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Operational Guidelines for Living Labs set-up

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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 in order to collaboratively design and test innovative solutions to mitigate waste management problems, promote circular economy approaches and improve the quality of life of local communities.

It will pursue the following specific objectives:

- Design a new collaborative model for reinforcing HEIs' third mission and for enhancing effective and successful Knowledge Square cooperation for social innovation with a specific focus on the topic of circular economy.

- Enhance community-based participatory research and citizen science at the same time promoting a new pedagogical framework for embedding community engagement actions as part of Higher Education study programmes.

- Set-up Living Labs as open innovation ecosystems that integrate education, research, development and innovation, and regional development to help trigger the adoption of green and more sustainable practices and a 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 solving 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, climate-conscious and active citizens and raise the awareness of students, young people and members of local communities on the topic of circular economy and sustainable development and promote alternative consumption habits and waste management practices underpinned by knowledge, research and innovation generated by Higher Education Institutions.

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The CIRCULAR Consortium brings together nine multidisciplinary institutions from Malaysia, Cambodia, Laos, Spain and Portugal as follows.

#	Role	Short name	Legal name	Country
1	COO	USM	Universiti Sains Malaysia	Malaysia
2	BEN	UNIMAS	Universiti Malaysia Sarawak	Malaysia
3	BEN	RUPP	Royal University of Phnom Penh	Cambodia
4	BEN	SRU	Svay Rieng University	Cambodia
5	BEN	NUOL	National University Laos	Laos
6	BEN	SKU	Savannakhet University	Laos
7	BEN	UAL	Universidad de Almeria	Spain
8	BEN	IPC	Instituto Politecnico de Coimbra	Portugal
9	BEN	INCOMA	International Consulting and Mobility Agency Sociedad de Responsabilidad Limitada	Spain

1.1 Purpose of the guidelines

This handbook is to describe the CIRCULAR model and proposed approach which will provide a framework for all partners to appropriately adapt for implementing WP3 and WP4. This CIRCULAR handbook was developed based on the results of two collaborative workshops by all the consortium partners.

The document has two main goals as follows:

1. Sets out the guiding principles and provide a common ground for reinforcing the links between the Knowledge Square (Teaching, Research, Innovation and Society), for boosting social innovation in circular economy, for enhancing community-based participatory research and citizen science, and for promoting a new pedagogical framework for embedding practical projects, experiential learning activities and community engagement actions as part of curricula.

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2. Provides a framework that will serve as the groundwork for WP3 (Design capacity building for social innovation) and W4 (Set up living labs).

The living lab consists of three main components: research, teaching and learning, and community participation, which are described in detail in the following sections 2.3.

1.2 Target audience

This handbook is recommended for project partners, social development workers, educators, students, and environment specialists. This document consists of the philosophy, purpose, and recommended strategies to run Living Lab.

2. Model of the Circular economy

Living lab project is a real time platform for citizen's research and implementation of its theoretical findings among the community. Which will be as a replacement of the existing one with innovative, non- traditional solutions to generate new ideas and directions. In order to achieve the purpose of the work, Living labs will be represented as a catalyst for the development of synergies between Teaching, Research, Innovation and Society by building a platform for the dialogue and cooperation among local stakeholders in Malaysia, Cambodia and Laos.

CIRCULAR Living Lab will involve multi-stakeholder participants from the whole axis of the Knowledge square and life experience, thus participation of students, civil society groups, citizens and all their diversities are highly welcomed, and has benefits for each of the participants.

Therefore, in contrast to the traditional research lab, a living lab envisions a work by the community for the community that will be described in the following section.

2.1 Living Lab vs Research Lab

A research lab is connected to theoretical research in a more fixed environment such as a laboratory work with collaboration of researchers unlike the community-oriented living labs. Besides, compared with Living labs a Research lab is a facility provided for the research in a particular field of study. Research is conducted with researchers in that field with constant observation. It narrows down the scientific research field for the researchers, with orientation on a particular topic or generation of new non-existing development in place of existing frameworks. It is mostly funded under various scientific grants.

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As for living labs, the lab is the practical implementation and application of the existing work with the community for the community. It focuses on studying the integration process into real life and aims for a more sustainable integration of circular policy practices into the learning process and involvement of the community for the lab's activities. Hence, the living lab covers several ranges of fields, sectors and innovation processes that request involvement of people as a member to assist obtaining knowledge and maintain the sustainability of the work in their community.

Table 1.1 Living Lab vs Research Lab

Aspect	Living Lab	Research Lab
Purpose	Focuses on real-world testing and experimentation	Concentrates on theoretical and/or experimental research
Setting	Typically situated in real-world environments	Often located within academic or institutional settings
Stakeholders	Involves diverse stakeholders such as users, businesses, and communities	Typically involves researchers, graduate students, and academic staff
Methodology	Utilises participatory approaches and co-creation methods	Relies on controlled experiments and systematic methodologies
Flexibility	Emphasises adaptability and responsiveness to real-world conditions	Often follows structured protocols and research methodologies
Application Area	Often used for testing new technologies, products, or services in real-world contexts	Used for conducting fundamental or applied research in various fields
Outcome	Aims to produce innovative solutions and insights tailored to real-world needs	Seeks to generate new knowledge, theories, or applications in a specific field
Duration	Projects may vary in duration, depending on the scope and objectives	Research projects may range from short-term studies to long-term investigations

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Collaboration	Encourages collaboration between researchers, educators, industry partners and end-users	Primarily involves collaboration between researchers and possibly industry partners

2.2 Vision of the CIRCULAR Living Lab

The world population is continuously growing. The linear economic policy alone won't be reliable in the coming decades without a Circular economy policy, since natural resources are limited to provide all population needs, the trajectory of the economy should be changed. Therefore, a Circular economy Living Lab is a practical trampling to build a trajectory for a new direction towards sustainable development. Implementing sustainable solutions for the circular economy will be based on real time problems solving projects. Living Lab will provide facilities to monitor the work throughout this duration, and work as a collaboration platform with local communities, potential learners, and stakeholders.

