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Policy, business, social, environmental and practice recommendations - POLICY

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HISTORY OF CHANGES			
Version	**Date**	**Author/Contributor**	**Changes**
01	01/07/2024	UNILODZ	The first draft of theoretical framework and methodological concept of research for recommendation
02	27.08.2024	UNILODZ	The first draft of report of recommendation: Policy, business, social, environmental and practice recommendations - POLICY
03	20.09.2024	STRESS/ UNILODZ	Development of the D2.4 report on recommendations concerning the environment and technologies for environmental protection
04	01.10.2024	OPUS/ UNILODZ	Development of the D2.4. Recommendation Report on the social engagement tools and solutions modelled in the D7.1 Report.
05	02.10.2024	UNILODZ	Editorial changes
06		STRESS/ UNILODZ	Development of recommendations in the area of environment and resource-saving innovations
07	05.10.2024	RIC/ UNILODZ	Development of the D2.4 report on recommendations concerning reference to new business models and new value chains for companies involved at the regional level
08	09.10.2024	SLOM/ UNILODZ	Additional comments and development of recommendations
09	09.10.2024	ZM Bzura/ UNILODZ	Additional comments and development of recommendations
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1. Executive summary

This report – Deliverable 2.4 (D2.4) - Policy, business, social, environmental and practice recommendations- POLICY - is the result of the work carried out under the Work Package 2 - Regional Systemic Circular Economic Approach, Task 2.4. - T2.4: Policy and practice recommendations for the Lodzkie Region.

This report is intended to lead to achieve the main goal of the FRONTSH1P project: to ensure the green and just transition of the Polish Region of Lodzkie towards decarbonization and territorial regeneration through the demonstration of highly replicable regenerative Circular Systemic Solutions (CSS). These Systematic Solutions aim to address the current challenges and needs of the region, transforming them into opportunities for economic growth, social inclusion, decarbonization of production and consumption systems, improvement of the quality of life for citizens, and reconnection between the urban and rural area.

The purpose of the D2.4 report is:

- to assess the current effects of implementing circular solutions implemented within the Frontsh1p project;
- to identify current trends and desired directions of circular transformation;
- to assess the maturity of the regional territory, in particular in the area of activity of the Circular Territorial Cluster, for circular transformation.

As a result of these goals, the tasks that were implemented consisted of:

- the definition of policy recommendations with impact on local CpEAP,
- identification of business recommendations with reference to new business models and new value chains for companies involved at the regional level,
- indication of social recommendations based on the developed model for citizens engagement and reskilling, including labour market innovation,
- formulation of environmental recommendations with a life cycle and circular approach,

In the process of formulating recommendations, the following institutions played a leading role: University of Lodz as coordinator, Research and Innovation Center Pro-Academia, OPUS, STRSS, Bzura Inter-commune Union, Lodz Metropolitan Area Association. However, the knowledge and practices of experts participating in the circular transformation of Lodzkie Region were also used. The experts included representatives of each of the sectors: society, company, government and academy. Recommendations formulated to improve the efficiency of the Circular Territorial Cluster in Lodzkie Region.

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2. Methodological framework for preparing recommendations

Networks and partnerships determine the territory's potential for development. The creation and existence of network organisations is grounded on the principle of mutual benefits. A network's fundamental benefits are reciprocity, interdependence, loose coupling and the supply of new energy to network elements (power) (Moulaert, Sekia 2003). The essence of the existence of a cluster is to strengthen relations and maintain the dynamics of contacts between network partners. Circular Territorial Cluster is an open network, the core and driving force of which is the territory with its properties. Who is the cluster leader, what is the role and form of the institution managing the network, and what form does the cluster broker have - these are important questions which should not overlap with the definition of CTC (detailed definition in D2.6, Fig. 3).

According to the assumptions (D.2.2), Circular Governance Model CircuPuncture allows territorial stakeholders to manage their transitions towards circular value chains, going beyond the existing conceptualisations of governance practices and including participatory, inclusive and socially innovative governance frameworks. This governance model allows a participatory, open, inclusive and socially innovative approach that includes key actors in the territories, such as public authorities and civil society as beneficiaries, as well as industry, farmers, NGOs, cooperatives, associations as stakeholders and key enablers in new circular value networks triggered by the four CSSs.

The recommendations we propose in this report are ongoing and result from the conclusions obtained while implementing the CpEAP Lodzkie Region.

- the definition of political recommendations with impact on local CEAP;
- business recommendations regarding new business models and new value chains for companies involved at the regional level;
- social recommendations based on the developed model for citizen engagement and reskilling, including labour market innovation;
- environmental recommendations with a life cycle and circular approach.

Project partners were actively involved in the process of preparing the recommendations. Business recommendations were formulated in cooperation with RIC; social recommendations were formulated in partnership with OPUS; and environmental recommendations were prepared in collaboration with STRESS. Due to their particular role in implementing the CpEAP at CTC, ZM BZURA and SLOM were also involved in formulating the content of the recommendations.

Recommendations in each of the areas were formulated based on the results of the research. The following types of research were planned and conducted:

- Desk research of current reports and source material,
- Computer Assisted Personal Interviewing [CAPI] direct interviews with a group of experts,
- adapted AHP method,
- in-depth interviews with experts from each of the regional stakeholder groups according to the quadruple helix model,
- questionnaire survey among local authorities in the Lodzkie region - diagnosis of needs in the area of circular economy

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- participatory observation during the implementation of the CpEAP in Lodzkie Region,
- Participatory observation in a group preparing a new training programme for waste management technicians.

Desk research involved the identification of available recommendations in the areas under study in existing knowledge sources. These studies were carried out based on reports and documents from EU institutions, the OECD, consulting leaders, and research results from the last three years. Computer Assisted Personal Interviewing (CAPI) direct interviews were carried out using structured lists of questions that were differentiated according to the stakeholder group.

The study was conducted in September 2024. Four stakeholder groups participated in the survey: company, society, government and academy directly related to environmental protection. A total of 48 interviews were conducted (Table 1). The survey aimed to identify development gaps in the secondary raw materials markets and the level of perception of the circular economy in the Lodzkie Region. The size and quality of the development gaps and the identified needs are the basis for formulating recommendations for future updates of the CpEAP. The inference is dynamic due to the surveys' cyclical nature. The first such study was conducted in 2022 before the Frontsh1p project activities were undertaken (Report D2.1.).

Table 1. Number of direct interviews with experts in 2024 using CAPI method

Respondent group	Number of interviews	Characteristics of respondents
company	11	Companies – representatives of the CSSs: wood, plastic, water, food and other companies involved in CE
society	15	representatives of NGOs, local social leaders
academy	11	Scientists involved in the research of CE according to the CSS logic, specialising in environmental protection
government	11	Representatives of the region and local government involved in planning, implementing and managing of the circular economy; Representatives of the institution supporting and controlling processes of circular economy in the region

Source: own study

The CATI data were qualitatively analysed, and an adapted pairwise comparison matrix was used to make in-depth inferences. The pairwise comparison method is a component of the Analytic Hierarchy Process (AHP) method, which belongs to the group of multi-criteria methods for hierarchical analysis of decision problems (Feltynowski & Szajt, 2021; Saaty & Kearns, 1985). Pairwise comparison is based on the use of a scale proposed by Saaty (Saaty & Kearns, 1985), which ranges from 1 to 9, where 1 means equal importance of the elements being compared and nine means of unequivocal significance of one of the elements being compared. The evaluations must meet methodological assumptions based on testing the consistency of the comparison matrix through the prism of two indicators CI (Consistency Index) and CR (Consistency Ratio). A matrix is considered consistent when the CR ratio is less than 10% (0.1). The weights established in this way can be used to make inferences based on evaluations obtained in studies with a certain level of subjectivity, even if they refer to expert indications.

In addition, two in-depth interviews [IDIs] with an expert were conducted with each group of respondents to complement the information obtained in the CAPI survey. These interviews aimed to

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gain a deeper insight into the situation being analysed and reveal non-obvious processes and crisis areas in the circular economy.

In the group of social stakeholders, due to the specificity of the group, an additional qualitative study was carried out in the form of 6 interviews with experts dealing professionally with CE and two quantitative studies: a survey using an online questionnaire among 61 inhabitants of the town of Parzęczew where the circular solutions designed within Frontsh1p are being tested and implemented (targeted selection of respondents) and a design thinking workshop among 110 students specialised in spatial economy and urban management.

The participatory observation during the implementation of CpEAP in Lodzkie Region consisted of identifying solutions and areas of inefficiency or reduced effectiveness in implementing CircuPuncture Governance Model and CircuPuncture Economy Action Plan in Lodzkie Region. This observation is an expert assessment and the results were discussed during the Regional Cluster Team meetings.

Two members of the FRONTSH1P project participated in the work of a public teacher training facility with a nationwide scope run by the Ministry of National Education from May to July 2024. As part of this external cooperation, a training program for the profession of Waste Management Technician, according to EU standards, was prepared. This work was an excellent opportunity to acquire source knowledge about competencies and skills that are desired but lacking in the Polish labour market in the field of circular economy. This knowledge strengthened the formulation of recommendations for reskilling and labour market innovation.

Moreover, the recommendations were supported by the research results and conclusions formulated in M. Podgórski's doctoral dissertation entitled International Cooperation of Local Government Units for Programming European Regional Policy in the Area of Circular Economy. This dissertation aimed to identify the level of involvement and effectiveness of the influence of local government units on the transformation towards a circular economy in the framework of European regional policy. The author is a co-author of the Frontsh1p project. The findings of the Frontsh1p project formed the basis of the author's in-depth analysis and study of the role of advocacy in implementing circular policies in local governments.

Selected results from surveys conducted in September 2024 by SLOM were also used to formulate the recommendations. The authors of the study are L. Wojdal and M. Skwierczyńska-Żak. The survey was conducted among all 26 municipalities - the Lodz Metropolitan Area Association members.

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3. Definition of Policy recommendations with impact on local CpEAP in Lodzkie Region

3.1. Recommendations for a multi-level management model in the Circular Territorial Cluster in Lodzkie Region

The primary goal of WP2 is “to develop the methodology and toolkits to support the regional transition to a circular economy, taking into account various types of local sources of waste as raw materials for reprocessing, reusing, recycling and upcycling”.

A particular CircuPuncture closed-loop management model has been prepared in this scope. This model proposes implementing dispersed activities in time and space, depending on the territory's capacity for operational activities and the implementation of Circular Challenges. The dispersed activity model is systemised, leading to a circular transformation in purposely selected Resource Missions.

Nevertheless, WP2 also aims to consider launching a Special Purpose Vehicle to engage all actors and act as an umbrella organisation to operate the Circular Territorial Cluster. A CTC is a network of local stakeholders oriented to seek industrial symbiosis in selected resources (definition according to D2.1, D2.2). In line with the first CpEAP Lodzkie Region, we are dealing with a classic multi-level governance based on dialogue, compromise and cross-institutional cooperation. At the core of this partnership are two public umbrella institutions: the Inter-Municipal Union BZURA and Lodz Metropolitan Area Association. In addition, an important role is played by a Local public leader of the Circular Territorial Cluster: Municipality - City of Parzęczew and the regional public institutional surroundings of the Circular Territorial Cluster: Lodz Marshal's Office in Lodz, Lodz Regional Office in Lodz. Frontsh1p project institution is also an informal advisory, opinion-giving, initiating institution: Regional Cluster Team (RCT), composed of Inter-Municipal Union BZURA, Lodz Metropolitan Area Association, Municipality - City of Parzęczew, K-FLEX, OPUS, Lodz Marshal's Office in Lodz, University of Lodz and the Technical University of Lodz. Thus, the current CTC coordination model has the character of an informal umbrella organisation integrating local partners in Resource Missions and jointly agreed Circular Challenges. The scope of activities of the CTC partners has been formalised as a CircuPuncture Economy Action Plan (CpEAP).

Multi-level governance emerges from the convergence of two forces: - EU common policies and/or the territorialisation (endogenisation) of processes. Multi-level governance enhances stakeholder communication, giving them more opportunities to influence their situation. Communication between actors does not shape the content of policy documents or projects but is an incentive for dialogue, an increased sense of influence over decisions and possible parallel involvement in complementary projects. This creates an environment and business climate for building industrial symbioses (Mik, 2015). Classically, the definition of governance in political science and public administration theory refers to the structure and functioning of power at different levels of government. It encompasses interactions between different levels of government, including national, regional, local and even global levels.

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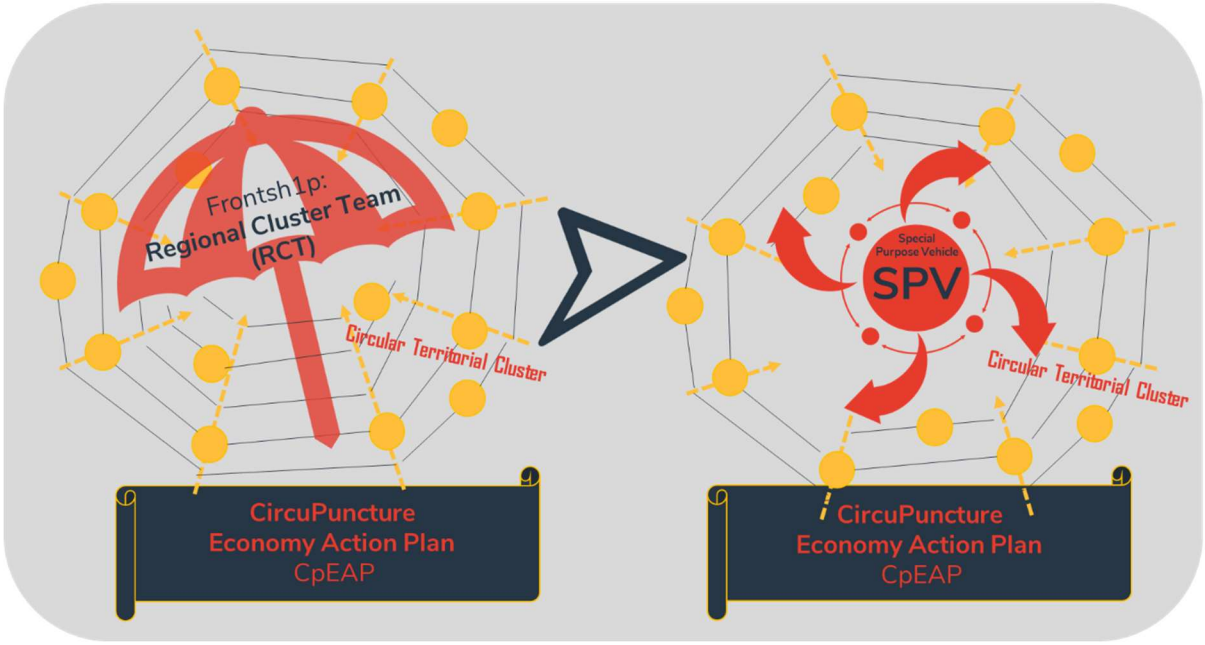
In contrast, governance at the local level implies integrating activities between the various stakeholder groups of the Quadruple Helix and intra-sectoral integration. This way of governing and creating development policy reflects the idea that decisions, policies and rules are formulated and implemented by negotiation between stakeholders. The concept responds to the decentralisation, regionalisation and internationalisation trends in policy-making, thus aiming to address complex and interdependent policy challenges. Multi-level governance is characterised by joint decision-making and overlapping competencies at multiple levels and among multiple actors rather than a clear hierarchy of authorities.

The multi-level governance approach regards integration as part of a broader phenomenon in which power is distributed across jurisdictions at different levels. The focus is primarily on regulatory measures, emphasising their importance over redistributive means. The decision-making process allows for all regional policy stakeholders to participate through communication and influence exerted by organisations at local, regional, and national levels within a system of interest representation (EC, 2023m).

The adopted multi-level model for managing circular transformation in the Lodzkie Region in the initiation phase has the character of a project institution; it is an agreement between project partners to construct a CTC and takes the form of a Regional Cluster Team (RCT). The project is a kind of umbrella that integrates the activities of local stakeholders. However, it is important to maintain the continuity of circular transformation activities in the future and not to 'fold the umbrella' at the end of the project, so we recommend changing the form of the local agreement from a project formula to a Special Purpose Vehicle formula (Fig. 1).

