.

6. Risk Management and Compliance

6.1 Risk Assessment

Identification of potential risks related to the labs' activities, including: interest of local communities and their engagement.

Purpose: The goal of risk assessment is to proactively identify potential risks that could hinder the success or integrity of CIRCULAR Living Labs' activities and objectives.

a. Conflict between members of the consortium.
b. Lack of interest from stakeholders and/or low number of beneficiaries, operational, and financial risks.
c. Specific barriers to the participation in CIRCULAR of women and/or students/citizens with a diverse background or facing fewer opportunities.
d. Project implementation delay.
e. Difficulties in engaging citizens in research /science due to insufficient knowledge of research processes.

6.2 Mitigation Strategies

Mitigation strategies provide a roadmap for managing and minimising the impact of identified risks, ensuring that CIRCULAR can adapt and respond effectively to challenges.

a. Continuous Monitoring and Feedback: Implement a system for ongoing risk monitoring and stakeholder feedback. This may include regular risk assessment updates, incident reporting, and review meetings, allowing for timely adjustments to risk management strategies.
b. Awareness and Communication: Create targeted outreach campaigns to highlight the benefits of circular economy practices. Emphasise the relevance of CIRCULAR initiatives for SEA HEIs and local communities through engaging workshops, presentations, and multimedia content.
c. Provide incentives, such as professional development opportunities, certifications, or co-authorship on research publications, to encourage participation among academic staff and researchers.
d. Design tailored initiatives that actively engage women and underrepresented groups, such as mentorship programs, leadership workshops, or funding for disadvantaged participants.
e. Use accessible language and real-world examples to explain research processes and benefits. Organise interactive sessions, such as citizen

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6.3 Compliance

Overview of regulations and standards to ensure compliance with local and international laws.
Purpose: Compliance ensures that all CIRCULAR Living Lab activities adhere to local and international regulations, thereby avoiding legal, financial, and reputational consequences.

- Local Regulations: Compliance with national and local laws, including health and safety standards, environmental protection policies, and waste disposal regulations in the countries where the labs operate (such as Malaysia, Cambodia, and Laos). Staying updated on local policies is essential for maintaining credibility and public trust.
- International Standards: Adherence to globally recognised frameworks and standards where applicable. Compliance with international standards can help CIRCULAR align with best practices, particularly when seeking collaborations with international stakeholders.
- Ethical Guidelines: Ensuring that all research and community engagement activities respect compliance with the CIRCULAR Diversity & Inclusion principles and Gender Equality principles.

7.Communications and Dissemination

The CIRCULAR Living Labs are at the heart of our commitment to advancing the principles of a circular economy through practical, community-driven solutions. By serving as dynamic hubs of innovation, these labs bridge research, education, and local engagement, fostering sustainable practices that create real-world impact. A well-structured communication and dissemination strategy is crucial to ensuring that the labs' mission, activities, and achievements resonate with diverse stakeholders—from policymakers and academics to businesses and local communities.

This strategy emphasises accessibility, engagement, and impact, offering a focused approach that aligns with the project's resources and scope. By leveraging digital platforms, social media, and interactive events, we aim to share the transformative work of the Living Labs and inspire adoption of circular economy practices. The following plan outlines actionable steps to achieve these goals while maintaining a realistic balance between ambition and feasibility.

The communication and dissemination strategies of CIRCULAR Living Labs are designed to effectively convey the mission, activities, and outcomes of the labs, promoting understanding and adoption of circular economy principles across diverse audiences. This section outlines the lab's approach to communicating its

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core identity, engaging through various platforms, and leveraging social media to maximise outreach.

1. Defining and Presenting the Living Labs

Introduction Campaign:
To familiarise stakeholders with the Living Labs, launch a dedicated introduction campaign on LinkedIn and Facebook. Each lab will be spotlighted through posts featuring engaging descriptions, photos, and a summary of its core focus and activities. This will establish the labs as key players in the project and spark curiosity among a broad audience.

Website Integration:
A dedicated section on the project's website will serve as a permanent home for Living Lab information. This section will include detailed descriptions of each lab, regular updates, and contact points for stakeholders interested in collaboration or learning more.

2. Sharing Living Lab Activities

News Updates:
Publish timely updates on Living Lab activities, such as events, workshops, and achievements, on the website's virtual hub and social media platforms. Each update will focus on outcomes and practical impacts, keeping followers informed and engaged.

Photo and Video Documentation:
Partner organisations will document their labs' activities with photos and short videos. This content will be shared on the project's online platforms and highlighted at major events like the final conference. The goal is to visually showcase the labs' efforts, making their work relatable and tangible.

3. Simplified Educational Content

Recognising resource constraints, we propose scaling down ambitious content production to focus on:
Short Educational Articles:
Publish accessible blog posts or articles explaining core circular economy concepts, tailored for a non-specialist audience.
Research Snapshots:
Highlight key findings from lab research in simple, visually appealing formats, such as infographics or concise summaries, for sharing online.

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4. Engaging Events and Online Content

Online Sessions:
Organise occasional webinars, live Q&A sessions, or panel discussions featuring Living Lab experts. These sessions can be recorded and uploaded to the project's YouTube channel, extending their reach beyond live audiences.
Final Conference Showcase:
During the project's final conference, present a comprehensive showcase of Living Lab achievements, supported by curated photo and video highlights. This event will serve as a platform to demonstrate the labs' collective impact and inspire future collaborations.