Living labs in SEA countries play a crucial role in addressing various needs of society on the way to sustainable development. The 3rd mission of the universities represents their economic and social mission and responsibility and its contribution for communities and territories. A living lab's goal covers education through teaching students about sustainability policy and handling facilitation through practice, promotion, and dissemination. A living lab is 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. They serve as dynamic hubs for experimentation, learning, and innovation, driving the transition towards a circular economy.

The vision of living labs is based on the provision of the new solutions, proposing trajectories, promoting new and innovative ways and approaches, fostering debates for best solutions, and collectively practising and analysing the sustainability of new models.

3. Three Pillars of CIRCULAR Living Lab

Citizen Science, Education for Sustainable Development, and Community Engagement and active citizenship are the main components of the CIRCULAR Living Lab which are deeply interconnected within the living lab framework, forming a dynamic ecosystem where co-creation, experimentation, and learning occur interactively to drive innovation and positive social impact (refer Diagram 1.3)

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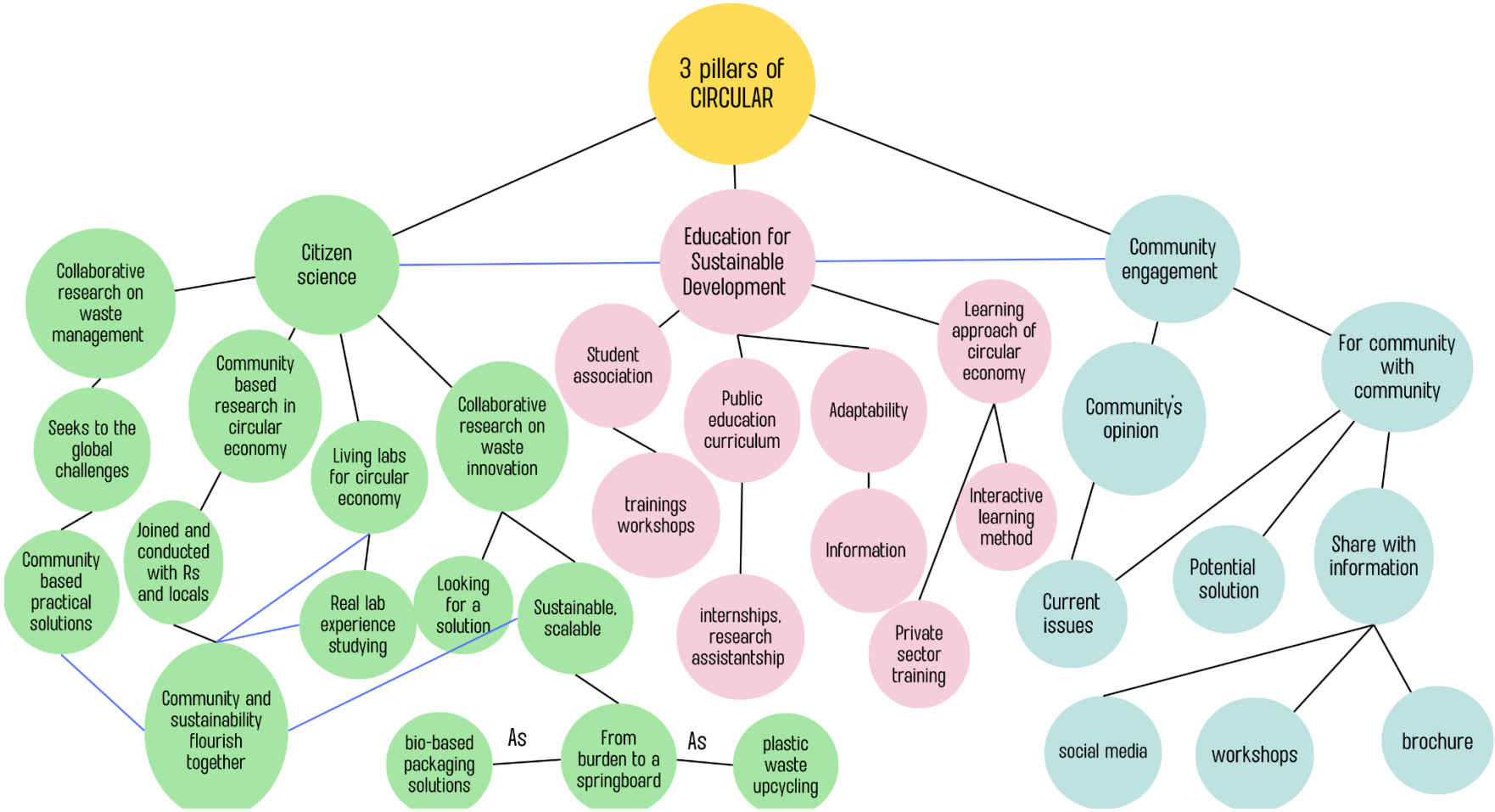
Diagram 1.3: Pillars of the CIRCULAR Living lab (according to the conclusion of partner universities meeting)



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3.1 Citizen science

Key step for the success on the research level is to rethink the design of the current community routine to maximise efficiency and minimise the waste to educate and to raise awareness among the communities.

This pillar of the Living lab is a theoretical part and one of the crucial aspects that underpins the development, implementation, and evaluation of innovative solutions within real-world environments.

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 general public with different backgrounds. By integrating knowledge and insights from industry, government, and researchers that create innovative solutions such as bio-based materials, recycling models, and solar energy can be created. 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.