Figure 1. Recommended evolution of institutional coordination of CTC



Source: own study

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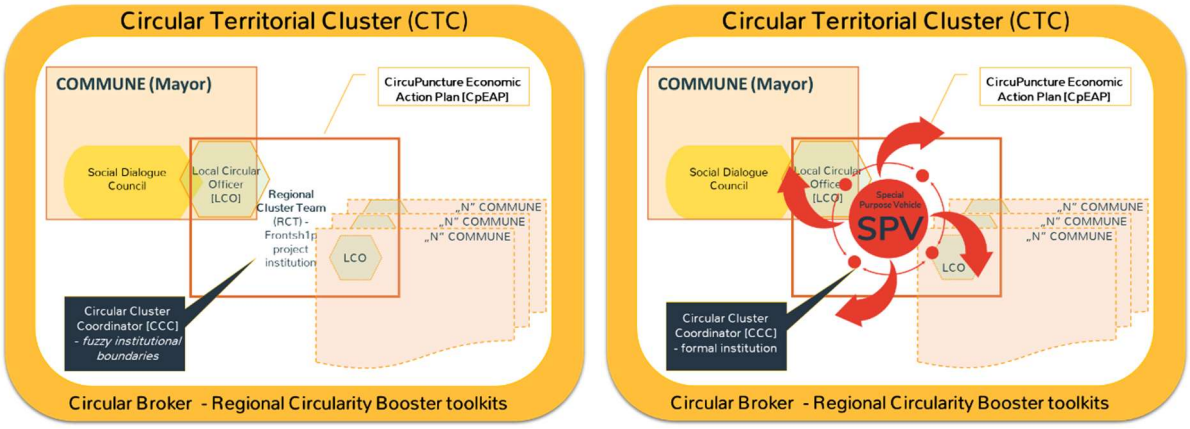
This will affect Circular Territorial Cluster integration's durability, flexibility and innovative capacity. The Special Purpose Vehicle is a higher form of integration that allows lobbying and partnering on a supra-regional scale. It is thus a demonstration of solid cooperation that strengthens the reliability of the local partnership. This feature is crucial for sustainable partnerships, e.g. with institutions such as the Voivodship Fund for Environmental Protection and Water Management in Lodz. The Special Purpose Vehicle formula will allow the cluster partners to act together as investors, service providers, educators and creators of modern circular system solutions (Fig. 2).

Figure 2. System for strengthening institutional coordination of Lodzkie Region stakeholders for circular transformation



Source: own study

The Special Purpose Vehicle is a company that local stakeholders should appoint to coordinate CTC activities. The scope of this coordination should be subject to discussion and consensus among the company's stakeholders. According to the current level of local stakeholder involvement, it is recommended that the founders of the company should be the key stakeholders involved in the Lodzkie region's circular transformation: local governments (both authorities and residents), economic leaders, financial institutions and R&D institutions.

The scope of the company's activities should be flexible, depending on the needs and capacities of local stakeholders. However, the company should be an active partner/ implementer of dedicated circular challenges in the CpEAP. The company should be a Circular Training and Business Centre (LT&BC). The main tasks are Circular education, Circular promotion, Circular coaching, Circular mentoring, Circular incubator and Circular investor.

3.2. Recommendations for Replication Strategy

The circular transformation of the economy in the Lodzkie Region was initiated and implemented using a bottom-up approach and an adaptive approach formula: CircuPuncture. This model is replicated in selected regions such as Portugal, Greece, Italy, and Denmark. The adopted action steps in this area are shown in Figure 3.

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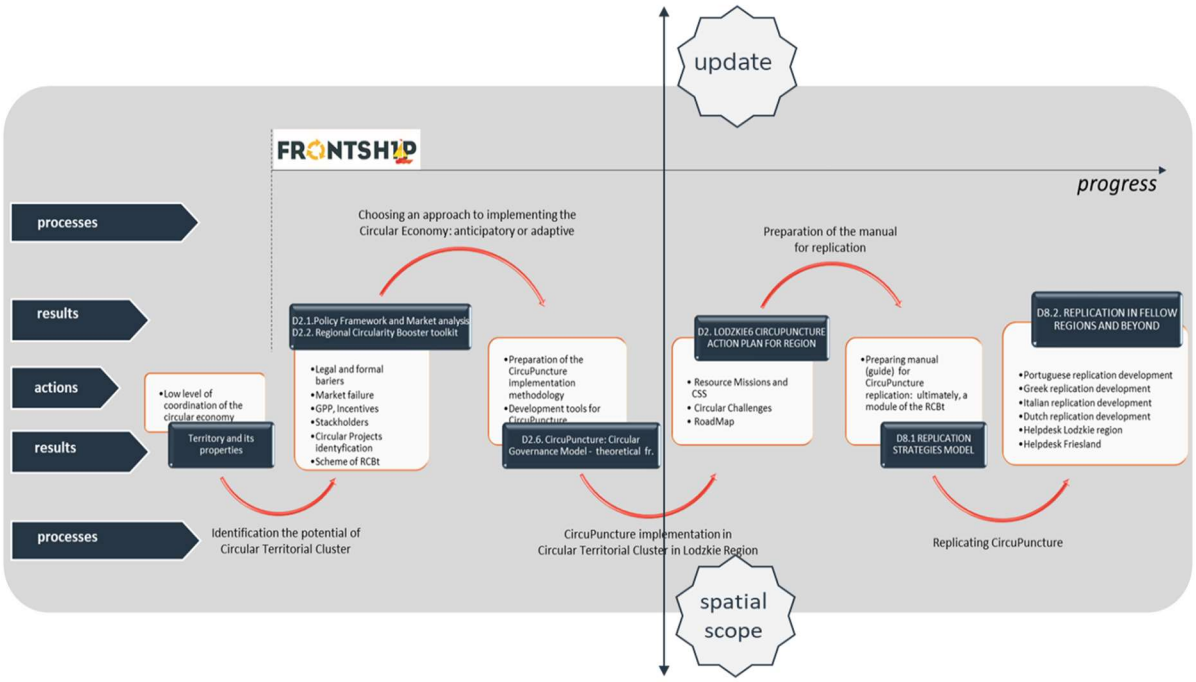
Figure. 3. Recommendations for the update and spatial scope of the implementation process of the CircuPuncture Model and CpEAP in the Lodzkie Region



Source: own study

Replication also takes place over time. Thus, this process also applies to the Lodzkie Region in the context of the evolution of circular transformation processes contained in the CpEAP for the Lodzkie Region. In this scope, two issues are recommended: (1) the timing and currency of the CpEAP and (2) the spatial extent of the CpEAP and CTC.

Firstly, at the stage of preparing the CpEAP for the Lodzkie Region, it was initially assumed that the document would be short-term (2-3 years) and subsequent CpEAPs would be prepared accordingly. However, at the stage of work on updating and finalising the CpEAP for the Lodzkie Region, a different model for the document and its update was recommended. It is recommended that a CpEAP be prepared considering all the possible and realistic Circular Challenges today. Therefore, the document should not have a closed time horizon. On the other hand, it is recommended that it be updated at 2-3 year periods due to changing external economic, political, financial, social, and environmental conditions. In summary, the first update should be carried out after the end of the Frontsh1p project to verify available funding sources. The next key update for the CpEAP for the Lodzkie Region should be carried out in 2027-2028 due to the following EU programming period and the new strategic documents for the Lodzkie Region being prepared. The update should consider the revision and correction of the existing circular challenges in the CPEAP and the addition of challenges or the removal of outdated challenges.

Secondly, due to the growing problems and challenges of the energy transition, extending the spatial extent of the CTC and, thus, the CpEAP is recommended due to the energy specialisation of the Lodzkie Region in the southern part. There is a concentration of triple helix stakeholders there with a specialisation in energy production due to the industrial traditions of the area and the current and still operating largest lignite mine in Europe (Bełchatów Lignite Mine, https://kwbbelchatow.pgegiek.pl/).

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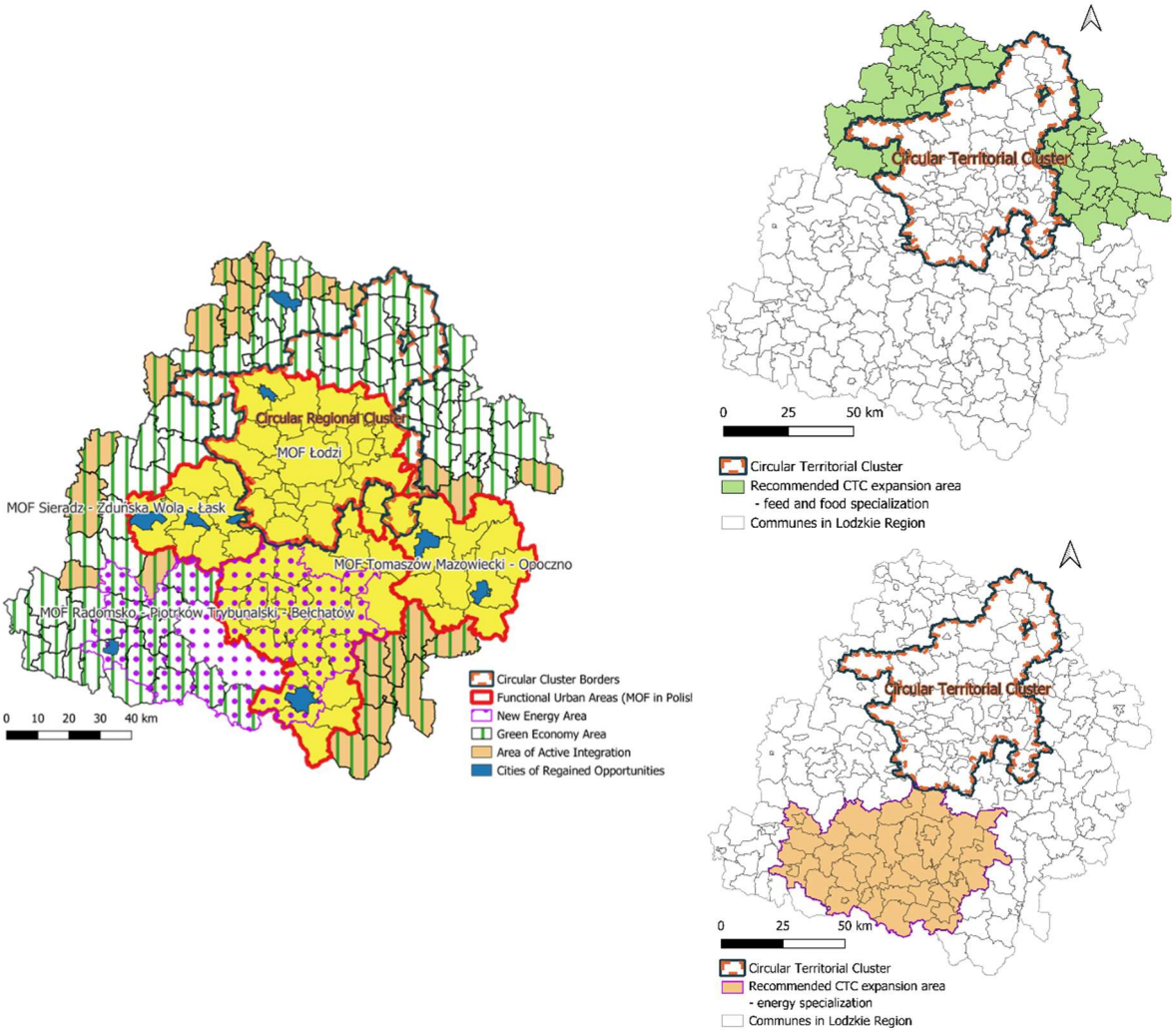
The area will undergo economic, social and environmental restructuring in the coming years. Hence, this territory is referred to as the New Energy Area in the strategic documents of the Lodzkie Region (Fig. 4).

Figure 4. Recommended functional areas for inclusion in CTC activities Lodzkie Region



Source: own study

Consideration should also be given to extending the spatial reach of the CTC to date to include further municipalities neighbouring the members of ZM Bzura and SLOM, particularly those associated with the Feed and Food specialisation. Above all, it is recommended that quadruple helix stakeholders from the territory specialising in fruit and vegetable crops be successively included. This specialisation is most easily adapted to the policy of building short supply chains and the adaptation of the Farm to Table policy. This territory is referred to as the Green Economy Area in the strategic documents of the Lodz Region (Fig. 3). The recommended extension mainly concerns the areas directly adjacent to the current CTC (north-western and north-eastern parts of the Lodzkie Region). The remaining areas of the Green Economy Area are dominated by specialisation in cereal crops and animal husbandry. Their inclusion should also be considered; however, it should probably be in the next phase of CTC development. Eventually, it is worth considering including smart specializations in the Resource Mission, as defined in the Regional Innovation Strategy of the Lodzkie Region.

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3.3. Recommendations for operationalisation of the CircuPuncture Model

The operationalisation of the region's Circular Transformation Strategy/Programme in the CircuPuncture formula consists of three main steps: selecting Resource Missions, selecting Circular Challenges, and preparing the CpEAP. The procedure for implementing the CircuPuncture model is described in detail in Report D8.1 Replication Strategy. In this context, the experience from the implementation of the CircuPuncture model in the Lodzkie Region allows some recommendations to be made regarding:

1. Considering the broader perspective of Resource Missions,
2. The 4NO Filter be operationalised,
3. Replacements: Circular Institutional Benchmarking tool: Resource Benchmarking. This is an adjustment to improve functionality and areas of inference for identifying Circular Challenges,
4. Improve the readability of the difference between CpEAP and CpEAP Blueprint.

The first recommendation is to extend the interpretation of Circular Systemic Solution 1 - Wood packaging. Previous research in the Lodzkie Region indicates that the area of Wood packaging interpreted mainly in the context of used wooden pallets does not need Circular Systemic Solutions for the most part, as the market in the Lodzkie Region is already dealing with managing this type of recyclable material efficiently. On the other hand, the issue does not apply to all wood waste, so it is recommended to extend the interpretation of CSS1 to unused wooden secondary raw materials in the future.

Furthermore, during the implementation of the CpEAP in the Lodzkie Region, the scope of the Resource Missions was arbitrarily defined based on the assumptions in the Frontsh1p project and contract. Of course, the focus on selected key areas of the Resource Mission and the identification of circular systemic solutions in this scope is appropriate and justified. However, during the various meetings and discussions between CTC stakeholders, other areas of the Resource Mission that have the potential to participate in the circular transformation process actively and have the potential to create circular systemic solutions are also noted. In the future, it is recommended to include the cluster of secondary resources in the Resource Missions, which today have the character of garment waste. This direction is particularly justified due to the long-standing industrial traditions of the Lodzkie region's textile industry (Fig. 5). As a consequence, the region has a robust stock of tangible and intangible capital related to the textile industry and a considerable stock of implicit and explicit knowledge in the area of textile production and properties. The problem of clothing waste affects almost every region. Hence, the need for development and replication potential in this area of circular activity is excellent.

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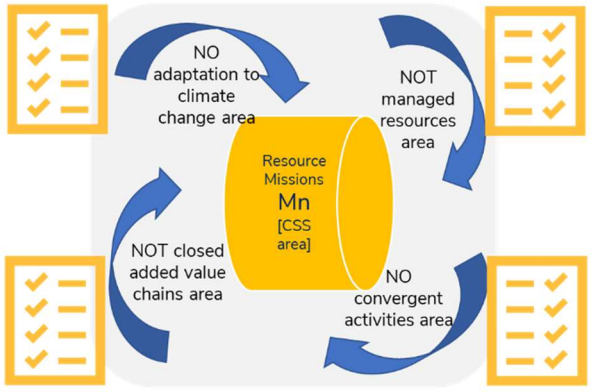
Figure 5. Recommended extension of CSS1 and identification of other Resource Missions in the future

Source: own study

The following recommendation for operationalising the CircuPuncture Model concerns clarifying the use of the 4NO Filter in identifying Resource Missions. This weakness was not revealed earlier, during the implementation process of the CircuPuncture Governance Model in the Lodzkie Region, due to the arbitrarily established Resource Missions, i.e. CSS areas, in the Frontsh1p project contract. On the other hand, during the implementation of the replication strategy, the need for more precise refinement of the 4NO Filter tool became apparent in the replication regions. Hence, in the future, it is recommended that the tool's characteristics be supplemented with in-depth characterisations of the individual four criteria and instructions for their application (Fig. 6).