5. Focus on Manageable Platforms

Social media:
Use Facebook and LinkedIn for consistent outreach. Share updates, photos, and stories in a way that sparks interaction and demonstrates the labs' relevance to everyday life.
Website as Hub:
The project website will act as the central information repository, ensuring all stakeholders have access to up-to-date information about the labs and their contributions.

6. Key Messages and Tone

Keep messages clear, relatable, and aligned with the project's mission of advancing a circular economy.
Use impact-driven narratives to illustrate how the labs contribute to sustainable solutions and inspire action.

Table 4 Introduction Campaign

Communication and Dissemination Strategy	Proposed Actions	Rationale and Scope
Social Media Campaign	- Introduce each Living Lab with descriptions and photos on Facebook and LinkedIn.	Ensure visibility and awareness among diverse audiences through targeted social media platforms.
	- Share updates on Living Lab activities and events	Promote engagement and real-time interaction with the wider community.

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	via project social media and website.	
Virtual Hub on Project Website	- Create a dedicated section for Living Labs with detailed descriptions, news, and updates.	Provide a centralised repository for accessing information about the labs and their activities.
	- Publish results of research and Living Lab activities, making them accessible to a broader audience.	Showcase the outcomes and impact of Living Labs to foster credibility and inspire participation.
Documentation and Dissemination	- Partners to document Living Lab activities with photos and videos.	Capture real-world implementation and highlight progress through visual storytelling.
	- Disseminate visual materials on the project's online platforms and during the final conference.	Ensure comprehensive reach and emphasise success stories and practical implementations.
Simplified Approach to Media Content	- Record selected online sessions or activities and upload videos to the project's YouTube channel.	Balance ambitions with feasibility while maintaining a resource for deeper engagement.
	- Focus on creating high-impact but manageable content, such as concise tutorials or snapshots of key activities.	Ensure resources are used efficiently while achieving meaningful communication outcomes.

This streamlined communication and dissemination strategy balances ambition with feasibility by leveraging existing resources and focusing on impactful, manageable actions. By concentrating on social media campaigns, centralised online resources, and carefully curated content, CIRCULAR Living Labs can effectively engage stakeholders and promote the principles of the circular economy.

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8.Monitoring and Evaluation

Effective monitoring and evaluation are crucial for assessing the impact of CIRCULAR Living Labs and for continuously improving their initiatives. This section outlines the framework and indicators used for monitoring and evaluation, as well as the feedback mechanisms implemented to gather insights from various stakeholders.

8.1 Framework and Indicators

The Monitoring & Evaluation Framework for CIRCULAR Living Labs is designed to capture both qualitative and quantitative data that reflect the labs' effectiveness in advancing the circular economy and achieving sustainable outcomes.
Performance Indicators:

- Number of thematic groups formed (≥6);
- Number of students from SEA HEIs (≥90) and in EU HEIs (≥10) involved in CIRCULAR Living Labs;
- Number of EU academics and researchers involved in CIRCULAR Living Labs (≥8);
- Number of actions and collaborative projects organised (≥12);
- Number of citizens and/or representatives from local communities reached (≥60) Longitudinal Studies

Longitudinal studies will be conducted to measure the long-term impact of the labs on students' careers, community sustainability practices, and local economic development.

By focusing on these areas, CIRCULAR aims to create lasting impact, foster engagement across communities, and ensure the ongoing relevance of its project outcomes.

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8.2 Feedback Mechanisms

Gathering feedback is important to measure the success of initiatives and to identify areas for improvement. CIRCULAR Living Labs uses several mechanisms to collect feedback from various stakeholders:

- Surveys: Conduct regular surveys with students, academics, and community members to assess their satisfaction and the perceived impact of the labs' activities. Surveys can be distributed after courses, workshops, or community events to gather immediate and specific insights.

- Visitor Feedback: Provide feedback forms (online or paper) at the labs for visitors to share their observations and suggestions. This feedback is particularly valuable for improving the labs' public engagement strategies and exhibits.

- Online Feedback Platforms: Utilise online platforms where stakeholders can continuously provide feedback. These platforms should be accessible from the labs' website and social media channels, encouraging ongoing interaction and engagement.

Implementing a robust monitoring framework with effective feedback mechanisms ensures that CIRCULAR Living Labs remain responsive to the needs of their stakeholders and can make informed decisions that drive continuous improvement and greater impact in their mission to promote sustainability and circular economy principles.

9. Conclusion

The Circular Living Lab Handbook serves as a comprehensive guide for implementing and sustaining innovative circular economy practices within academic institutions and their surrounding communities. It underscores the importance of integrating cutting-edge technologies, participatory methods, and adaptable models to address pressing environmental challenges.

By fostering collaboration among universities, industries, governments, and local stakeholders, the Living Labs aim to create dynamic spaces for education, research, and practical applications that drive sustainability forward. Through initiatives like Citizen Science, hands-on student engagement, and life cycle assessment tools such as SimaPro, the framework empowers individuals and organisations to actively contribute to a circular economy.

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Looking ahead, the Circular Living Labs aspire to become global exemplars, catalysing systemic change and inspiring widespread adoption of circular practices. By bridging theory with action and local solutions with global goals, this initiative is a vital step toward achieving sustainability, mitigating climate change, and fostering a resilient, resource-efficient future.

This handbook is not merely a blueprint—it is an invitation to innovate, collaborate, and lead the transition toward a circular and sustainable world.

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