Table 3.1, Summary of elements and activities for citizen science component

#	Stakeholders	Elements
1.	Communities Government agencies University staff and students	Collaborative waste management research To develop bio-based materials from food waste, plastics in place of traditional resource-intensive materials. To construct intelligent waste collection technology to optimise routes and enhance operational efficiency for the recycling process. To explore new recycling technologies such as chemical recycling or pyrolysis to tackle complex waste streams. To test the effectiveness of deposit-refund schemes for reduction of plastic pollution. To establish recycling facilities to promote local employment opportunities and enhance initiatives for a circular economy.
2.	Researchers from academia Communities Government agencies	Community based participatory research in circular economy. The implementation of upcycling practices is examined by both rural and urban communities. Collaborative design approaches for circular business models.

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3.	Researchers from academia Communities Government agencies University staff and students	Living laboratory for circular economy as: • Mondragon Unibertsitatea Campus Circular y Sostenible (mUCS), Spain. • The Fab Lab Barcelona, Spain. • Social Cooperative Palm Work & Project Onlus, Italy. • Karlsruhe Transformation Center for Sustainability and Cultural Change (KAT) establishment project, Germany. • Waste Management Project of Faculty of Environmental Sciences, National University of Laos, Lao PDR. • The Seoul Circular City Living Lab, Korea. • The Bioeconomy Village, Turku, Finland
4.	Researchers from academia Industries Communities	Collaborative research on waste innovation to promote circular economy as: • Collaborative research on plastic waste upcycling • Collaborative research on bio-based packaging solutions

Furthermore, the concept of living laboratories serves as hubs for research, innovation, and collaboration in advancing circular economy principles. Overall, the goal is to reduce resource-intensive materials, improve operational efficiency, tackle complex waste streams, and promote local employment while fostering collaboration among stakeholders to transition towards a zero-waste circular economy.

Table 3.2, Universal suggestion of organisation strategy for circular economy research pillar

Aspect	Description
Understanding	Educate stakeholders about circular economy principles and benefits.
Research and Analysis	Conduct analysis to identify local opportunities for circularity.
Stakeholder Engagement	Engage with stakeholders to understand issues and create a support strategy.
Design for Circularity	Redesign products and processes according to the Circularity concept

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Supply Chain Optimization	Optimise supply chains by less waste concept priority
Waste Management	Implement waste reduction and recycling programs.
Technology Adoption	To use technology for resource tracking, recycling, and data analytics.
Policy and Regulation	Advocate and promote supportive policies and regulations of CIRCULARITY
Monitoring and Evaluation	Establish measures for tracking progress and evaluating effectiveness.
Education and Awareness	Conduct training programs, campaigns, workshops, and online internships for awareness.

3.2 Education for Sustainable Development

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 and at promoting green ecology programs of the Circular economy among stakeholders.

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 changing issues on a daily basis.

Via various training programs 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 for understanding and implementing Circular economy ideas in a variety of fields of education.
There are five components in Education for Sustainable Development and Environment Sustainability pillar in the circular economy namely:

- 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 that can adapt to each country.
- A practical and participatory approach to the circular economy.

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Below in the Table 3.3 information with explanation and summary of elements, information of stakeholders for teaching and learning components.

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 programs, 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.

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.

Table 3.3, Summary of elements, activities and stakeholders for the teaching and learning component:

#	Perspective	Suggestions	Stakeholders
1)	Clean and Green Student associations	● Organise interactive sessions where experts and practitioners can share their knowledge and experiences regarding the circular economy. ● Assign case studies or group projects that require students to analyse and propose solutions based on circular economy principles. ● Organise visits to businesses or organisations that have successfully implemented circular economy practices. ● Collaborate with other student associations or organisations that share similar goals.	Students, CE experts, Businesses or organisations, Other student associations
2)	Student engagement in circular awareness	● Prioritise the integration of circular economy concepts and principles into the school curriculum. ● Providing students with hands-on learning experiences related to the circular economy.	Lecturers, Students, Educational institutions,

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		• Fostering partnerships between educational institutions and local businesses that embrace circular practices. • Organise competitions focused on the circular economy.	Local businesses
3)	Learning approach of circular economy	• Providing formal and informal education programs, workshops, and training sessions to equip individuals, businesses, and communities with the knowledge and skills needed to contain circular economy principles. • Promoting collaboration among stakeholders, including businesses, governments, academia, and civil society, to share experiences, insights, and lessons learned. • Building the capacity of individuals, businesses, and institutions to implement circular practices through skill development, access to resources and support networks	Individuals, Businesses, Communities, Governments, Academia, Civil society
4)	Dynamic model that can be adapted to the different need that can vary in each country	• Promoting the efficient use of resources through measures such as eco-design, product life extension, and resource recovery. • Encouraging the development of circular supply chains by promoting the use of renewable materials, reducing waste in production processes, and facilitating the reuse and recycling of products. • Fostering collaboration between governments, businesses, academia, and civil society to develop and implement circular economy strategies tailored to each country's specific needs. • Raising awareness and providing education about the principles and benefits of the circular economy to encourage behavioural changes and promote sustainable consumption patterns	Governments, Businesses, Academia, Civil society
5)	A practical and participatory approach to the circular economy	• Facilitating dialogue and collaboration among businesses, governments, communities, and consumers to collectively identify challenges, set goals, and develop strategies for implementing circular economy practices. • Implementing small-scale pilot projects to test and demonstrate the feasibility and effectiveness of circular economy practices in specific sectors or communities,	Business, government, Communities, Consumers

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		these projects can serve as learning experiences and inspire broader adoption. ● Engaging local communities through initiatives such as community-based recycling programs, repair cafes, or sharing platforms to encourage resource sharing and reduce waste generation.	