Figure 6. Recommended areas for interpretation of the 4NO Filter criteria



Source: own study

Another recommendation is to change the functionality and concluding areas from benchmarking to identifying Circular Challenges. The modification consists of replacing the subject of the conclusion. The conclusion to stakeholders has been dropped, with the conclusion revealing process activity gaps in the resource area. Circular Institutional Benchmarking was replaced by the tool Resource

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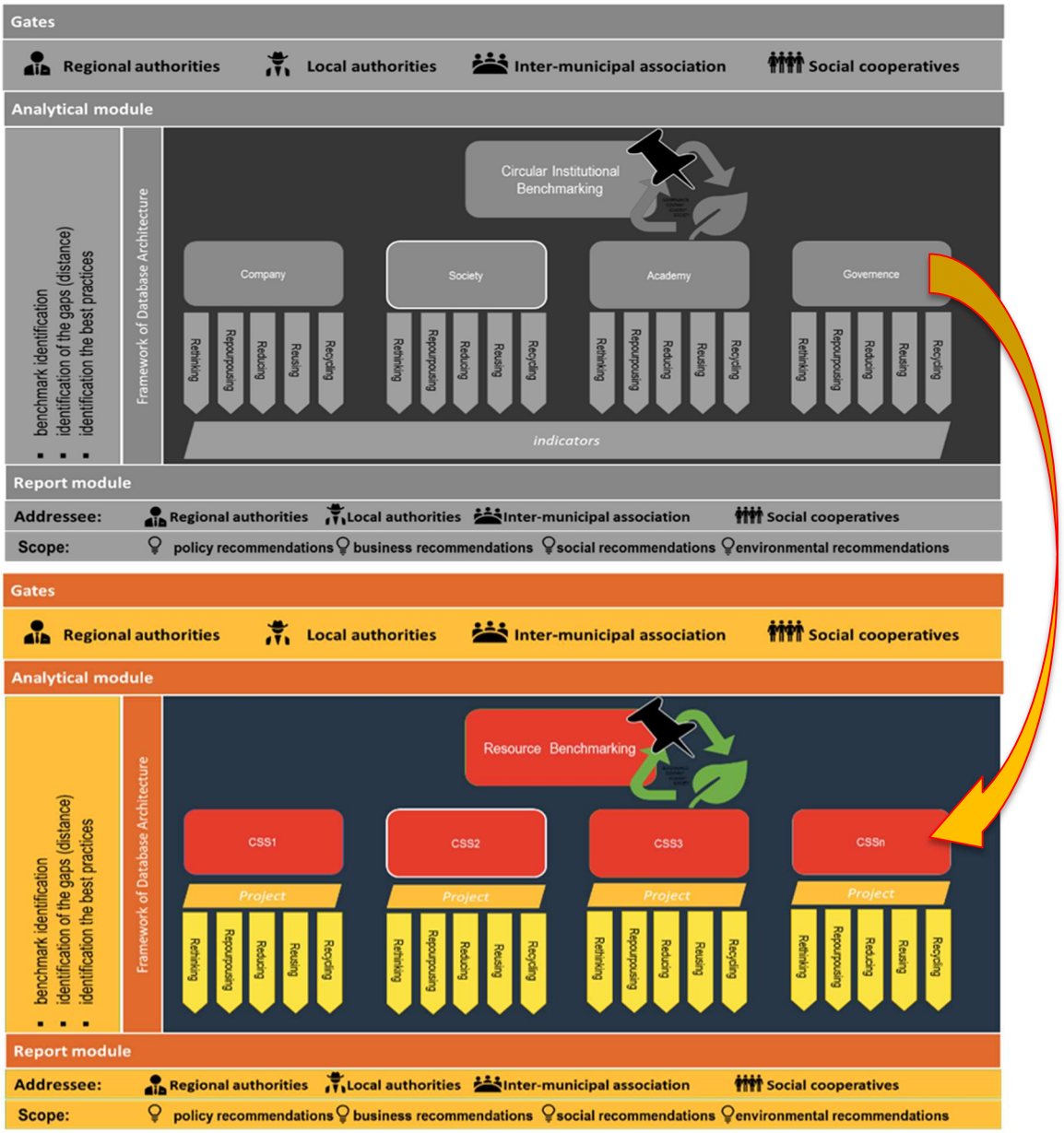
Benchmarking (Fig. 7). This adjustment was already made during the implementation of the CircuPuncture Governance Model in the Lodzkie Region and the creation of the CpEAP.

Figure 7. Scope of adjustment in the benchmarking tool supporting the identification of Circular Challenges in the CircuPuncture model



Source: own study

An innovative solution of a spin-off nature in the Frontsh1p project is the development of a second (additional) implementation path for the CircuPuncture model at the Circular Economy Action Plan level. This tool has been named the CpEAP Blueprint. Due to the similarity of the names and, at the same time, a completely new design solution, there is often a misunderstanding among the recipients of the difference between CpEAP and CpEAP Blueprint. The recommendation is to improve the readability of using CpEAP and CpEAP Blueprint. These tools are identical in their structure and function. CpEAP is dedicated to territorial units and other territorial social co-operatives (e.g., unions

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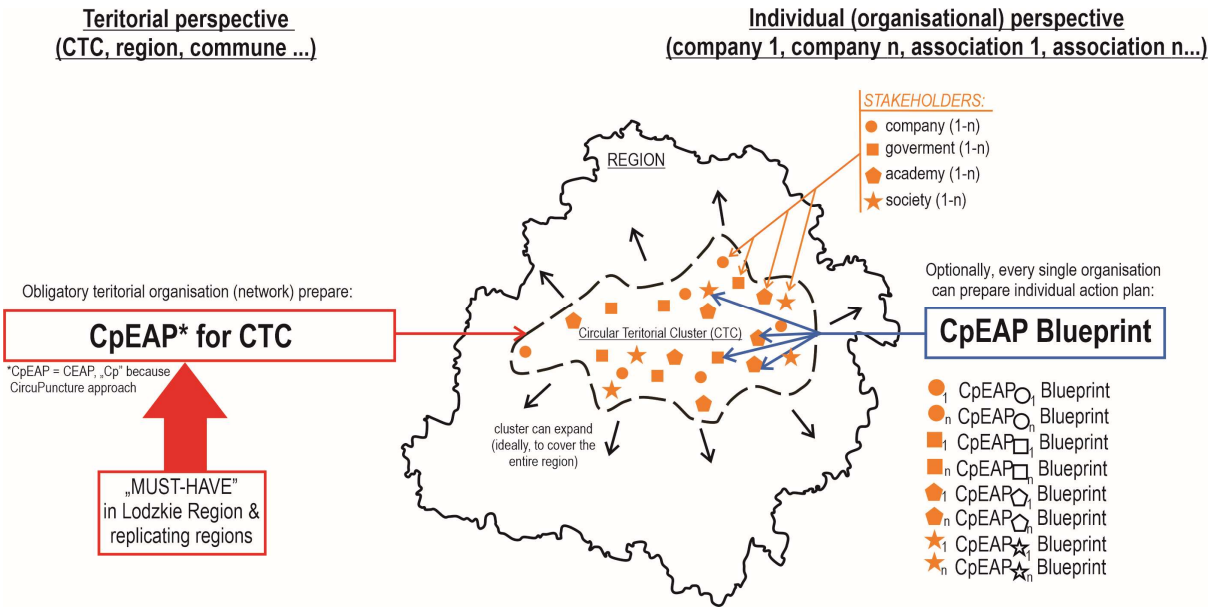
and associations of local authorities, housing associations, etc.), while CpEAP Blueprint is a tool dedicated to a specific organisation (authority, company, university, school, NGO, etc.) (Fig. 8).

Figure 8. Recommended CpEAP and CpEAP Blueprint



Source: own study

Implementing the CpEAP Blueprint in all Regional Cluster Team entities is recommended as a first step. The aim is to raise self-awareness and identify actions to strengthen resource efficiency in the circular economy. The aim is also to show a good example to cooperating organisations, especially those interested in circular transformation.

3.4. Recommendations for Circular Local and Regional Policy in expert opinion – impact on CpEAP

Recommendations for shaping the conditions for the circular transformation of the local and regional economy were also made through in-depth interviews with local and regional experts. 11 IDIs were carried out with respondents from the region and local government involved in planning, implementing and managing CE and respondents from the institution supporting and controlling processes of CE in the region. The research made it possible to identify recommendations for local and regional policy direction.

First, doubts about the scope of public sector intervention in the region's economy were verified. In the opinion of most experts, public intervention in secondary raw materials, plastic, wood waste, and wastewater does not violate the rules of the market. This intervention at both the regulatory and operational levels is desirable. Only in the area of green waste is expert opinion split in half. Half of the experts recognise that, in this area, the involvement of public sector activities pushes out private companies.

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On the other hand, the experts are almost unanimous (7 opinions out of 11, one undecided vote) that there is unhealthy and destructive competition between secondary raw material companies. Only three experts considered that companies cooperate to strengthen their position and expand their markets. In other words, the market requires local and regional policy intervention and coordination. This is confirmed by the almost unanimous opinion that waste management operators operating in the Lodzkie Region try to use their monopolistic, oligopolistic position) by trying to force their conditions on their suppliers or customers (8 opinions, 1 against and 2 not clear).

The experts almost unanimously recommend that local and regional policy should primarily act as a regulator in the circular transformation process. Most experts also believe that public sector companies should not dominate the market for secondary raw materials and waste management in the long term (5 opinions; 3 against and 3 undecided). Interestingly, the experts also do not have a precise opinion on whether municipalities and their representatives should be prosumers in this market. Experts point out that this indecision is mainly due to the lack of clear legal regulations at the EU and governmental level regarding the energy sector's market and institutions. The lack of information and predictability of the behaviour of operators in this sector creates a high state of uncertainty and reluctance to advise a broad investment stream.

The experts' opinions are roughly 50/50 in assessing the completeness of the regulations in each important CSS area from a Frontsh1p perspective (plastic, wood waste, wastewater and green waste). In particular, experts from the public sector, IDI respondents, are reserved in assessing their effectiveness. Only one person believed that the effectiveness of public entities' support for actors who want to enter the waste management market, the market for recyclables or actors who care about the circularity of their products is entirely satisfactory. 4 experts are of the opposite opinion. On the other hand, as many as six people did not have a clear opinion, considering, for example, that a lot can still be done using, for example, support through the Green Public Procurement system. The GPP system is still of marginal importance for the circular transformation of the region. At the same time, experts give a fairly good assessment of the willingness of public institutions to adapt and be flexible in their decision-making on CE matters. Five respondents indicate that public institutions in the Lodzkie Region are open to new areas of intervention, services, training, new strategy directions and investments in CE (3 people think the opposite, and another 3 have no clear opinion).

According to experts, the situation is interesting and favourable concerning residents. Residents adapt well to secondary raw materials management rules, especially regarding plastic by-products and green waste. On the other hand, water and wood waste should be a particular area of local policy intervention. Wastewater problems usually relate to unproductive, uncontrolled, and illegal discharges, resulting in environmental pollution. The second challenge is related to registration and documentation. In contrast, recommendations for local policy on wood waste relate to effective management. Some residents, especially in rural areas, use this waste for heat energy in inefficient household cookers. A major drawback in this scope is air pollution and CO_2 emissions. It is recommended to continue in the direction of replacing traditional cookers with ecological, low-emission boilers. Assessing the inhabitants' willingness to change and accept the new circular economy conditions is challenging. 4 experts indicate a high level of environmental awareness among residents and a high acceptance of circular transformation. Only one expert assesses this tendency differently. However, as many as six experts assess this condition ambiguously. Hence, it is also recommended to continue investing in raising environmental awareness, especially in understanding

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the needs of a circular economy. The experts see an urgent need for more involvement of the inhabitants in waste management in each of the surveyed areas. They particularly emphasise the need to involve residents in closed-loop processes for wastewater and green waste management (corresponding 9 and 10 indications). The experts also recommend paying particular attention to awareness-raising activities. Most respondents believe the existing regulations do not affect the possibility of creating long-term cooperation networks in secondary raw materials management (6 opinions, 2 against and 3 undecided). This assessment applies to the possibility of cooperation between residents and other stakeholder groups, especially companies and scientists.

To strengthen cross-sectoral cooperation on CE in the Lodzkie Region, experts recommend:

- Invest in instruments and areas to strengthen the tendency, possibilities, opportunities, and benefits of knowledge sharing in the CE area (networking, study visits, collaborative projects, etc.). The majority of respondents believe that those involved in CE activities do not see the need or have a low tendency to share their knowledge (6 opinions, 4 against and 1 undecided);
- Activate regional research institutions to cooperate and search for new systemic organisational, technological or product solutions (CSS) to strengthen closed-loop in companies and other institutions and households. The knowledge supply regarding CE research institutions in the region is very low or unrevealed. According to experts, both the first and second reasons result in its low availability. This situation applies to a similar scope to all four areas of the Resource Mission: plastic, wood waste, wastewater, and green waste (7-5 opinions, 1-2 views against).
- Strengthen the completeness and utility of information available in databases, especially external ones. The aim is to improve the availability of market information in the area of waste and secondary raw materials management. None of the experts evaluated the existing databases positively. Seven directly expressed negative opinions, while 4 had no opinion.
- Use the knowledge gathered locally by individual entities (local authorities, public institutions, companies) to build a knowledge platform on the current status and availability of secondary raw materials in the Lodzkie Region. Experts estimate that locally maintained databases by individual entities often have high utility. However, this knowledge is hidden. The challenge and recommendation for regional authorities in this area is to build an integrated knowledge system or a distributed blockchain system with interoperability properties.

It is worth noting that, compared to 2022, the assessment of the secondary raw materials market in the Lodzkie Region in the opinion of experts representing public entities has improved significantly (Table 2). The experts note the greatest change in the area of externalities. Although there are still important challenges in strengthening the conditions for circular transformation, the situation has improved in the areas of authority support for entering and existing market players, the behaviour of market players and the impact of existing regulations on the possibility of establishing long-term cooperation and networks. Significant changes are also indicated in the public good and information asymmetry. There has been minimal change in the assessment of market imperfection in the area of incompleteness of the market. No change was recorded in the area of imperfect competition.

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Table 2 Comparison of assessments of areas of market failure for secondary raw materials in the Lodz region in 2022 and 2024 from the Government's perspective

Market participant:	GOVERNMENT		
Characteristics of the IDI research target group:	Representatives of the region and local government involved in planning, implementing and managing of CE Representatives of the institution supporting and controlling processes of CE in the region		
Type of market failures	Question to identify market failure	Synthetic assessment of market failure occurrence	
		2022	2024
Imperfect Competition	▪ number of operators in the municipal and industrial waste market ▪ competitiveness of public enterprises ▪ type of relationship between market players (openness to cooperate) ▪ compliance with current waste management rules by the public ▪ openness of society to new solutions in CE	3,2	3,2
Public Goods	▪ the role of the authorities in the market ▪ flexibility in decision-making by authorities ▪ evaluation of law regulations on the market of secondary raw materials	4,0	2,6
Externalities	▪ authority support for entering and existing market players ▪ behaviour of market players as market barriers ▪ the impact of existing regulations on the possibility of establishing long-term cooperation and networks	5,0	2,5
Incompleteness of the market	▪ number and type of market actors vs. level of need satisfaction ▪ adequacy of the offer of R&D on the market (availability of new solutions) ▪ the possibility of greater participation of residents in the market	3,3	3,0
Information Asymmetry	▪ willingness of secondary raw material market actors to share knowledge and information ▪ database interoperability	4,5	3,1

Source: own study

A study carried out by SLOM discovered interesting recommendations addressed to the CpEAP update. The survey had a diagnostic character. The aim was to identify the needs of the members of the Lodz Metropolitan Area Association in terms of priority directions for action in the area of circular economy. The survey was conducted as an online questionnaire supported by a telephone call. Out of 26 local government units participating in the survey, 19 expressed needs regarding implementation and investment in the circular economy (1 unit replied that it had no needs, and 5 municipalities gave no reply). The most frequent needs expressed by respondents were for the need to strengthen awareness through environmental and informational activities addressed to the inhabitants, investments in composting, organisation of exchange and repair points and specialised places for selective storage of secondary raw materials intended for re-marketing (organisation of PSZOK - Selective Waste Collection Points). It was also indicated less frequently managing rainwater and

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snowmelt resources and green waste. That is, the postulates related to the areas of intervention of the two Resource Missions in the CPEAP: CSS2 and CSS3. Detailed indications from respondents are included in Table 3

Table 3. Recommendations on proposed investment directions for building CE submitted by SLOM municipalities

Scope of activities recommended	Particular types of action
Construction of a composting and biogas plant system	Building a municipal composting plant Information campaigns on the building of biogas plants in rural areas Home composting systems Solar drying of biomass
Rainwater management	Individual rainwater storage systems Development of a small retention system for rainwater and snowmelt
Development and multifunctionality of PSZOK	Development of the Selective Waste Collection Points (PSZOK) The organisation of repair points at PSZOK Increase availability of PSZOK through computerisation and App Economy tools Increase availability of small-scale architecture to enhance circular economy (infrastructure for waste sorting, alternative energy use, rainwater, etc.).
Environmental education	Demonstration lessons Field trips Educational festivals Competitions to promote circular economy Involvement of local businesses in activities in the area of circular economy Involvement of tourists in promotion and activities for CE
Management of textile waste	Strengthening textile recycling systems through reuse or upcycling Management of textile waste
Construction of a cross-municipal waste sorting plant	Analysis of needs and available solutions Development of a municipal waste sorting plant
Management of agricultural foils	Identification of technologies and directions for the management of agricultural foils
Installation of pro-ecological solutions for the production of electricity used in public utility services	Installation of energy-efficient street lighting systems

Source: own compilation based on Wojdal & Żak-Skwierczyńska (SLOM) Research 2024

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4. Business recommendations regarding new business models and new value chains for companies involved at the regional level

4.1 Frontsh1p project values - to support circular business models

Effective policy and governance are critical for the successful development of circular business models. By creating a supportive legal, financial, and infrastructural environment, national, regional and local governments can accelerate the shift to a circular economy, helping businesses thrive sustainably while addressing pressing global challenges like resource depletion, climate change, and waste.

The FRONTSH1P project positions policy and governance as foundational pillars in supporting circular business models. By aligning with EU-level directives and engaging with local and regional governance structures, the project creates a favourable environment for businesses to innovate and adopt circular practices. Through targeted regulations, financial incentives, and public-private collaborations, policy frameworks drive systemic change and enable the transition to a circular economy.

The following policy and governance aspects to support regional and local development of circular business models are addressed in the FRONTSH1P project:

- **Alignment with EU Circular Economy Action Plan (CEAP):** The FRONTSH1P project operates within the framework of the European Green Deal and the **EU Circular Economy Action Plan**, which aims to make sustainable products the norm in the EU. The CEAP and the CpEAP, originally developed within the project, support the development of circular business models by promoting policies that prioritize waste reduction, resource efficiency, and product design for durability, reuse, and recycling. FRONTSH1P aligns with these EU-level policies by piloting and scaling circular economy solutions in regional and local contexts, ensuring that businesses comply with evolving EU regulations and circular principles.
- **Regional and National Policy Support:** The FRONTSH1P project targets regional ecosystems and value chains, particularly in Lodzkie Region (Poland) and replication regions in Italy, Portugal, Greece and Netherland, where local policies and governance structures are critical to fostering circular business models. National and regional governments play a central role in creating enabling environments by aligning their strategies with EU directives on sustainability, waste management, and climate action. The project collaborates with local policymakers to implement region-specific policies that address unique challenges of circular business models implementation.
- **Policy as a Driver of Systemic Innovation:** Within FRONTSH1P, policies are not just seen as regulatory frameworks but as drivers of systemic innovation leading to the development of circular business models. Governance structures are critical for coordinating multi-stakeholder collaboration across industries, research institutions, and government agencies. The project encourages the integration of circular economy principles into regional innovation policies,

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helping businesses design new value chains that close material loops and reduce dependence on virgin resources.

- **Governance Mechanisms Supporting Circular Business Models:** The FRONTSH1P project emphasizes the role of governance in establishing the necessary mechanisms for circular business models to thrive. This includes:
  - **Extended Producer Responsibility (EPR):** Encouraging manufacturers to take responsibility for the entire lifecycle of their products.
  - **Public-Private Partnerships (PPPs):** Facilitating collaboration between public authorities and businesses to create shared circular infrastructure.
  - **Green Public Procurement (GPP):** Encouraging governments to adopt sustainable procurement policies that prioritize circular products and services, thereby creating demand for circular businesses.
- **Regulatory Support for Circular Value Chains:** One of the core goals of FRONTSH1P is to create **circular value chains or value circle** in sectors like manufacturing, waste management, and agriculture. Policy and governance frameworks are necessary to support the integration of businesses across these sectors, ensuring that by-product from one industry becomes a resource for another. Local governments can provide regulatory support by encouraging resource exchange, waste recovery, and the use of secondary raw materials through subsidies, tax incentives, and streamlined permitting processes.
- **Promoting Circular Economy Standards and Certifications:** In line with FRONTSH1P's objectives, policies that promote circular economy standards and certifications (such as the **EU Ecolabel** or **Cradle to Cradle Certification**) play a crucial role. By endorsing and regulating such standards, policymakers ensure that businesses within the FRONTSH1P project meet recognized benchmarks for sustainability. This helps create market trust, ensuring that circular products and services are competitively positioned in the market.
- **Innovation-Friendly Regulatory Environment:** FRONTSH1P seeks to foster a regulatory environment that encourages **circular innovation**. Policies that support research and development in circular technologies, such as recycling processes, waste valorization, and sustainable product design, are critical. Governments within the project's regions can provide funding for R&D, intellectual property protections, and innovation hubs to help circular startups and established businesses scale their solutions.
- **Education and Capacity Building through Governance:** The FRONTSH1P project acknowledges that policy-driven education and awareness programs are essential for building the capacity of businesses and consumers to embrace circular models. Policies that incorporate sustainability education, workforce training, and consumer awareness campaigns foster an ecosystem where circular products, services and generally – circular practices can flourish.

Project framework and core pillars of circular business models development:

- Circular Economy Integration – The Frontsh1p project focuses on embedding circular principles into regional value chains by encouraging companies to adopt practices such as waste reduction, resource recovery, industrial symbiosis creation, and closed-loop production cycles.

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Circular governance model from the perspective of local and regional authorities as well as from the perspective of different stakeholders has been developed. (D2.6.).

– Addressing Global Megatrends (D.2.2) – Frontsh1p actively responds to current global megatrends that are reshaping industries and economies, including:

  #Circular Economy: Moving away from the traditional linear "take-make-dispose" model to one focused on sustainability, waste minimization, and resource reuse.

  #Shared Economy: Encouraging the adoption of shared resources, products, and services to optimize efficiency and reduce overproduction.

  #On-Demand Economy: Adapting to the increasing demand for personalized, on-demand services and goods, ensuring that production aligns more closely with consumption patterns to minimize waste.

  #App-driven Economy: Leveraging digital platforms and mobile applications to drive efficiency, collaboration, and real-time decision-making across businesses and consumers in the region.

– Collaboration and Cluster Development – A key element of the Frontsh1p project is the formation of a Circular Territorial Cluster. This cluster serves as a collaborative platform where businesses, local governments, and academic institutions can exchange knowledge and co-develop solutions that drive regional circularity.

– Policy Support and Innovation – By engaging with local policymakers, Frontsh1p aims to create a favourable environment for circular innovations, supporting both regulatory measures and incentives that encourage businesses to transition to sustainable practices.

Baseline analysis within the Frontsh1p project were focused on identifying the current state of circularity in the Lodzkie Region (D.2.1.). Key insights included:

- Low levels of resource recovery: Existing businesses predominantly operate within linear value chains, resulting in inefficient use of materials and significant waste generation.
- Fragmented collaboration: Although there are various stakeholders interested in circular practices, there is limited coordination and knowledge-sharing across sectors.
- Regulatory gaps: The Lodzkie Region lacks comprehensive policies that would accelerate the adoption of circular economy models by businesses.

These findings underscore the need for systemic changes, including better cooperation among stakeholders, increased investment in circular technologies, and stronger policy support to drive the transition.

The conclusions and insights from this sub-chapter will be crucial for shaping the performance of future project deliverables, particularly:

D2.5: Financing solutions for cluster and cluster stakeholders & VER scheme.

D7.3 Circular economy business models and roadmap to regional enhancements.

The future development of the circular economy in the Lodzkie Region can leverage the outcomes of the Frontsh1p project by focusing on supporting circular business models by offering the regional

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companie's practical tools and frameworks that facilitate the transition to circular operations. The role of the Circular Territorial Cluster is emphasized: the cluster can play a key role in long-term sustainable development and promoting the idea of local/ regional coopetition and open innovation instead of competition.

4.2 Understanding circular business models and circular value chains: definitions and comparison with linear business models

A circular business model is a type of business model designed to break away from the traditional linear "take-make-dispose" approach, focusing instead on sustainability by minimizing waste and maximizing resource efficiency. In circular models, products and materials are kept in use for as long as possible, either through reuse, recycling, refurbishment, or remanufacturing, thereby creating closed-loop systems where waste becomes a resource. This approach aims to reduce environmental impact, conserve natural resources, and create economic value by extending the life cycle of products and materials.

There isn't just one type of circular business model. Researchers and experts in this field identify numerous classifications. One such classification, developed by the organization Forum for the Future, highlights 10 archetypes of circular business models, dividing them into two distinct categories: truly circular business models and supportive business models.

The truly circular business models represent those that fully embrace the principles of the circular economy, where the entire value chain operates in a closed-loop system. This means resources are continuously cycled back into the production process, waste is minimized or eliminated, and products are designed for durability, reparability, and recyclability. These models focus on long-term sustainability and resource regeneration, addressing the complete lifecycle of products and services.

In contrast, supportive business models play a crucial role in facilitating the transition to a circular economy. While they may not operate in fully closed-loop systems themselves, they contribute by providing services, infrastructure, or innovations that support circular practices. This could involve optimizing the use of resources, extending the life of products, or enabling sharing and reuse systems. These models often serve as stepping stones for companies looking to move toward more comprehensive circular approaches.

By distinguishing between these two groups, the Forum for the Future's classification provides a nuanced understanding of how different business models can contribute to circularity [https://www.forumforthefuture.org]. It acknowledges that while some businesses are already operating in a fully circular manner, others are in the process of evolving, offering valuable support in various aspects of the circular economy. Together, both groups play an essential role in driving the global transition towards sustainability.

Alternatively, Jonker, Faber, and Haaker present a classification that identifies seven types of circular business models. These models reflect different approaches to integrating circularity into business operations. The seven models in their classification are:

1. **Resource Models** – Focused on optimizing the use of resources through practices such as resource recovery, reuse, and minimizing waste in production processes.

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2. **Design Models** – Emphasize designing products with circularity in mind, ensuring that products are durable, repairable, and easily recyclable.
3. **Lifetime Extension Models** – Aim to extend the lifespan of products through strategies like repair, refurbishment, and remanufacturing, reducing the need for new resources and minimizing waste.
4. **Platform (Sharing) Models** – Involve sharing platforms where users can access products and services without owning them, promoting more efficient resource utilization (e.g., car-sharing or tool-sharing platforms).
5. **Product-as-a-Service (PaaS) Models** – Instead of selling products, businesses offer them as a service. For instance, customers pay for the utility of a product (e.g., renting equipment) rather than owning it, and the company retains ownership and responsibility for the product's lifecycle.
6. **End-of-Life Models** – Focus on managing products at the end of their lifecycle, ensuring that materials and components are recovered, recycled, or safely disposed of, minimizing environmental impact.
7. **Lifecycle Models** – Encompass the entire product lifecycle, integrating circular practices at each stage, from design and production to end-of-life management, ensuring a fully circular approach to business.

Van Renswoude et al. [2015] offer another classification, dividing circular business models into six distinct archetypes, each representing different strategies for achieving circularity. These are:

1. **Short Cycle** – Includes models that emphasize short product lifecycles, such as pay-per-use systems and repair services, which keep products in circulation for longer without requiring new resources.
2. **Long Cycle** – Refers to models based on performance-based contracting, where companies focus on maintaining and extending the life of products through continuous service, repair, and optimization.
3. **Cascades** – Focuses on upcycling and recycling practices that ensure materials are repurposed or reused in multiple cycles, extracting the maximum value from resources before they are fully disposed of.
4. **Pure Circles** – Based on the cradle-to-cradle approach, this model ensures that products are designed to be fully recyclable or biodegradable, creating a closed-loop system where waste is eliminated entirely.
5. **Dematerialized Services** – Involves replacing physical products with virtual services, reducing the need for material resources (e.g., digital media replacing physical books, movies, or music).
6. **Produce on Demand** – Focuses on manufacturing products only when there is a demand, reducing overproduction and waste. This can include methods like producing on order or utilizing 3D printing technology for customized products.

These two classifications, by Jonker et al. and van Renswoude et al., highlight the diversity of approaches that businesses can adopt to integrate circular economy principles. Whether through

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resource efficiency, product lifecycle management, or innovative service models, these frameworks offer companies various paths to contribute to a sustainable and circular economy.

Lacy and Rutqvist [2015] also provide a classification of circular business models, highlighting several fundamental types, each with distinct features and applications:

1. **Circular Supply Model** – This model focuses on replacing traditional, single-use, biobased materials with renewable or fully recyclable alternatives. Companies that adopt this model often invest heavily in research and development of new materials and production technologies, aiming to close material loops within their supply chains.
2. **Resource Recovery Model** – Cantered on extracting value from by-products or waste, this model is employed by businesses that specialize in advanced recycling technologies, upcycling, or converting waste into energy.
3. **Product Life Extension Model** – This model aims to extend the useful life of products through repairs, upgrades, refurbishment, or remarketing. Companies using this approach often provide after-sales services, exchange programs, or platforms for selling used goods.
4. **Sharing Platform Model** – This model promotes the sharing of underutilized assets or resources among multiple users, often leveraging digital technologies to efficiently match supply with demand.
5. **Product as a Service Model** – Rather than selling products outright, this model offers customers access to products without ownership. It typically involves innovative leasing or subscription schemes, with the producer retaining responsibility for the product's lifecycle.

According to Lacy and Rutqvist [2015], the key characteristics of circular business models include:

- **Design for Circularity:** Products are designed with the aim of easy disassembly, repair, and recycling. This ensures that products can be reused or repurposed efficiently, reducing waste and extending their lifecycle.
- **Closed Material Loops:** The goal is to eliminate the concept of "waste" by transforming residual materials into valuable resources. In this model, materials are reused and circulated continuously rather than being discarded.
- **Use of Renewable Energy:** Emphasis is placed on using energy sources with a low carbon footprint, prioritizing renewable energy over traditional, fossil-fuel-based sources. This helps in reducing environmental impact and promoting sustainability.
- **Systems Thinking:** Circular business models take into account the entire business and environmental ecosystem when making decisions. This means considering the interdependencies between various components, such as supply chains, resource use, and environmental impacts, to create more sustainable outcomes.
- **Innovation:** There is a continuous search for new technological and organizational solutions that support circularity. Innovations can range from product design to business operations and supply chain management, all aimed at making the system more sustainable.
- **Cross-Sector Collaboration:** Building partnerships and alliances across different sectors is essential for achieving synergies in closing material loops. Collaboration with various

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stakeholders, including suppliers, customers, and even competitors, is encouraged to facilitate shared benefits.

- **Transparency and Traceability:** Implementing systems that allow for the tracking and monitoring of material and product flows throughout their lifecycle is critical. This not only ensures accountability but also enhances the efficiency of the circular system by identifying areas for improvement.
- **Flexibility and Adaptability:** Circular business models are designed to quickly adapt to changes in the market and technological advancements. This flexibility allows businesses to remain resilient and competitive in a dynamic environment.
- **Value Creation for Stakeholders:** The model focuses on creating value not only for shareholders but for a broader group of stakeholders, including local communities and the environment. By considering the interests of multiple parties, businesses can achieve more sustainable and socially responsible outcomes.

These characteristics represent the pillars of circular business models, emphasizing sustainability, collaboration, and long-term value creation across the entire business ecosystem.

Jonker et al. [2022] describe seven key characteristics of circular business models, which can be viewed as seven areas of inquiry. These questions are crucial for determining the circularity of a business model and should guide the creators of a circular business model during its development stage. The seven characteristics are:

1. **Focus** – This addresses the question: *What is the primary business goal?* It's important to define the main objective that drives the business model, ensuring alignment with circular principles, whether it's reducing waste, maximizing resource efficiency, or promoting sustainability.
2. **Value Creation (Multiple)** – The focus here is on answering: *What values will this business model create, and for whom?* In a circular model, value creation goes beyond profit and includes benefits for multiple stakeholders, such as customers, suppliers, communities, and the environment. It encourages looking at how the model provides economic, social, and environmental value.
3. **Organisation** – This asks: *What kind of organization is required for this business model?* The structure of the organization needs to be designed to support the circular business model, which could involve rethinking supply chains, roles, and partnerships to ensure the smooth functioning of circular practices.
4. **Strategy** – This focuses on: *Which of the "R-strategies" or combinations of strategies best fit this business model?* The R-strategies refer to key strategies in circularity, such as reuse, recycle, refurbish, and reduce. The model must identify which of these strategies—or a mix of them—will drive its operations.
5. **Support** – This question looks at: *What supporting processes are critical for this business model?* For a circular model to succeed, it requires certain processes, systems, and infrastructures that enable key activities. This could include systems for material tracking, recycling processes, or technology that facilitates resource recovery.