3) Learning approach of circular economy

The learning approach of the circular economy emphasises the importance of continuous learning, knowledge sharing, and capacity building to drive the transition towards a more sustainable economic model. It recognizes that education and awareness are key drivers in fostering understanding, engagement, and action towards circular practices.

4) A Dynamic model that can be adapted to the different needs that can vary in each country.

The dynamic model of the circular economy is a useful framework that can be fitted to meet the unique requirements of each country. It recognizes that the needs and circumstances may differ from one nation to another, allowing for customization and adaptation. This model promotes sustainable practices by emphasising efficient resource utilisation, waste reduction, and the establishment of closed-loop systems where materials are reused, recycled, or repurposed. By accommodating varying country-specific needs, the dynamic circular economy model enables the optimization of economic, social, and environmental benefits on a global scale.

5) A practical and participatory approach to the circular economy

The practical and participatory approach of the circular economy emphasises hands-on implementation and active involvement of stakeholders. It goes beyond theoretical concepts and focuses on practical solutions that can be implemented at various levels, from individual actions to systemic changes. This approach recognizes the importance of engaging all relevant actors, including businesses, governments, communities, and consumers, to collectively drive the transition towards a circular economy. By involving stakeholders in decision-making processes, fostering collaboration, and encouraging innovative solutions, the practical and participatory approach aims to create a more inclusive and sustainable circular economy that addresses the diverse needs and challenges of different contexts.

Based on the concept of waste management problem solution in Malaysia, Cambodia, and Laos, UNIMAS low carbon campus program will

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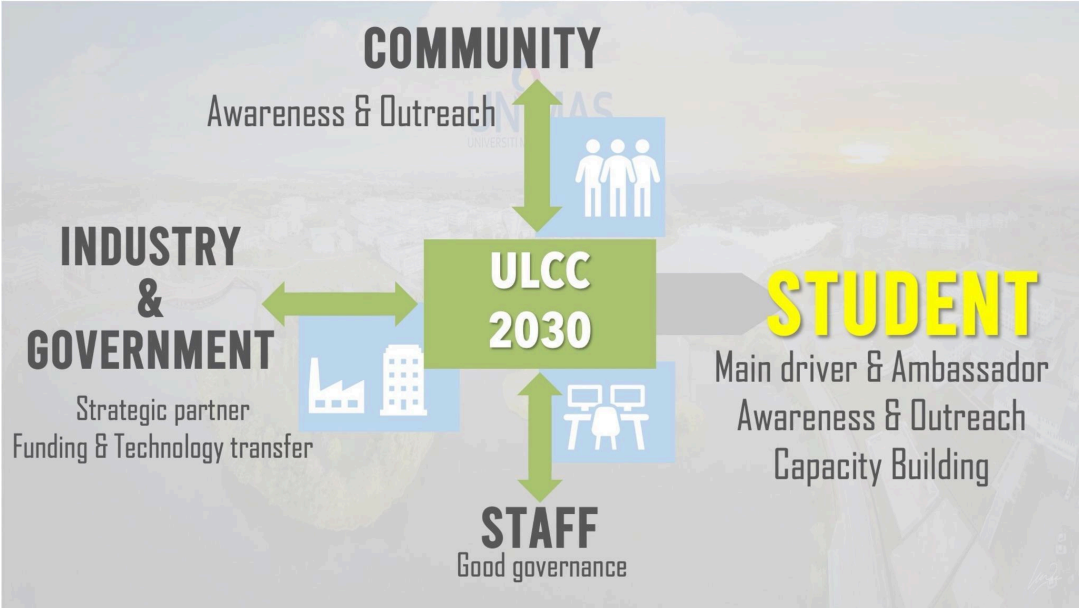
provide green economy initiatives to support Sarawak government for the GHG inventory development for all economic sectors pointing to the university campus as a starting point of the program. Besides, the student engagement of this project will produce graduates with different major backgrounds as experienced green economy specialists. And the interaction with Sarawak's Climate Change Centre to exchange the expertise and knowledge during the work. Oriented to:

- Develop Sarawak's urban areas with infill development and create more green lungs within urban areas.
- Adapt nature-based solutions when building or redeveloping infrastructure.
- Introduce low carbon public transportation and encourage more cycling and walking.
- Implement sustainable construction practices in future buildings.

Table 3.4, Low carbon campus strategy of UNIMAS:



Workshop separate real environment activities of the project; its outcome will provide students with practical experience of EU experience and development with promotion of the circular economy development among their community. With increasement of the community awareness as well. So the proposed plan will go as a part decade strategy of the state government under our input as a UNIMAS project.

Therefore, inclusion of the mentioned sectors will contribute to the achievability of the project.

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3.3 Community engagement and active citizenship

Community participation is a significant part of the sustainable implementation of the circular economy policy into real life. The involvement of the citizens in the transition process to the Circular economy concept will demonstrate an impact and lead to its constant implementation by the community.

Moreover, the involvement of 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 will be based on the interest of the local communities. After the details clarification we can start to analyse the coming data and possible challenges during the work.

There are several approaches, challenges and needs of local communities in applying the CIRCULAR Living Lab activities. As in example below:

- 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 better understand 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, the aim of this pillar is to seek ways to actively engage the community and potential audience. Citizen science emphasises the community's role in shaping the circular economy policy, the advantage of collaboration and encouraging individuals from different fields and backgrounds to work together for the comprehensive understanding of the CIRCULAR 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 take action via constantly highlighting the importance of reducing, reusing, and recycling waste within the context of the circular economy. Another way to raise the community's awareness is to design an inclusive circular model as the examples suggested in previous sections. In this

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way, communities will be able to process waste management practices and advocate for the circular economy.