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6. **Revenue Model** – This focuses on: *Which revenue model or combination of models best suits this business model?* Circular business models often demand innovative revenue mechanisms, such as subscription services, leasing, or pay-per-use, rather than traditional one-time sales. The choice of revenue model should complement the circular practices and provide long-term financial sustainability.

7. **Impact** – Finally, this addresses the question: *What impact will the implementation of this model have?* This looks at the actual outcomes of the model in practice, assessing both the positive and negative effects. The impact includes how it influences the environment, society, and the business itself, and what benefits or challenges arise from its adoption.

These seven areas form a comprehensive framework for evaluating and designing circular business models, ensuring that all critical aspects are addressed from the initial stages of development. By focusing on these questions, businesses can align their models with circular economy principles while maximizing value creation and minimizing environmental impact.

4.3 Recommendations for developing the circular economy, defined by companies in 2022 and 2024

Conducted in 2022 for the Frontsh1p project, the research (D2.1.) was aimed at identifying areas of imperfection in the broader market for recyclables in the Lodzkie region. For the study, we assumed that by this term, we mean segregation, storage, disposal, processing, reuse, landfill, utilization, energy recovery, or transportation.

The surveyed entrepreneurs had the opportunity to comment on the main market failures limiting the possibility of implementing a circular economy in the Lodzkie region. Given that the survey was planned as a dynamic study implemented cyclically, it was repeated in 2024. This allows us to observe changes in respondent assessments and infer changing needs over time. This also provides an opportunity to develop recommendations for entrepreneurs relevant to their current situation and market realities. What should primarily be viewed positively is that, except for one area of market failure identified for the study, all others show positive changes in evaluations (Tab.4).

Table 4. Comparison of company assessments of areas of market failure for recyclables in the Lodz region in 2022 and 2024

Market participant:	COMPANY		
Characteristics of the IDI research target group:	Companies – representatives of the CSSs: wood, plastic, water, food and other companies involved in CE (i.e. waste collection and recycling)		
Type of market failures	Question to identify market failure	Synthetic assessment of market failure occurrence	
		2022	2024
Imperfect Competition	• number of entities on the market • type of relationship between market players (openness to cooperate) • activity of public institutions on the market	4,3	3,1

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Public Goods	• evaluation of the regulations related to the activities of secondary raw materials market operators	5,0	3,3
Externalities	• consumption patterns • cost-effectiveness of using secondary raw materials	4,5	3,6
Incompleteness of the market	• number of secondary raw material suppliers on the market • availability of secondary raw materials on the market • complexity of the value chain • the entry barriers to the market	4,3	2,8
Information Asymmetry	• utilities of data on the secondary raw materials market • access to information on new techniques and technologies • willingness of/ secondary raw material market actors to share knowledge and information	3,3	3,5

Source: own compilation

In 2022, the surveyed entrepreneurs from industries related to the CSSs selected in the project highlighted public goods as the main imperfection in the recyclables market (see Table 4). In their view, the biggest problem in 2022 was the current regulations and how public institutions interpret and apply them. One respondent even spoke of "beating their heads against the wall" due to legislative absurdities. In addition, according to respondents, public entities are favoured in tenders, making it difficult for private entities to compete. Another problem was regulations that made it difficult to process and use waste as a secondary raw material. Furthermore, heavily formalised procedures forced entrepreneurs to spend a lot of time dealing with official matters related to their business. According to information from 2024 respondents, this situation has improved. While it would appear directly from the assessments that there could be a significant change in favour (a decrease from a maximum of 5.0 in 2022 to 3.3 in 2024), their statements indicate that the regulations are still complicated, especially from the point of view of smaller market players who do not have their own adequately developed legal and financial departments and/or have limited resources to devote to specialised external assistance in this regard. One of the respondents said that the current regulations are a "massacre" and impose a considerable number of additional obligations on entrepreneurs and the need to implement additional procedures. He pointed to 2018 as the point at which the situation in this regard began to change to the disadvantage of entrepreneurs. Considering the matter at the level of individual CSSs, it can be seen that the incidence of inadequacies in public goods is less of a problem for those in CSS 2 (Food and feed), especially CSS4 (Plastics), than for those in CSS 1 (Wood packaging) and CSS 3 (Water and nutrients) (see Table 4).

In this situation, further legislative work to simplify existing regulations seems justified. For this to happen and for the changes to be in line with the expectations of entrepreneurs, the latter should be involved to a greater extent in developing friendly legislation for them, both at the level of preparing specific legal solutions and evaluating the effects and implementation. For this, there is a need to change the perception of lobbying as a solution that promotes good changes and affects the development of the circular economy rather than as a potential source of abuse and the settlement of vested interests. In this context, it seems reasonable to create a network of cooperation (a kind of cluster, but preferably at least national in scope) of economic entities already involved in the

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development of the circular economy but also willing to engage in this area of activity. It could be a lobbying group, promoting needed changes and engaging in lawmaking processes as an advisory body. However, not only lawmaking poses problems, but also their interpretation and enforcement on the part of public institutions, or rather, the people working in them (officials). The low level of knowledge and competence indicated by entrepreneurs in the Lodzkie region does not support the belief in the stability of laws and their uniform interpretation by all public institutions. Of course, it is impossible to make a law considering all possible cases in its provisions. Still, it seems necessary to increase the activities of ministries and public institutions at the central level to inform lower-level institutions about the interpretation of the law being made. This should reduce the uncertainty of entrepreneurs and increase their willingness to engage in new circular solutions. Indeed, public authorities should also strive to improve the knowledge and competence of their officials, but without increased funding for training and advisory activities, it will be challenging to realise this demand.

In 2024, the most highly rated category of market failure in the recyclables market in the Lodzkie region was the one related to the occurrence of externalities. Also, in 2022, market failure in this area was a frequently indicated and highly rated phenomenon in terms of the scale of occurrence (see Table 4). Respondents suggested that the profitability of using recyclable materials depends on their type. First, primary materials with simple components are cheaper than secondary raw materials. Second, secondary raw materials with more complex components are limited. Similar opinions could also be encountered during the 2024 survey, with problems arising from inadequacies in externalities being more of a concern for those in CSS 1 and CSS 2, rather than CSS4, especially CSS 3 (see Table 2).

Entrepreneurs stressed that the profitability of using recycled materials is affected by several factors. On the one hand, it is the type of industry and even the specific type of raw material, and on the other, logistics, including the costs associated with transporting the product. A representative of a company in the non-hazardous waste treatment and disposal industry (CSS 2) said that from his point of view, the profitability of using the supplied secondary raw material and the possibility of finding a buyer is only justified in the case of short distances (up to several tens of kilometres) between the supplier, the raw material processor and the end customer. A similar opinion could also be heard from the representative of CSS 4, with the problem in his case being not too much but too little weight of the raw material compared to its volume.

Thus, efforts to collect and use recyclables should be concentrated in relatively small areas (the locality of this solution). The formation of circular territorial clusters that would shorten the length of the supply chain would undoubtedly increase the profitability of the use of secondary raw materials. The condition is to ensure that as many entities as possible that are part of the circular value chain and circular supply chain operate in it.

According to the 2024 survey respondents, seasonality and fashion changes make customers willing to change their possessions frequently, and they expect the market to do the same. Interestingly, this is influenced by solutions that have little to do with the circular economy and consumers' inclination to save, repair and reuse products that have gone out of fashion. We are talking, for example, about funds from the government's 800+ program, which has increased the public's tendency to buy new furniture or products from consumer electronics and household appliances products. The increase in these products was pointed out by a representative of one of the collectors of such electronic and bulky waste.

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This is not a good phenomenon, of course, but it offers great opportunities for improvement in this regard. However, for this, it is necessary to constantly make the public aware and create a fashion for being "unfashionable" but for being ecological (and fashionable in this regard). Entrepreneurs' approach to their products and services is also critical in this case. This involves both redesigns, i.e. designing products with greater durability, with the possibility and even guarantee of their reconditioning or repair, and repair, i.e. providing not only warranty service but also post-warranty service, as well as a system for the consumer to return the products they offer (return/recover). For this, a change in the environmental awareness of entrepreneurs and the introduction of circular changes in their business strategies is certainly needed. However, as long as most of them will be more profitable to offer cheap "disposables" with a short life cycle, it will be hard to scale up the offer of products that will serve consumers for a long time.

Another area of market failure in the secondary raw materials market, the assessment of which has improved over the past two years, was the imperfect competition of players operating in the market (see Table 4).

Entrepreneurs participating in the 2022 survey stressed that, compared to countries with a high level of circular economy implementation, Poland lacks an elaborate and well-functioning public procurement system. Nevertheless, an important issue they pointed to be the preference of public institutions for in-house entities at the expense of private entities operating in the market. This was fostered by the possibility of using the in-house formula to implement a public task. This, unfortunately, did not serve, in their view, to ensure the efficiency of private entities, which cannot compete with public entities on a free market basis. In the 2024 survey, entrepreneurs focused more on the low willingness to cooperate than on the distortion of the market by the presence of public entities in it (see Table 4). The willingness to cooperate within the entities of CSS 1 was assessed as the weakest, and CSS 2 was assessed as the best. However, the surveyed entrepreneurs believe it is impossible to function nowadays without cooperation. At the same time some of them only consider cooperation within the supply chain, between the direct supplier and later the recipient of the goods they offer. In this case, one respondent states that he cooperates with other entities but is unwilling to share knowledge or information with them. We can speak of limited cooperation, which does not fit into the concept of coopetition. Not insignificant in this case is also the collusion between companies already established in the market, which try to prevent the emergence of new players or eliminate weaker ones already on the market. The result is that 2-3 dominant players serve the market. This simultaneously constitutes a barrier to entry, discussed later in the report, which is a component of the market failure associated with market incompleteness.

It seems that it is most difficult to point to any recommendations for this market failure. Of course, it is possible to point to the need for changes in the public procurement system that would eliminate the competitive advantage indicated by entrepreneurs on the part of public entities. Still, this type of change seems unlikely at present in practice. However, this does not mean lobbying for such changes should be abandoned. As for the tendency for cooperation among second-raw materials market players, the promotion of the idea of coopetition, networking and circular territorial cluster activities and good practices by public authorities and academia should change the awareness of entrepreneurs and increase their awareness for cooperation instead of strong competition. In the case of bid-rigging and stacking up among each other by market-dominant business entities, it is advisable to intensify action on the part of existing institutions overseeing these processes (in the form of the Office of

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Competition and Consumer Protection, Public Procurement Office, the National Board of Appeals, or the Supreme Audit Office), but above all on the part of specialised law enforcement agencies such as the Public Prosecutor's Office or the Central Anti-Corruption Bureau.

Turning to the market failure of the secondary raw materials market related to the market's incompleteness, there is also a notable positive change in the assessment from those participating in this year's survey (see Table 4). This is in 2024, the area with the most minor market failure of all the areas identified in the study. This does not mean, of course, that there is nothing to improve in this area either. The collusion mentioned above between market leaders to eliminate existing players and keep new ones out can be a barrier to entry. At least as significant a barrier to entry is the very high investment required to create the appropriate infrastructure and purchase machinery and technology. In addition, starting a business involves going through the complicated procedures necessary to obtain approval for a company of this nature and to meet stricter quality requirements regarding the product (secondary raw material) produced. This mainly affects entities from CSS 2 and CSS 3. However, it is worth noting that from the respondents' declarations, the more significant problem is the availability of secondary raw materials on the market and the number of entities supplying such raw materials on the market. Subjects from CSS 4 most point out these inadequacies.

At this point, one should consider how the market could be improved (availability of secondary raw materials). It would seem that the first step would be to improve the waste collection and segregation system, which would be more responsive to the needs of those interested in obtaining and using recyclables in their business. This is a potentially undeveloped part of the market/value chain and supply chain that could, and should, be developed by those interested in changing their business models and value chains. However, this is difficult to do when, for example, waste processing facilities are built based on municipal waste management plans that are based on incomplete or even inaccurate data. After all, the potential of the secondary raw materials market in Poland is large, as the volume of waste generated by the public or businesses is, unfortunately, increasing year after year - in the case of industrial and municipal wastewater and industrial waste, or only slightly decreasing - in the case of municipal waste [Environmental Protection in 2022]. Therefore, it is not their lack, but the inadequate method of collection and segregation, as well as the lack of up-to-date and functional databases with information on the quantities and types of individual waste/recyclables generated at the local level inclusive, that is the source of this deficiency. It is therefore necessary to improve the system in this regard (access to reliable and up-to-date information). This should start already at the level of enterprises, which, being waste generators, often provide information about the quantities of this waste that is not true. A good solution in this regard is to popularise and apply waste management and environmental audits in enterprises.

This brings us to the last of the market failures in the Lodzkie region identified during the study - information asymmetry. This is the only area where respondents rated worse in 2024 than in 2022 (Tab. 4). Although the pattern of ratings at the level of the entire area of inadequacies is similar for the individual CSSs, there is a noticeably lower level of information inadequacies in CSS 4 (Tab. 5), both in the context of access to up-to-date and reliable databases and, in particular, in the context of the willingness to share knowledge among supply chain companies. This shows that within the CSS4, we have the best chance of achieving cooperation within a circular territorial cluster. On the other hand, within this CSS, entrepreneurs see the most significant lack in the availability and usefulness of data on the amount of secondary raw materials in the market, which they believe is not conducive to

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networking and hinders action planning and collaboration. As a result, the previously recommended changes to the data collection, processing and sharing system should first include waste and secondary raw materials made from plastic.

According to the respondents, access to know-how is so good that as long as one only has money, there are no significant problems in finding the necessary solutions to introduce technical and technological innovations. The situation is worse when finding know-how for circular business management processes. The key statement in this case is "as long as one only has money." Suppose we want as many companies as possible to change their business models and implement circular economy assumptions. In that case, there should be more financial support for those willing to invest and change in the spirit of the circular economy (preferably of a repayable nature so that these funds can return to the fund and be reused by other entities) and training and consulting support in the area of management (so that they know how to do it most effectively). Regardless, it is worth promoting and convincing entrepreneurs to cooperate and look for comprehensive solutions beyond a single process or even function within the supply chain. Joint financing of such solutions will lower the unit cost of the investment, increasing the possibility of its implementation.

Table 5. Comparison of assessments of the areas of market failure for secondary raw materials in the Lodz region by CSS

Type of market failures	CSS's number			
	CSS 1	CSS 2	CSS 3	CSS 4
Imperfect Competition	3	3,1	3	3,1
Public Goods	3,5	3,3	3,5	3
Externalities	3,8	3,8	3,3	3,6
Incompleteness of the market	2,9	2,9	2,3	2,9
Information Asymmetry	3,5	3,6	3,5	3,3

Source: own compilation

To conclude the section on recommendations resulting from the analysis of the research results, it is still worth looking at the data presented in Table 6, which presents a comparison and ranking of the weights of market failures for each CSS. The data presented herein was developed using the determination of weights based on pairwise comparisons, which is part of the hierarchical problem analysis (AHP) method. By calculating average ratings, it was possible to make pairwise ratings of individual areas of imperfection in terms of their relevance to the surveyed entrepreneurs from each CSS.

Looking overall at the individual market failures in the secondary raw materials market, it is clear that, from the point of view of all surveyed entrepreneurs, the area posing the least problems in pursuing circularity is market incompleteness. In contrast, the most significant area of imperfection in this regard is related to externalities, followed immediately by imperfect competition (Tab. 6). CSS 4 entities have the slightest variation in ratings.

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Table 6. Comparison of the weight and rank of market failure in the secondary raw material market for in the Lodzkie region under each CSS's

Type of market failures	CSS's number							
	CSS 1		CSS 2		CSS 3		CSS 4	
	Weight rating	Ranking	Weight rating	Ranking	Weight rating	Ranking	Weight rating	Ranking
Imperfect Competition	18,4%	2	15,8%	3	31,9%	1	25,0%	1
Public Goods	18,4%	2	15,8%	3	10,9%	4	12,5%	4
Externalities	18,4%	2	29,8%	1	31,9%	1	25,0%	1
Incompleteness of the market	9,8%	5	8,9%	5	6,8%	5	12,5%	4
Information Asymmetry	34,9%	1	29,8%	1	18,4%	3	25,0%	1

Source: own compilation

Table 6, discussed in the previous section, and the data contained therein will inspire the scaling of the relevance of the recommendations classified in Table 7. Within the categorisation, 6 areas of recommendations related to: ;

- business management
- substantive support for entrepreneurs (including adapting their business models to the circular economy assumptions and building their circular awareness);
- financial support, enabling circular changes (including changes of a technological nature);
- information and promotion of circular activities in the business community;
- necessary systemic changes (e.g., the way the waste collection and processing system is organised);
- lobbying for changes to eliminate areas of inadequacy and create a system of incentives for entrepreneurs.

Table 7. Categories and level of relevance of proposed recommendations

Type of recommendation	Area of recommendations	Scope of recommendations		
		H*	M*	L*
Management	The use of a point action method (e.g. within a single process) in implementing circular economy by market entrepreneurs (especially small ones)	X		
	Applying a comprehensive approach to business planning for companies just entering the market	X		
	Introduction of waste management and environmental audits in companies		X	
	Conducting an in-depth analysis of current business practices among entrepreneurs in the Lodzkie region and identifying areas where circular solutions can be introduced	X		

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Substantive support	Increase funding for training and advisory activities that improve the knowledge and competencies of public institution staff making decisions related to the activities of businesses		X	
	Changing the environmental awareness of entrepreneurs through advisory and training activities.		X	
	Training and advisory support in the area of circular management	X		
	Increasing and individualising the offer of technical and technological support from universities and research institutions		X	
	Creation of a complex tool to diagnose the state of the business in terms of circular change opportunities (including the development of new business models) within the RCBT platform.	X		
Financial support	Increase financial support for companies willing to invest in solutions to increase their circularity (preferably repayable support).	X		
Information and promotion	Promotion of networking and activity within the circular territorial cluster and good practices in this field by public authorities and the academic community from the Lodzkie region		X	
	Changing the environmental awareness of entrepreneurs by promoting circular changes in their business strategies			X
	Preparing a guide to change and create circular business models specific to each CSS		X	
	Promotion of cooperation and joint investment among entrepreneurs who may be participants in the Circular Territorial Cluster		X	
	Ensure access to information on current and planned support instruments (training, counselling, funding of investment activities, etc.).	X		
	Increasing the availability of information on circular economy solutions offered by universities and research institutions		X	
	Promoting waste management and environmental audits in companies.		X	
Systematic changes	Measures to collect and use secondary raw materials, concentrated on relatively small areas (localisation of this solution).	X		
	Intensification of activities on the part of institutions supervising tender processes and law enforcement bodies			X
	Improving the waste collection and separation system to be more responsive to the needs of businesses interested in collecting and using secondary raw materials in their business.	X		
	Improve local waste collection and segregation systems in terms of reliability and complexity of data on the number and type of waste generated.	X		
	Increased availability of data on the number and type of waste (easy and universal access to digitised and functional databases).	X		
Lobbing	Create a circular business lobbying group (a kind of supra-regional cluster) to promote needed changes and engage in lawmaking processes as an advisory body.		X	
	Lobbying for changes in the law and the public procurement system reducing/eliminating the tendency of public institutions to use in-house entities and the use of collusive tendering by companies.			X

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* W - high level of recommendation, M - medium level of recommendation, N - low level of recommendation.

Source: own compilation

4.4 Development circular business models in practice - How companies can transform value chains into value cycles in line with the circular economy paradigm

Enabling circular business model development in practice involves a fundamental shift in companies' thinking about how value is created, used, and preserved. The traditional linear approach, which moves from resource extraction to product creation, use, and disposal, is replaced by a regenerative system that seeks to extend the lifecycle of materials and products.

Companies can approach this transformation and convert value chains into value cycles, in alignment with the circular economy paradigm:

1. **Rethink Business Models: Transition from ownership to access**

To enable circular business model developing as well as value cycle implementation, companies can shift their business models from selling products only to offering a full range of services, thereby retaining control over resources and extending product lifecycles:

- **Product-as-a-Service (PaaS)**: Instead of selling products, offer them as services. For example, leasing or subscription models allow companies to retain ownership of products, maintain them, and eventually reuse or recycle materials when the product reaches the end of its life.
- **Leasing and Renting**: Businesses can lease or rent out equipment, machinery, or even consumer goods, offering maintenance and upgrades to extend their life.
- **Performance-based contracts**: Offer solutions where customers pay for performance outcomes (e.g., light or heat) rather than the equipment itself (e.g., lightbulbs or heaters). This shift focuses on maximizing efficiency and longevity.

These business models keep products and materials circulating in the economy for longer, reducing the need for virgin resource extraction.

2. **Close Material Loops: Implement reverse logistics**

An essential part of transforming value chains into value cycles is creating closed material loops, where materials are reused and cycled back into production. Hence, companies can:

- **Establish partnerships with recyclers**: Collaborate with recycling companies or establish in-house recycling facilities to recover materials.
- **Industrial symbiosis**: Engage in partnerships with other companies to use one industry's waste as a resource for another. For example, a food processing plant's organic waste could be used to generate bioenergy in another plant.

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- **Set up reverse logistics systems**: Create systems to collect used products from customers for repair, refurbishment, or recycling.

Table 8. Examples of notable companies which have the revers logistics systems implemented

1. **Patagonia, Program**: **Worn Wear**
Patagonia is known for its strong commitment to sustainability and circular economy principles. Through the **Worn Wear** program, customers can return used Patagonia gear, which is then repaired, refurbished, and resold at a discount. They also encourage repairing items instead of discarding them, providing repair kits and guides to customers.
#Circular Focus: By repairing and reselling used items, Patagonia extends the lifecycle of its products and reduces waste.
2. **IKEA, Program**: **Buy Back & Resell**
IKEA runs a **Buy Back & Resell** program where customers can return used furniture, which is then refurbished and resold in their circular hubs or second-hand sections. The company also offers repair services for certain products to keep them in use longer.
#Circular Focus: This program promotes reuse and reduces the number of items sent to landfills, supporting IKEA's goal of becoming a fully circular business by 2030.
3. **Nike, Program**: **Nike Reuse-A-Shoe**
Nike's **Reuse-A-Shoe** program collects worn-out athletic shoes (from any brand) and recycles them into material used for sports surfaces like tracks, courts, and playgrounds. They also resell gently used shoes through **Nike Refurbished** and provide options to repair shoes via **Nike Grind**.
#Circular Focus: The program focuses on recycling worn shoes and keeping them out of landfills, while also refurbishing shoes for reuse.
4. **Levi's, Program**: **Levi's Second-Hand**
Levi's offers the s**econd-hand** program, where customers can trade in their old Levi's jeans at participating stores. These jeans are then repaired (if necessary) and resold at a lower price through the Levi's Second - Hand platform.
#Circular Focus: By promoting the resale of used jeans, Levi's encourages circular consumption and reduces the environmental impact of producing new garments.
5. **The North Face, Program**: **Renewed**
The North Face runs the **Renewed** program, where customers can return used or damaged clothing. The items are then cleaned, repaired, and resold at discounted prices. This initiative is part of their effort to keep clothing out of landfills and encourage sustainable fashion.
#Circular Focus: By refurbishing outdoor gear, The North Face extends product life and reduces the need for new material production.
6. **REI (Recreational Equipment, Inc.), Program**: **Used Gear**
REI encourages customers to return gently used outdoor gear through their **Used Gear** program. Returned items are inspected, refurbished if needed, and then sold at reduced prices on their online platform.

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#Circular Focus: This initiative supports a circular economy by giving outdoor equipment a second life and reducing waste.

7. **Timberland, Program**: **Timberloop**

Timberland's **Timberloop** program invites customers to return worn-out shoes, clothing, and accessories. These items are then repaired or disassembled for recycling, with materials being reintegrated into new products.

#Circular Focus: Timberloop reduces waste by creating a closed-loop system for materials, promoting product longevity through repair and recycling.

Reverse logistics and closed-loop systems allow materials to cycle through the economy rather than being lost as waste.

3. **Adopt Circular Design Principles**

Circular business models start with product and service design. Companies should focus on designing products that are:

- **Durable and long-lasting**: Emphasize product quality to increase lifespan and reduce the need for frequent replacement.
- **Repairable and upgradable**: Design products so that components can be easily replaced or repaired, rather than forcing consumers to buy new ones.
- **Modular and disassemble:** Create products that can be taken apart easily for upgrading, repurposing, or recycling.
- **Recyclable and reusable materials**: Use materials that can be fully recycled at the end of their lifecycle and integrate recycled content into new products.

By focusing on product longevity, modularity, repairability, and recyclability, companies can contribute to the circular economy, minimizing waste, and extending the useful life of materials and products across various sectors. This shift not only reduces environmental impact but also opens up new business models and value creation opportunities.

Table 9. Examples how companies have adopted circular design principles

1. **Fairphone**

Fairphone is a pioneer in applying circular design principles to electronics. Their smartphones are designed to be modular and easy to repair. Customers can replace components such as the battery, camera, or screen without needing to buy a new phone. They also use ethically sourced and recycled materials wherever possible.

#Impact: Fairphone promotes repairability and long product lifecycles, reducing e-waste and encouraging responsible consumption of electronics.

2. **Philips**

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Philips has integrated circular design into its product development process, focusing on creating products that are modular, upgradeable, and designed for refurbishment or recycling. They offer "circular lighting" solutions, where businesses lease lighting systems instead of owning them, ensuring that Philips takes back and refurbishes components at the end of their life.

#Impact: By designing products for longer lifecycles and reuse, Philips reduces resource consumption and waste, while also enabling more efficient product returns and recycling.

3. **Adidas**

Adidas is working towards creating fully circular products. Their **Futurecraft Loop** sneaker is designed to be fully recyclable, made from a single type of plastic, and intended to be returned and remade into new shoes. The design avoids the use of adhesives, which typically make recycling difficult.

#Impact: Adidas' focus on creating recyclable shoes minimizes material waste, allowing old products to be broken down and reused in new ones, reducing the environmental impact of footwear production.

4. **IKEA**

IKEA has committed to a circular design approach, creating furniture that is modular, durable, and easily repairable. They design products to be taken apart and reassembled, making it easy to replace parts or refurbish furniture. Additionally, IKEA's "Buy Back & Resell" program supports the circular model by allowing customers to return old furniture.

#Impact: IKEA's circular design approach reduces waste in the home goods industry, extends product lifecycles, and promotes a culture of reuse and sustainability.

5. **Apple**

Apple has committed to using more recycled materials in its products and has designed its devices, such as the MacBook and iPhone, to incorporate renewable or recyclable materials. Apple's **Liam** and **Daisy** robots disassemble old iPhones to recover valuable materials, like aluminum and cobalt, for reuse in new devices.

#Impact: By focusing on recyclable materials and creating systems for recovering and reusing components, Apple is working to close the loop in electronics manufacturing, reducing e-waste and the need for raw material extraction.

6. **MUD Jeans**

MUD Jeans applies circular design to fashion, offering **jeans-as-a-service**, where customers lease jeans rather than purchasing them outright. When jeans are worn out, customers can return them, and MUD either recycles the material into new denim or refurbishes the jeans for resale. Their products are designed to be durable and made from organic cotton and recycled denim.

#Impact: MUD Jeans reduces textile waste and resource consumption by keeping materials in circulation through leasing, recycling, and refurbishing practices.

7. Ellen MacArthur Foundation – Circular Design Guide

While not a company, the **Ellen MacArthur Foundation** has been a key driver of circular design thinking across industries. The Foundation developed the **Circular Design Guide**, a tool that helps companies design products and services with circular principles. It encourages businesses to rethink materials, product longevity, and business models to promote reuse, remanufacture, and recycling.

#Impact: The foundation's work has influenced many companies to adopt circular practices, from product design to operational strategies, reducing the linear "take-make-waste" approach.

4. **Embrace Digitalization, Data-Driven and App-Driven solutions**

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Digital technologies can play a significant role in enabling circular business models:

- **Internet of Things (IoT)**: IoT-enabled devices can track the condition and usage of products, helping businesses offer maintenance services and collect items when they reach end-of-life.
- **Blockchain for transparency**: Blockchain technology can help companies track and trace materials throughout the value cycle, ensuring transparency and accountability in circular supply chains.
- **Data analytics**: Companies can use data analytics to optimize resource use, reduce waste, and improve efficiency in production processes.

These technologies can provide the real-time data and insights needed to keep value cycles running smoothly and efficiently.

5. **Incorporate Renewable Energy and Efficient Resource Use**

To align with the circular economy paradigm, companies should prioritize:

- **Using renewable energy**: Transitioning from fossil fuels to renewable energy sources like solar, wind, or biomass for powering production and operations reduces the environmental impact of their activities.
- **Maximizing resource efficiency**: Optimize processes to minimize waste and resource use. For example, companies can implement water recycling systems or use waste heat for energy.

Incorporation of renewable energy and efficient resource use with the companies' industrial activity not only reduces environmental footprints but also makes businesses more resilient and sustainable in the long term. Hence, companies focus on maximizing the utility of resources throughout their value chains to enhance sustainability and reduce environmental impacts.

Table 10. Examples of companies leading in resource efficiency

1. **Unilever**
Unilever has made significant strides in reducing its use of water, energy, and packaging materials across its product lines. Through the **Sustainable Living Plan**, they have reduced the environmental footprint of their manufacturing operations by improving water efficiency and cutting waste to landfill.
#Initiatives: Unilever's factories have achieved **zero waste to landfill** status by optimizing production processes and recycling waste materials. The company has also worked to **reduce plastic use**, committing to halving its use of virgin plastic by 2025 and increasing the use of recycled materials.
2. **Nestlé**
Nestlé has implemented numerous initiatives to improve resource efficiency, particularly in terms of water and energy use. As part of their **Nestlé in Society** commitments, the company focuses on optimizing water use in agricultural sourcing and reducing food waste across its operations.
#Initiatives: Nestlé has introduced **water-efficient technologies** in its factories, reducing water consumption per ton of product. In high-risk areas, they have achieved **water neutrality**, meaning the water withdrawn is returned to the environment in the same quality. They have also focused on **reducing food waste**, both within their operations and across the value chain by partnering with farmers and retailers.
3. **Siemens**

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Siemens aims to improve efficiency in energy usage and material consumption, aligning with their **carbon-neutral** manufacturing goals by 2030.

#Initiatives: Siemens has developed solutions like **energy-efficient automation systems** and **smart grids** that help companies reduce their energy consumption. In its manufacturing plants, Siemens uses **resource-efficient production processes** and has reduced waste by implementing advanced recycling systems.

4. **Tesla**

Tesla focuses on energy efficiency both in the products it creates and within its production processes. Tesla's electric vehicles (EVs) are designed to be more energy-efficient than traditional internal combustion engine vehicles, and the company's Gigafactories prioritize sustainable, resource-efficient manufacturing.

#Initiatives: Tesla's **Gigafactories** are designed with energy and resource efficiency in mind. They aim to produce batteries and EV components using renewable energy, minimizing the carbon footprint. The **closed-loop battery recycling** program is designed to reclaim valuable materials from spent batteries, reducing the need for mining raw materials.

5. **Danone**

Danone has made resource efficiency a key part of its sustainability strategy, with a focus on **water stewardship**, energy efficiency, and waste reduction. The company has a goal of becoming **carbon-neutral** by 2050 and improving the efficiency of water and energy use in its global operations.

#Initiatives: Danone has implemented **water recycling and reuse systems** in its factories, reducing water consumption by optimizing processes. The company also focuses on **sustainable sourcing of agricultural products**, which helps reduce resource use across the value chain by promoting regenerative farming practices.

6. **Heineken**

Heineken has implemented resource efficiency initiatives aimed at reducing water and energy use and improving waste management in brewing operations. Their **Brewing a Better World** program includes targets for sustainable sourcing, reducing CO2 emissions, and optimizing water use.

#Initiatives: Heineken's breweries have implemented **water-efficient technologies**, significantly reducing the amount of water needed to brew beer. They also focus on **energy efficiency** by using renewable energy in production and reducing the overall energy footprint of brewing and distribution.

6. **Engage consumers and encourage responsible consumption**

Circular business models require a shift in consumer behaviour, so businesses should actively engage their customers:

- **Offer incentives for returns and recycling**: Provide financial incentives, loyalty programs, or discounts for customers who return used products for recycling or participate in take-back schemes.
- **Educate consumers**: Inform customers about the environmental and economic benefits of circular consumption. Transparency about material sourcing and circular processes builds consumer trust and loyalty.

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- **Create community-based initiatives**: Encourage community-based sharing models, like clothing or equipment rental platforms, to reduce unnecessary consumption.

Consumer engagement is key to the success of circular business models, as it ensures that products and materials continue cycling within the economy.