3.4 Pillars interconnection and living lab design.

Each of the components outlined above (chapters 3.1, 3.2, 3,3) comprises various elements and activities which need to be implemented to ensure that the objectives of all components are fulfilled. CIRCULAR Living Lab participants are equal, diverse and might be from different backgrounds and the vision is aligned with the specialties of the local community in the context of global changes, which even with local orientation will have a global positive impact. As an example, circular development progress of the food sector will give huge progress to the sustainable development in Malaysia, Cambodia, and Laos. The three pillars of the CIRCULAR Living Lab remain interconnected at every stage of the process.

As an example, a multicultural community engagement program is not just about community engagement, but also this process will cover teaching at least about multicultural effective working. At the same time, stakeholders may play the role of science representative based on previous successful project experience.

3.5 Operation of the CIRCULAR Living Lab

The CIRCULAR Living Lab in SEA countries work interconnected with all 3 pillars. This interconnectedness ensures that the main outcome of the work remains consistent across the entire process. To summarise the integration of three components, the universal foundational strategy of the operational framework can be defined as the following:

- Objectives Definition: Define specific goals for the CIRCULAR Living Lab development, focusing on product development and social impact.
- Stakeholders and Community Engagement: Engage users, researchers, industry partners, and policymakers, educators from the start to ensure inclusive co-creation.
- Co-Creation Workshops: Organise interactive workshops where stakeholders collaborate to generate ideas and develop prototypes.
- Data Collection and Analysis: Collect user feedback throughout the process to assess effectiveness and areas for improvement.
- Knowledge Sharing: Share findings and insights with relevant stakeholders through reports, presentations, and other channels.
- Scaling and Implementation: Identify successful strategies for scaling and work with partners to implement them widely.

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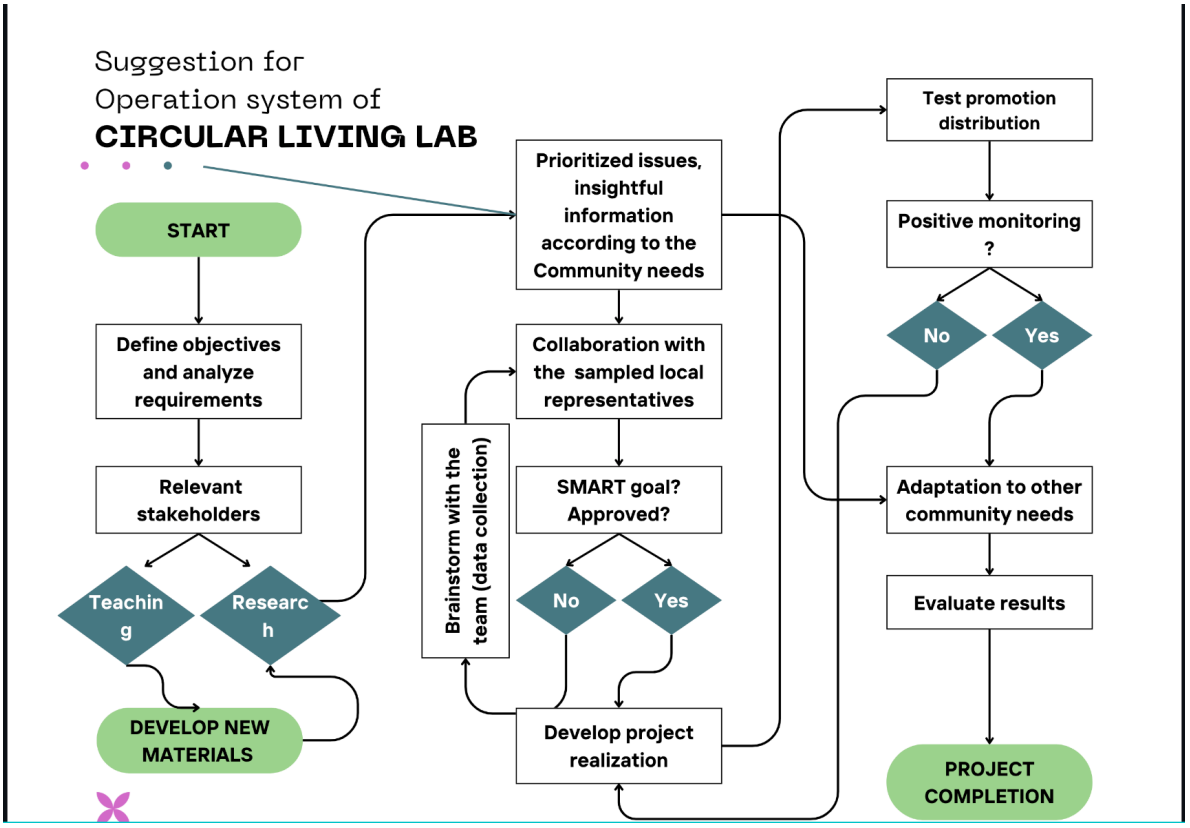
- Continuous Learning: Encourage constant reflection and learning to improve future initiatives and the overall quality of the living lab approach.

One suggestion to run the operational system of a living lab effectively is to establish clear communication channels and regular feedback mechanisms among pillars. This ensures that all parties involved stay informed about project progress, share insights, and address any issues or challenges promptly. Additionally, fostering a collaborative and inclusive environment where everyone's input is valued, can enhance engagement and participation, leading to more successful outcomes in implementing circular economy initiatives.

Prototype of operational strategy for the living labs (based on the conclusion of partner universities meeting):



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4. Strategies to implement CIRCULAR Living Lab

To implement the CIRCULAR Living Labs it is necessary to have a systematic approach to integrate circular principles into various aspects of community routine. Here are strategies to implement each component of the living labs to consider table 3.5 (based on the conclusion of partner universities meeting):

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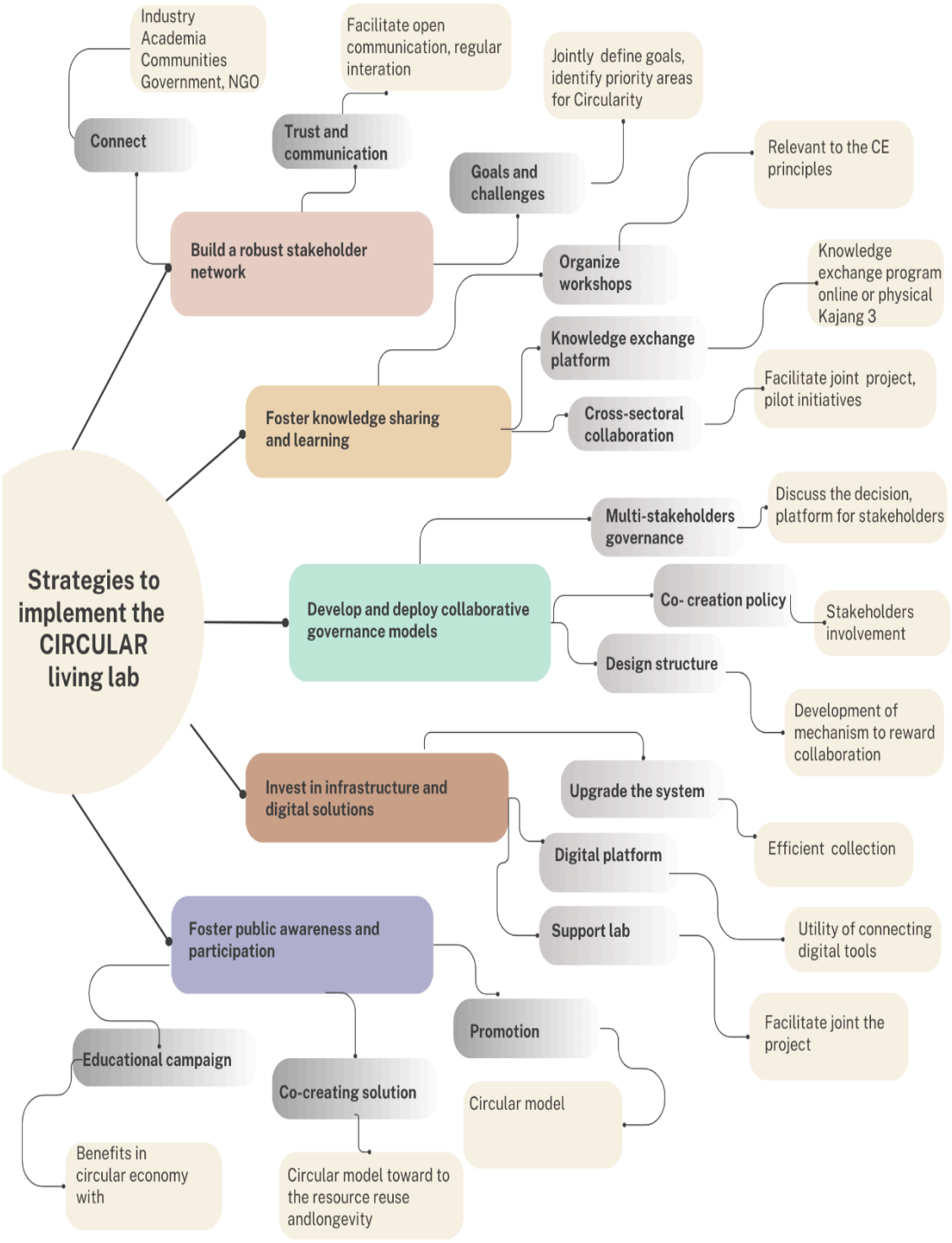

The CIRCULAR Living Lab implementation concept requires a multi-pronged approach that engages diverse stakeholders and fosters an ecosystem of shared innovation and action. Here are some key strategies to consider:

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1. Build a robust stakeholder network
    - Connect diverse players: Actively engage academia, industry, government, NGOs, and communities to create a dynamic network of expertise and resources.
    - Establish trust and communication: Facilitate open communication channels, regular interactions, and collaborative planning to ensure all voices are heard and understood.
    - Jointly define goals and challenges: Work together to identify priority areas for circularity and co-create a shared vision for a sustainable future.

2. Foster knowledge sharing and learning
    - Organise workshops and training programs: Empower stakeholders with knowledge and skills relevant to circular economy principles and practices.
    - Promote knowledge exchange platforms: Create online or physical platforms for sharing best practices, innovative research findings.
    - Encourage cross-sectoral collaboration: Facilitate joint research projects, pilot initiatives, and knowledge exchange between different sectors and disciplines.

3. Develop and deploy collaborative governance models
    - Establish multi-stakeholder governance bodies: Create platforms where stakeholders collectively discuss and make decisions about circular economy initiatives.
    - Promote co-creation of policies and regulations: Involve stakeholders in developing supportive policies and regulations that incentivize circular practices and address market barriers.
    - Design incentive structures and reward systems: Develop mechanisms to reward collaboration, innovation, and successful implementation of circular economy solutions.

4. Invest in infrastructure and digital solutions
    - Upgrade waste management systems: Invest in infrastructure for efficient collection, sorting, and processing of waste streams.
    - Develop digital platforms: Utilise digital tools for data sharing, resource mapping, and connecting stakeholders within the circular economy ecosystem.
    - Support research and development: Invest in research into new technologies and models for resource recovery, product design, and closed-loop systems.