Table 11. Examples of companies that engage consumers and encourage responsible consumption

1. **The Body Shop** The Body Shop, through campaigns and educational initiatives, encourages consumers to consider the ethical implications of their purchases, from sourcing to packaging. **#Initiatives: Return, Recycle, Repeat**: This program encourages consumers to return empty product containers to The Body Shop stores for recycling. In return, customers receive incentives such as discounts or loyalty points. **Community Trade Program**: The Body Shop highlights its ethically sourced ingredients through its **Community Fair Trade** program, encouraging consumers to make informed choices about products that support marginalized communities. **2. H&M** H&M actively engages consumers in sustainability through its **Conscious Collection** and in-store recycling programs, encouraging shoppers to return old clothes for recycling or reuse. **#Initiatives: Garment Collection Program**: H&M's garment collection initiative encourages customers to bring in unwanted clothes (from any brand) for recycling or reuse. Customers receive vouchers in return, which incentivizes responsible disposal of clothing. **Conscious Collection**: H&M's **Conscious Collection** features products made from recycled and sustainably sourced materials, providing consumers with eco-friendly fashion options. **Sustainability Labelling**: H&M uses sustainability labels on certain products to educate consumers about eco-friendly materials and promote responsible purchasing. 3. **Levi's** Levi's encourages responsible consumption by promoting the longevity of its products through repair and recycling initiatives. The brand highlights how long-lasting denim can help reduce waste in the fashion industry. **#Initiatives: Buy Better, Wear Longer**: Levi's promotes the concept of buying fewer but higher-quality items that last longer. They encourage consumers to reduce clothing waste by repairing their jeans rather than buying new ones. **Tailor Shops**: Levi's provides in-store tailoring services, allowing customers to repair or customize their jeans, extending the life of their garments. **SecondHand**: Through Levi's **SecondHand** program, customers can trade in old jeans for credit toward new purchases. These jeans are then cleaned and resold, promoting a circular economy. **4. Samsung** Samsung encourages responsible consumption of electronics through its recycling and refurbishment programs, while also engaging consumers in environmental education. **#Initiatives: Galaxy Upcycling**: Samsung's **Galaxy Upcycling** program gives old smartphones a second life by repurposing them for new uses, such as IoT devices, reducing electronic waste. **Samsung Eco-Packaging**: Samsung engages consumers by offering packaging that can be repurposed into household items, such as furniture or storage boxes, encouraging reuse and reducing waste. **Trade-In and Recycling Programs**: Samsung's trade-in programs allow consumers to return old devices for credit toward new purchases, while their recycling services offer an easy way to responsibly dispose of electronics.

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As can be seen from the examples shown above, the leaders in implementing circular business models are large enterprises and international corporations. They have the financial, technological, and operational capacity to lead in circular business models. Large enterprises often have greater control over their supply chains and can influence suppliers and partners to adopt circular practices. They have the leverage to demand sustainable materials, invest in reverse logistics, and enforce environmental standards throughout their global networks. Circular business models often require innovative technologies for product lifecycle tracking, recycling, and resource management. Large corporations have the resources to develop or acquire advanced technologies, enabling them to implement circularity at scale. Operating on a global market, they can reach more consumers, access more diverse markets, and create impactful circular business models that span multiple regions. This reach enables them to implement circular initiatives across different markets and influence consumer behaviour. Global reach, control over the supply chain, access to capital and brand influence allow them to overcome barriers that are very difficult or even impossible to overcome by SMEs operating in local markets.

4.5. Circular business models in SMEs: recommendation for identifying and addressing implementation challenges

While the transition to circular business models can bring significant long-term benefits for SMEs as well, such as reducing costs and enhancing brand reputation, the implementation process is often complex and resource intensive. Implementing circular business models in **small and medium-sized enterprises (SMEs)** presents unique challenges, despite the potential long-term benefits in terms of sustainability, efficiency, and competitiveness.

Within the Frontsh1p project we have identified some the key challenges, which SMEs face when transitioning to a circular business model:

1. Limited financial resources

Circular business models often require upfront investment in new technologies, systems, and processes to optimize resource use, product life cycles, and waste reduction. SMEs, however, typically operate with smaller budgets and may struggle to allocate resources to these long-term initiatives, especially if immediate financial returns are unclear.

#Example: Installing new machinery for recycling or reusing materials can be capital-intensive, and many SMEs may not have access to affordable financing to support such initiatives.

2. **Lack of expertise and knowledge**

SMEs often lack the internal expertise or knowledge to design and implement circular models effectively. Understanding the complex interactions between different value chain components, materials management, and circular design principles can be a steep learning curve for businesses that are used to traditional, linear business models. Very often SMEs don't have the technical know-how to shift to product design that allows for easy disassembly and recycling or may be unfamiliar with how to set up closed-loop systems.

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3. **Supply chain dependencies**

Many SMEs rely heavily on external suppliers for raw materials and components. Transitioning to a circular model often requires collaborating with new suppliers to implement circular principles, such as using recycled materials, creating take-back programs, or reducing waste. SMEs may have limited bargaining power to influence or change their suppliers' practices. If an SME wants to switch to using only recycled materials, it must look for new suppliers or even enter into a new distribution channel.

4. **Consumer awareness and demand**

A shift to circular business practices requires consumer buy-in, but many consumers, especially in certain markets, may still prioritize convenience or cost over sustainability. Educating customers about the benefits of circular models, such as repairability, durability, or take-back programs, can be a slow and costly process. An SME offering durable, repairable products might struggle if customers are more accustomed to disposable, cheaper alternatives. Convincing consumers to embrace repair services or take-back programs can be a challenge without significant marketing and awareness efforts.

5. **Regulatory barriers**

Regulatory environments on national, regional or local levels may not always support circular initiatives in companies, especially in sectors where regulations are designed around linear production and disposal models. Hence, SMEs may face difficulties navigating complex regulations related to waste management, product disposal, or recycling, which can vary widely across regions.

In EU countries, legal restrictions on waste transport or recycling processes in individual regions or countries make it difficult for SMEs to create closed systems or product take-back programs. Compliance with regulations related to building circular business models involves additional costs and time, which is difficult for SMEs to accept.

6. **Cost of innovation and technology adoption**

Circular business models often rely on innovative technologies and processes to track product life cycles, enable material recovery, and optimize resource use. However, investing in the necessary technologies, such as digital tracking systems, advanced recycling technologies, or energy-efficient manufacturing can be prohibitively expensive for SMEs and may be beyond the financial reach of many small businesses.

7. **Short-term profit pressure**

SMEs, spatially in such countries as Poland and Greece, often operate with tight profit margins and short-term financial goals. Circular business models, however, tend to be more focused on long-term sustainability and value creation, with benefits that may take time to materialize. This mismatch can make it difficult for SMEs to justify circular strategies when faced with immediate financial pressures.

A company might hesitate to invest in product designs that facilitate repairability or durability if these changes lead to higher production costs in the short term, despite long-term savings and environmental benefits.

8. **Challenges in scaling circular models**

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For circular business models to succeed, they often require scale to achieve efficiencies, such as through collection networks for product returns or access to recycling facilities. SMEs may lack the scale needed to make circular initiatives financially viable or to achieve the economies of scale enjoyed by larger companies. Example: setting up a product take-back program or establishing partnerships for material recovery might require infrastructure or logistical investments that are too large for the separate SME, acting alone.

9. **Cultural resistance to change**

Employees, suppliers, and customers generally resist the change from traditional linear models to circular practices, either due to a lack of awareness or an aversion to altering established workflows and relationships. Changing organizational culture and consumer habits can be time-consuming and require dedicated resources to ensure a smooth transition. Workers accustomed to a certain production method might resist new processes that prioritize resource efficiency or waste reduction, while suppliers may be unwilling to modify their offerings to support circular practices.

10. **Difficulty in measuring circularity**

SMEs may struggle to measure the impact and success of their circular business initiatives due to a lack of standardized tools and metrics for assessing circularity. Without clear ways to quantify the benefits (e.g., in terms of reduced waste, emissions, or resource use), it can be difficult to communicate the value of circularity to stakeholders. A small manufacturer might find it challenging to track the lifecycle of its products, making it hard to assess the true impact of their circular initiatives or calculate the return on investment. Remark: within the Frontsh1p project the blueprint of Circular Economy Action has been developed, tested and prepared ready for exploitation by SMEs.

11. **Unpredictable market conditions**

Market conditions, including instabilities in the cost of materials or energy, especially last years because of the pandemic time and the wars in Ukraine, can make it difficult for SMEs to maintain circular business models. For example, when raw materials are cheap, there may be less incentive to invest in recycling or material recovery systems, leading to inconsistent circular efforts. Or if the cost of virgin plastic falls, it may temporarily become cheaper for an SME to use new materials rather than invest in recycled plastics, disrupting circular supply chains.

4.6. Key policy and practice recommendations for supporting the circular economy development directed to regional authority for strengthening the circular business models

By addressing challenges identified within the chapter 4.3, regional authorities can significantly enhance the capacity of SMEs transition to circular business models, fostering a more sustainable local economy. The proactive involvement of regional authorities can empower SMEs to innovate, collaborate, and thrive in an increasingly competitive marketplace while contributing to broader sustainability goals.

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A particularly important instrument to support the creation of regional or local circular systemic solutions, with a leading role for businesses operating with circular business models, are territorial circular clusters. Circular Territorial Clusters (CTC) can create an enabling environment for SMEs to overcome the challenges of implementing circular business models. This collaborative approach not only enhances the capacity of individual businesses but also fosters a regional economy that prioritizes sustainability and circularity. The cluster's activity as a partner and network organization should be supported by a coordinating institution – ultimately a Special Purpose Vehicle, as mentioned in subchapter 3.1. The CTC could be a main regional driver to circularity, because bringing together diverse stakeholders, including businesses, government bodies, academia, and civil society, and fostering collaboration and knowledge sharing across industries and sectors. By pooling joint resources such as expertise, infrastructure, and funding, the cluster reduces the burden on individual companies, particularly SMEs, making circular initiatives more accessible and scalable.

CTC being tailored to regional needs can focus on addressing local environmental and economic challenges, making solutions more relevant and impactful. It can act as hubs that facilitate the flow of information, materials, and waste streams within the local economy, enhancing resource efficiency and reducing the environmental footprint.

The Table 12 below outlines practical suggestions/ recommendations for regional and local authorities to foster the development of circular business models. These actions of public bodies aim to support companies by collaboratively addressing the challenges they face in transitioning to a circular economy. Simultaneously, as the Circular Territorial Cluster serves as a vital regional driver of circularity by building a collaborative ecosystem, fostering innovation, and aligning policies and infrastructure toward sustainable goals, the table below outlines the key forms of support expected from the cluster to assist SME members in implementing circular business models.

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Table 12. Recommendations for Lodzkie Region/ Regional Authority and support from Circular Territorial Clusters to facilitate the development and implementation of circular business models in SMEs.

No.	Challenge of implementation circular business model in local SMEs	Response of the Lodzkie Region/ Regional Authority	Support of the Circular Territorial Cluster
1	**Limited Financial Resources**	– Establish regional grants, subsidies, or programs specifically designed to fund circular initiatives, enabling SMEs to invest in necessary technologies and processes without financial strain; – Introduction of priority competitions and rewarding local SMEs for implementing CBM to the EFRD; – Encourage Public-Private Partnerships between SMEs and larger enterprises to share costs and resources, reducing the financial burden on individual SMEs; – Facilitate access to public green procurement SMEs that implement circular business models; – Offer low-interest financing options to support investments in circular technologies and infrastructure.	– Shared funding opportunities and pool resources to apply for grants and subsidies, making it easier for SMEs to access funding for circular initiatives; – Collective investment in infrastructure.
2	**Lack of expertise and knowledge**	– Training, capacity building and educational programs, workshops, and seminars focused on circular economy principles in line with the regional circularity development; – Knowledge sharing on-line platforms, like the Regional Circularity Booster Toolkit (Frontsh1p Digital Platform), developed within the Frontsh1p project for SMEs, facilitating to share resources, case studies, and best practices related to circular initiatives.	– Knowledge exchange programs of workshops, seminars, and training sessions led by experts in circular economy practices, providing SMEs with the necessary knowledge and skills to implement circular models; – Mentorship and support networks, programs that connecting experienced businesses with SMEs which can help transfer knowledge and best practices in circularity.
3	**Supply chain dependencies**	– Facilitating access to supplier networks, which can help SMEs connect with suppliers involved in circular economy practices, such as waste management companies, or suppliers producing recycled materials; – Joint procurement initiatives and organization of collective procurement programs to enhance SMEs' bargaining power and access to sustainable resources;	– Supplier development initiatives which can encourage collaboration among SMEs and suppliers to adopt circular practices, helping to create a network of suppliers committed to sustainability; – Collective procurement by organizing joint procurement efforts of SMEs within the cluster which can enhance their bargaining power to

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		– Provide incentives for suppliers to adopt circular practices, ensuring that SMEs have access to sustainable raw materials without significant price increases.	source sustainable materials and negotiate better terms with suppliers.
4	**Consumer awareness and demand**	– Public regional awareness campaigns, launching initiatives to educate consumers about the benefits of the local circular products and services; – Showcase local circular products during the local events or on the virtual regional platforms that highlight the circular initiatives of local SMEs to boost consumer demand; – Showcasing local success stories of SMEs successfully implementing circular practices to inspire other businesses and inform consumers about available sustainable options.	– Regional awareness campaigns can be launched by the CTC to educate consumers about the benefits of circular products and services, fostering a demand for sustainable options, offered by local circular companies; – Showcase local circular products and services by organizing events or platforms to showcase the circular initiatives of cluster members (it will be feasible on the RCBT.
5	**Regulatory barriers**	– Advocacy for supportive policies on the national governments and the European Commission to strive for governance solutions that facilitate circular initiatives on the regional and local levels, such as simplifying waste management regulations and supporting product take-back schemes; – Provide SMEs with the Regulatory guidance on navigating complex regulations related to circular practices, helping them to understand compliance requirements and avoid potential pitfalls.	– Advocate for supportive regional and local policies, work with local policymakers in order to create regulations that facilitate circular practices and reduce compliance burdens on regional and local levels; – Share experiences and expertise how to meet all legal and regulatory obligation.
6	**Cost of innovation and technology adoption**	– Innovation regional funds to support SMEs in researching and adopting new technologies that enhance circularity; – Encourage collaboration between SMEs and research institutions to develop collaborative research projects and cost-effective solutions for circular business practices.	– Joint investment in shared technologies, laboratory or devices that SMEs can access, reducing the individual financial burden of adopting innovative solutions; – Encouraging joint research projects between SMEs and research institutions, what can foster innovation in circular practices while spreading costs.
7	**Short-term profit pressure**	– Create long-term funding models that recognize and support long-term investments in sustainability, allowing SMEs to balance short-term pressures with long-term benefits; – Offer tax incentives or rebates for SMEs that successfully implement circular practices, helping them alleviate short-term financial pressures.	– Demonstrating long-term value, communicating to stakeholders the long-term financial and sustainability benefits of circular economy practices, aligning short-term actions with long-term goals; – On-going presentation of good practices on the cluster's platform;

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			– Organizing matchmaking meetings with business partners who can offer long-term contracts in line with circularity; – Supporting circular business model innovation by sharing cluster's resources and providing guidance on alternative business models, e.g., product-as-a-service, etc.; – Explore sustainable options that align with local SMEs' financial goals.
8	**Challenges in scaling circular models**	– Promote collective initiatives among SMEs to establish shared resources or infrastructure (e.g., joint recycling facilities, waste collection systems, resource sharing initiatives etc.) that make circular practices more viable; – Foster networking and regional collaboration opportunities for SMEs to join forces on scaling circular initiatives, leveraging combined resources for greater impact.	– Development of regional or local infrastructure that supports circular initiatives, such as centralized recycling facilities, making it easier for SMEs to scale their efforts. – Collective action by organizing joint initiatives, such as take-back programs or material recovery networks; – Demonstrating the financial community of cluster members to achieve the financial scale required, for example, in green public procurement
9	**Cultural resistance to change**	– Provide support for SMEs in developing change management strategies to facilitate cultural shifts within their organizations, including training for employees on the benefits of circular practices; – Encourage SMEs to engage with their employees, suppliers, and customers through workshops and forums to foster a culture of sustainability and collaboration; – Engaging local media to facilitate cultural change towards circular business models implementation.	– Providing cluster's resources, e.g. experts and training facilities for training on change management to help SMEs facilitate the cultural shift required for implementing circular practices among employees and stakeholders; – Organizing community engagement activities that involve employees, suppliers, and customers in discussions about the benefits of circular practices, fostering a culture of sustainability.
10	**Difficulty in measuring circularity**	– Collaborate with industry experts to create standardized metrics and tools for measuring circularity, allowing SMEs to track their progress and communicate successes effectively; – Develop regional circularity development oriented metrics and tools, useful for SMEs;	– Developing standardized metrics and tools for measuring circularity, making it easier for SMEs to assess and report on their circular initiatives; – Support with indicators of circularity and monitoring tools to meet all legal and regulatory obligations, like Ecodesign Regulation for

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		– Provide resources and training for SMEs to develop reporting frameworks that highlight their circular initiatives and their impacts, improving transparency with stakeholders.	Sustainable Products (ESPR), Digital Product Passport (DPP), Rules to address Distribution of Unsold Consumer Products and Corporate Sustainability Reporting Directive (CSRD); – Sharing best practices and benchmarking data within the cluster to help SMEs understand their performance and progress toward circular goals.
11	**Unpredictable market conditions**	– Offer support by the regional entrepreneur service centre (COP) for market research to help SMEs understand trends in material costs and consumer demand, enabling them to make informed decisions about their circular strategies; – Develop contingency plans and support programs that help SMEs respond to market fluctuations and crises, ensuring they can maintain circular practices even in challenging times.	– CTC Resilience Building Programs, that enhance the tolerance of SMEs for market instabilities, such as diversifying supply chains or creating flexible business models to maintain circular practices during challenging times.