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5. Foster public awareness and participation

- Organise educational campaigns and community outreach programs: Raise public awareness about the benefits of circular economy and encourage individual action.
- Promote circular consumption models: Support initiatives like sharing platforms, product-as-a-service models, and repair cafes to shift consumption patterns towards resource reuse and longevity.
- Engage communities in co-creating solutions: Encourage community participation in local waste management initiatives, upcycling projects, and circular economy pilot projects.

4.1 Examples of existing Living labs

By delving deeper into these aspects, the framework aims to not only inform but also inspire action, fostering a sense of collective responsibility and collaboration among diverse stakeholders. Through empowerment, sustainable solutions, and collaborative research, the guidelines seek to create a framework for meaningful environmental impact. It outlines the essential elements to guide individuals in creating and running a successful living lab.

Adjustments can be made based on the specific focus and goals of the living lab in question. Under the living Lab program several formal and non-formal opportunities are given for the participants. SEA countries participants are able to propose a debate for the solution to tackle the waste management program and to organise formal and non-formal skill development training.

- Students who are enrolled in CIRCULAR economy courses can apply for the participation in the research development alongside researchers and experts in SEA and EU. This plays a significant role for their future job and career prospects.
- For PHD students the living lab can be a platform for data collection or conducting research activities related to their dissertation.
- SEA staff and researchers can benefit from the platform, using it to implement and refine their methodologies.

The CIRCULAR Living Lab offers experiential learning and knowledge in real time and is well known as a dynamic community shaping the tomorrow. Over the last century we have seen a significant number of successful living lab projects by students and various backgrounds of people in their target area.

The table 4.1, below presents a diverse range of living labs from various countries, each focused on different aspects of sustainability, innovation, and community engagement. Examples include student farms for sustainable food production, water resource engineering trials for climate adaptation, and urban

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living labs aimed at city planning, and retail sectors. These living labs serve as collaborative platforms, bringing together stakeholders from academia, government, industry, and civil society to address complex challenges and test innovative solutions. They emphasise hands-on learning, research, and experimentation to drive positive social, environmental, and economic outcomes in their respective regions.

Table 4.1, existing living lab concepts

Name	Country (place)	Summary
Student Farm	Penn State	To gain skills and knowledge about sustainable food production, harvesting, and marketing.
Water Resource Engineering	Penn State	To create an information platform about adaptation of tree populations to their environments and place for students to be involved in research about spatial change in climate.
Coventry Living Lab	United Kingdom	To bring together a diverse and innovative partnership of local authorities, a local university and its social enterprise partner. Collaborative capitalisation on each organisation's strengths and knowledge.
Future Self and Design Living Lab	Australia	Games are focusing on improving communication avenues for people living with advanced dementia. To enhance a person's ability to share experiences and social interactions
ENERGY & WATER - Greater Copenhagen Living Lab	Denmark	The Collaboratorium for Climate Adaptation empowers communities to collaborate and engage with city and utility authorities in the participatory planning of local climate adaptation projects.
Hub.Brussels	Belgium	The platform shows the results of the research and experimentation. And may be a tool for all actors of territorial development who want to create a smart specialisation strategy on their territory.

· Mondragon Unibertsitatea Campus Circular y Sostenible (mUCS), in Spain. The project's goal is to design and implement a methodology for identifying, evaluating, prioritising, deploying, and monitoring circular economy strategies, which will improve the efficiency of resource management (energy, water,

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materials) on the different campuses of Mondragon University and contribute to achieving the Sustainable Development Goals 2030.

· The Social Cooperative Palm Work & Project Onlus, Italy, is a social cooperative whose mission is to create harmony between ecology and socio-economic systems. Following the criteria of eco-design, it has been promoting the work placement of young people with disabilities. Through an innovation and social carpentry lab, the project enhances a systemic approach to design and upcycling in the creation of eco-furniture for the home and community.

· Karlsruhe Transformation Center for Sustainability and Cultural Change (KAT) establishment project. The KAT wants to accompany and initiate transformation processes towards sustainable ways of life and sustainable business activities. It also promotes research (transformative sustainability research), experimental spaces (in form of a real-world lab), innovation & action (sustainable development in all areas of life), education about sustainable development at university, schools and public level as well as advice and consulting about sustainability, communication & networking with different stakeholders or companies and to establish a space for reflection and contemplation as well as a thinking space open for the community.

· The case study in Laos is the Waste Management Project of Faculty of Environmental Sciences, National University of Laos. It aims at practising waste separation at source, promoting the application of 3Rs principle, and introducing Refund-Deposit Scheme (RDS) called waste recycle bank. Waste recycling bank aims at increasing students' awareness of the value of waste.

· The Seoul Circular City Living Lab, Korea, tackles electronic waste (e-waste) through innovative recycling and upcycling initiatives. Residents can drop off used electronics at designated points, with some transformed into art installations or educational tools. The lab also promotes repair cafes and responsible e-waste management practices.

· The Bioeconomy Village, Turku, Finland, is a living lab focusing on bio-based materials and circularity in the construction industry. Here, researchers and companies test innovative building materials like mycelium bricks and wood-based insulation, aiming to reduce reliance on traditional, resource-intensive materials.

· The Fab Lab Barcelona, Spain, is a community-driven makerspace that fosters circularity through upcycling workshops, collaborative design projects, and access to digital fabrication tools. Local residents learn to repair broken items, create new products from discarded materials, and share their circular innovations with the community.

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Collaborative research on waste innovation to promote circular economy.

Collaborative research on waste innovation weaves a vibrant tapestry of expertise, aiming to unleash ground-breaking solutions for a circular future. All stakeholders of mentioned projects are people from different age groups, educational backgrounds, etc. And the collaboration of different vision stakeholders with one idea is the key for success of the Living Lab. Ultimately, its objectives strive to tackle global challenges, facilitate knowledge transfer, and develop sustainable, scalable solutions grounded in real-world testing and community engagement, transforming waste from a burden to a springboard for a circular economy.

4.2 Embedding circular economy as a class into Education system

As the most urgent problem, climate change issues need more serious steps from humans to reduce spreading.

As one optional solution, inclusion of the Climate action class for CIRCULAR economy will help to raise the knowledge of youth in SEA countries about the responsibility and their right to claim clean environmental conditions. As an educational strategy the inclusion of the class or an internship as more practical option to deal with the problem of Circular Economy might be on the following directions as:

- promotion Climate Justice activities via student social media accounts.
- climate change classes from student to students.
- a strategy for implementing this habit via various contests;
- climate change social companies at online platforms.

Therefore, the above activities will be actively engaged by students and will be able to create different student platforms to find solutions for the certain environment protection problem within their community. The above-mentioned ideas can be implemented at the SEA universities within the scope of the CIRCULAR Living Lab.

Within this part it is recommended to have educational toolkits online and offline for distribution.

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5. Recommendations

Tailoring the CIRCULAR Living Lab requires a nuanced approach, adapting it to specific contexts and needs of stakeholders. Here are some recommendations:

Stakeholder Identification: A thorough examination is to be carried out to identify and classify stakeholders from various sectors such as academia, industry, government, NGOs, and community organisations, evaluating their capacities, resources, and interests in the circular economy.

Initiative Mapping: The assessment of current circular economy projects in the area is essential to identify opportunities for collaboration, prevent redundancies, and ensure efficient allocation of resources.

Waste Stream Analysis: A comprehensive study of the local waste streams and resource movements is necessary to pinpoint key areas for intervention, guiding the development of focused circular economy strategies.

Community-Driven Focus: The facilitation of participatory processes is crucial to engage local communities in the co-creation of circular economy solutions, highlighting their requirements, resources, and cultural standards for sustainable waste management and resource utilisation.

Trust and Communication Establishment: Transparent communication channels and participatory decision-making mechanisms must be established to build trust and secure community ownership and sustained involvement in circular economy projects.

Promotion Multi-Stakeholder Platforms:

The establishment of dedicated platforms or networks is recommended to promote collaboration across various sectors, allowing stakeholders to exchange expertise, share successful strategies, and jointly develop innovative circular economy solutions.

Incentive Mechanisms: The introduction of incentive structures, such as funding opportunities or recognition programs, is advised to encourage collaboration and motivate joint efforts among diverse stakeholders, fostering collective action towards circular economy goals.

Power Dynamics Mitigation: Efforts should be made to address potential power imbalances within collaborative frameworks through fair representation and inclusive decision-making processes, ensuring equitable participation and engagement of stakeholders.

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Flexible and Adaptive Framework Design:

Designing flexible frameworks with modular elements that can be tailored and expanded to suit different contexts and evolving challenges is crucial to promote adaptability and responsiveness in circular economy implementation.

Pilot Project Emphasis: Encouraging the implementation of pilot projects and experimental initiatives is important to assess the feasibility and efficacy of circular economy interventions, enabling iterative improvements and optimization based on empirical data. Progress Monitoring and Evaluation: The implementation of robust monitoring and evaluation mechanisms is essential to evaluate the impact and effectiveness of collaborative circular economy models, facilitating continuous enhancement and evidence-based decision-making.

Technology Integration for Enhanced Collaboration Digital Platform Development:

The development and implementation of digital platforms and tools for data sharing, collaboration, and communication among stakeholders is recommended to enhance coordination and knowledge exchange in circular economy endeavours.

Digitalization Embrace: Embracing digital technologies to streamline processes, improve communication, and facilitate virtual collaboration is crucial, leveraging digital tools to overcome geographical barriers and enhance resource utilisation in circular economy projects.

Utilisation of artificial intelligence and data analytics: The implementation of AI-driven solutions to optimise waste management systems, match resources with demand, and inform policy decisions is vital for promoting transparency and accountability in circular economy initiatives.

6. Conclusion

This document explores the transformative potential of CIRCULAR Living Lab as innovative platforms to lead for sustainable development, serving as a guiding tool for the operational set-up of the Living Labs within the scope of the CIRCULAR project. CIRCULAR Living Labs offer a holistic approach to address pressing environmental challenges and foster a regenerative economy through the integration of teaching, research, and community engagement pillars.

The first pillar of CIRCULAR Living Lab promotes evidence-based decision-making strategy and fosters innovation. By facilitating collaborative research projects among academia, industry, and community stakeholders,

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CIRCULAR Living Lab generates valuable insights into the environmental impacts of products and systems. The outcomes of this research contribute to advance knowledge and inform the development of policies and practices that promote sustainability at various scales.

The second pillar of CIRCULAR Living Lab, education, highlights the significance of education as a catalyst for change. By incorporating circular economy principles into educational curricula and providing hands-on learning opportunities, institutions can equip students with the knowledge, skills, and mindset necessary to navigate sustainability activities. Through practical projects, students will be empowered to become change agents, promoting innovation, and advocating for more sustainable practices in their respective fields.

Community engagement serves as the third pillar of CIRCULAR Living Lab, emphasising inclusivity of the citizens. By involving local communities as active participants in the co-creation process, CIRCULAR Living Lab ensures that solutions are contextually relevant and socially equitable. Community members contribute valuable insights, traditional knowledge, and their experiences, increasing the collaborative learning experience. Through stakeholder dialogue and participatory decision-making, CIRCULAR Living Lab fosters a sense of ownership and collective responsibility for driving positive change within communities.

In conclusion, CIRCULAR Living Lab holds great promise in advancing sustainability through research, education, and community engagement. By embracing circular economy principles and promoting collaboration among diverse stakeholders, CIRCULAR Living Lab offers a transformative model for achieving a more regenerative and inclusive society. This handbook will serve as a guiding tool for each participant of the living lab.

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