Source: RIC

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5. Social recommendations based on the developed model for citizens engagement and reskilling, including market innovation

5.1. Social recommendations based on the developed model for citizens engagement

Social engagement is important for the individual's and collective life. On the one hand, it allows the individual to be cognitively and emotionally active; on the other hand, it forms the basis for the functioning of diverse social groups.

According to Report D7.1, a definition of citizens engagement was created for Frontsh1p project. “Its main assumption is to indicate that appropriate behaviours involving residents in the circular economy (CE) require both **activities addressed to the residents themselves** (in our definition, resident = household) and **activities related to the external environment**, where mainly local governments can support the process of engaging citizens in CE. Citizens engagement in the circular economy refers to the involvement of society (households) in activities (processes) for the implementation of solutions constituting the circular economy system (CES), also known as the circular economy (CE) or closed-loop economy (CLE). This concept means, above all, commitment to real processes related to management (processes from the real sphere - R) - undertaking specific practices.” (Report D7.1)

It defines citizen (household) action for a circular economy as actual (R) (and not just declarative) involvement in the following practices and processes: refusal, reduction, reuse, renovation, repair, and recycling. As well as activities not directly related to but supporting such practices as sharing, leasing, segregation, and selective collection in the local waste management system. The second key element necessary to engage citizens in CE is for external institutions to take specific actions. This consists of 1. Activities increasing awareness and knowledge of issues related to the circular economy (soft activities). Actions include informational, educational, promotional and consulting activities; 2. Activities modifying the behaviour of citizens (households) in the sphere of managing material resources in an institutionalised way, i.e. as a result of legal and administrative compulsion, as well as through a system of incentives and/or negative incentives; 3. Activities involving citizens in creating systemic and regulatory solutions in the field of the circular economy (activities such as regulations by reaching agreements and, co-creating policies and participating in decision-making processes). Following the principle of co-management (governance by co-governance), 4. Activities encouraging citizens' (households) behaviour and practices to be consistent with the a circular economy introduced by private entities based on self-regulation (voluntary regulation). This includes activities such as the voluntary introduction of deposit systems, including the return of certain types of packaging, and introducing a free collection service for used material goods when purchasing a new one (Report D7.1).

The aim of this report creates the need to look at the issue of citizens engagement in a broad and multifaceted way. It also prompts broadening the above definition to include additional aspects, often

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going beyond observed and declared social behaviour. In this context, it should be noted that the term social engagement is used alternatively in psychology and the social sciences with the terms social involvement, civic involvement, social commitment, civic commitment, and civic engagement (Eide, Roysamb, 2002; Harwood, Pound, Ebrahim, 2000; Gamson, 1991). Self-efficacy, efficacy motivation, a sense of control in the social sphere and alienation (the opposite of commitment) are listed as determinants of social activity in the literature (Craig, Niemi, Silver, 1990; DeCharms, 1983; Grzelak, 2008; Inglehart, 1981). It is also associated with terms such as trust and social capital and an individual's beliefs about their competence. Social commitment (taken from a psychological perspective) can be defined as goal-directed behaviour linked to a group goal, which is subject to volitional control, does not result from sanctions (cultural, formal or institutional) and has a conscious or unconscious instrumental value for the acting subject (Kanafa-Chmielewska, 2016).

Formulating recommendations based on a social model of citizens' engagement in CE requires drawing on both of these perspectives: the psychological (individual) and the social (collective). The social research carried out for this purpose (qualitative and quantitative) referred to both approaches, combining them into a complementary whole. In the social engagement research concerning the individual resident's life, the focus was on insights into the cognitive aspect of the individual's attitude towards the CE - i.e. their internal beliefs about the circular economy in its broadest sense, the effectiveness of their actions, their competences, perceived barriers/blockages and, importantly, habit building. Building CE habits, i.e. those micro-decisions ('droplet' decisions) that one makes at the level of one's household, is an important step in shaping circularity. When cumulated, seemingly insignificant everyday decisions (e.g., whether to drink tap water, buy bottled water, throw a book in the rubbish or give it to someone) have deep meaning and lead to significant change. In terms of social engagement concerning the collective life of the individual, the residents' perceptions and views on the waste management system and their direct contribution to it were explored. Individual interviews were also conducted with experts, which provided insights into the observed changes in the labour market due to CE's development and the need to adapt employee skills to the current challenges of CE. Social engagement in this dimension involves participation in collective action, strengthening social capital and shaping social norms. It is based on elements such as activity, interaction, social exchange and the absence of compulsion.

The first part of the discussion, the presentation of the research results and recommendations, will deal with the collective (social) understanding of the concept of social engagement.

Based on quantitative surveys conducted among representatives of selected local communities in the Lodzkie region, key conclusions and directly resulting recommendations (supporting the involvement and inclusion of the public in the ideas and practices related to CE) were formulated. The research was carried out in 2024:

a) Nearly ¼ of the surveyed respondents still do not feel part of the local waste management system (**recommendation**: Involve the resident in the waste management system at the local level (closest neighbourhood - this level is considered the most influential and essential for the individual). Top-down solutions are necessary here - transparent information about the activities carried out, consultations with residents on important decisions (inclusion of residents in the processes of information and consultation of solutions following the principles of the

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'Ladder of participation'), organising joint actions, activities, projects - stimulating involvement and integration and providing a sense of ownership and decision-making);

b) About 2/3 of respondents do not get personally involved in additional activities connected with waste management and segregation (e.g. group cleaning of the neighbourhood, joint collection of bottle tops) (Recommendation: The type of action should be matched to the needs of the inhabitants, its formula should be made more attractive and dedicated to specific social groups, e.g. youth, seniors; information about the action should be distributed through various channels, adjusted to the potential recipient; real benefits of participation in the action should be shown. Because to get involved, you need to recognise the social issue and that it is crucial. The next step is to take personal responsibility for the situation. The benefit is raising or maintaining high self-esteem or creating a positive social image. This should be built on when constructing the offer of actions and proposed events);

c) Almost half of the respondents assess the level of involvement of the inhabitants of their place (thinking of their closest neighbours) in the waste reduction and segregation system as very low and low. People who are very much involved in the above system are a definite minority (rather, these are individual cases) (Recommendation: Awareness of the inhabitants in this respect should be increased: inform, provide knowledge, organise everyday events, e.g., circular picnics, implement good examples from other places. Actions in consultation and a network of different actors: NGOs, companies, community centres, and libraries. An integrated approach is more likely to deliver the expected results);

d) the respondents unanimously see the need and possibility for residents to be more involved in waste management (recommendation: such a result is very good feedback and creates space for actual involvement of residents in the CE. It is recommended to investigate resident's needs, opinions and expectations in this regard, e.g., through a survey or workshop meetings with residents);

¾ of the respondents assessed the regulations in force for them regarding waste segregation and collection as understandable. As for the respondents' perception of real benefits resulting from the functioning of the waste collection and management system in their locality, the opinions are evenly divided (between those who notice them and those who do not), with a slight predominance in the direction of noticing benefits (Recommendation: information on waste segregation and collection should be made more accessible, e.g., by including this information in a dedicated phone app and flyers; develop an incentive system to provide the individual with a benefit, e.g., tokens for waste paper (by introducing a local currency for specific raw materials). This type of exchange for waste collection and segregation would increase the awareness and motivation of residents). Surveys carried out show that the initiative to introduce a local currency (consulted and attractive to residents) meets with interest. Collecting - collecting and then exchanging is a chain of behaviours with social benefits: satisfaction of needs, social integration, positive competition, etc., if, in addition, the resident sees their actions sens, their motivation to maintain their participation in the local currency system is strengthened).

e) ¾ of the respondents believe that local authorities should introduce additional measures to reduce cases of non-respect of the current principles of waste segregation and waste collection

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(recommendation: the introduction of sanctions (in balance with incentives) as an initial measure (to consolidate good habits) could work provided that sanctions are dedicated, follow immediately after the offence, are communicated (as a consequence), adequate, appealing to emotions. This result of the survey also shows that top-down, regulatory solutions that stimulate bottom-up action are expected);

f) according to 2/3 of the respondents, the waste management infrastructure in their municipality is not sufficient (e.g. the number, quality and availability of public waste bins or PSZOK (recommendation: adaptation of the waste management infrastructure to the needs of the inhabitants so that the waste management activities are easy, intuitive and accessible, often also attractive);

g) according to almost 2/3 of the respondents, public authorities and waste management companies do not sufficiently inform citizens about their activities in this field (recommendation: increase transparency and access to knowledge and information by adapting communication channels to different social groups, e.g., social media, on-site meetings, etc.);

h) at the same time, all respondents declare to a greater or lesser degree their willingness to become more involved in the waste management system, in case of certainty that the segregated waste will be reused or become a secondary raw material (Recommendation: This result also provides very good feedback underlining the resident's willingness to become involved, with particular emphasis on the fact that the resident must see the sense of their actions. This is a key factor to pay attention to in constructing an offer of inclusive activities;

i) additionally, all surveyed respondents declare their efforts to buy products made of secondary raw materials (recommendation: the constant raising of awareness in this scope (on the part of both the producer and the consumer), solutions for producers at the level of top-down legal requirements resulting from eco-design principles would help eliminate possible dilemmas as to which product to buy. On the other hand, when it comes to individual consumer choices, these are mainly determined by the consumer's knowledge, the price of the product, and their beliefs. In this case, working on raising awareness and access to knowledge of what product one is dealing with are key.

Surveys were also carried out to assess the areas of market failure for secondary raw materials in 2022 and 2024 for the designated market gaps. The table below shows a comparison of the averages for respondents' answers. These surveys aimed to determine the trend and direction of observed changes in five key areas (the elements of which - the individual questions and the distribution of responses, are described above) (Table 13, Fig. 9).

Table 13. Comparison of assessments of areas of market failure for secondary raw materials in the Lodzkie Region in 2022 and 2024 from a SOCIETY perspective

Market participant:	**SOCIETY**		
Characteristics of the FGI research target group:	Representatives of NGOs, representatives of the social enterprise, local social leaders		
Type of market failures	Question to identify market failure	Synthetic assessment of market failure occurrence	
		2022	2024

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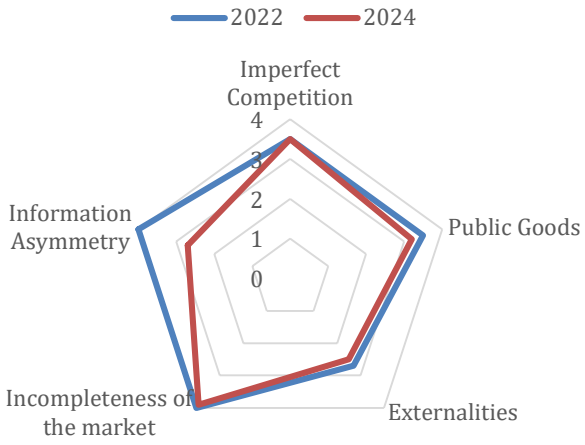
Imperfect Competition	▪ awareness of being a link in the value chain of industrial symbiosis ▪ cooperation between residents in CE	3,5	3,5
Public Goods	▪ the social responsibility of residents as producers of waste ▪ evaluation of regulations on collection and use of waste	3,5	3,2
Externalities	▪ benefits of participating in a recycling management system ▪ willingness to buy goods made from secondary raw materials ▪ free rider effect - gaps in the system of motivation and control of waste management	2,7	2,5
Incompleteness of the market	▪ incompleteness of municipal recycling collection infrastructure ▪ gaps in the involvement of residents in waste management processes	4,0	3,9
Information Asymmetry	▪ completeness of information on the waste collection system ▪ completeness of information on the waste reuse system	4,0	2,7

Source: own study

Figure 9. Recommended areas of intervention in the areas of market gaps in the opinion of the society of Lodzkie Region in 2022 and 2024



Source: own study

Comparing the five areas for improvement in terms of the involvement of social actors and development stakeholders in the broader waste management economy in 2022 and 2024, several conclusions can be drawn. Firstly, during these two years, the most fundamental change has occurred in information asymmetry. Information asymmetry has decreased, which is definitely a positive. Information on the waste collection system and the waste reuse system is slowly being completed and supplemented. This trend should be developed and deepened. Imperfect competition has been maintained at the same level. Here, the lack of change probably results from the fact that two years is a relatively short time to observe the effects of the cooperatives developed and the impact on raising awareness. However, it certainly needs attention and strengthening by continuously increasing access

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to knowledge and expanding cooperation between organisations, CE actors and residents. In the other three areas, public goods, externalities, and incompleteness of the market, the changes observed are slight but are taking a good direction. It is recommended that the current activities undertaken in these areas be maintained.

The survey shows that around ¾ of the respondents believe there are opportunities to reduce waste in their household: wood packaging and plastic waste. Over half of the respondents include bio-waste, and just under half include organic waste. Therefore, Organic wastewater is the least optimistic regarding waste reduction opportunities. In this area, solutions are not implemented that enable residents (at their household level) to reduce organic wastewater.

The results received in the surveys also made it possible to calculate the average ratings used in the determination of the weights. This made it possible to make pairwise assessments of the individual CSS areas that the surveyed experts evaluated regarding their potential for implementation in the circular economy. According to the results obtained, the actors - residents' representatives - indicated that the CSSs concerning wood and plastic achieved the highest level of implementation. In second place, respondents indicated the possibility of implementing circular solutions for bio-waste, while wastewater received the lowest ratings. While in the case of wastewater, this requires specialist knowledge, for the other CSSs it should be recognised that both bio-waste management and wastewater management should be strengthened.

Table 14. Determination of weights based on pairwise comparisons using the AHP method

CSS	Wyniki wagi ranking
Wood packaging	35.10%
Food and feed	18.90%
Water and nutrients	10.90%
Plastics	35.10%

Source: own study

Responders were asked explicitly what solutions they would need to become more involved in the daily practice of the circular economy. Table 15 shows the needs that emerged in response to this question. The solutions listed are precise indications of what would need to be provided to support public engagement in the CE. Additional comments from some of the respondents accompany some of them.

Table 15. Public demand for solutions to engage in closed-loop practice daily

TYPE OF SOLUTION
1. Infrastructural
- public bins for separate waste
-separate waste collection: enable residents to separate waste by introducing local collection points for paper, plastic, glass and biowaste on the estate
- more places to separate waste
2. Services
- repair points (e.g. electronics) - at prices not exceeding the purchase of a new item

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- repair programmes: introducing programmes that enable people to repair broken items instead of throwing them away. This could include repair points or service centres.
- new solutions from the trade and manufacturers
- support of companies that offer spare parts (e.g. for sports equipment)
- more collection points for secondary raw materials, especially the less common ones (waste electronics, textiles), the excessive distances to collection points make it difficult to return such items systematically
- more collection points for secondary raw materials
- more places to exchange second-hand goods
- more shops where you can fill your packs with shampoo, soap, etc.
3. Technological
- Mobile apps: Develop apps to help track waste volumes, available recycling programmes and local circular economy initiatives.
- Creation of accessible and user-friendly platforms (e.g., in the cloud) that collect data and information (e.g., to match suppliers with waste recipients)
4. Educational
- showing the benefits and practical examples 'from the neighbourhood' of what waste can be turned into and how to use it;
- educational workshops: Organise regular workshops and training for residents that promote the principles of the circular economy and teach about ways to reduce waste and reuse secondary raw materials.
5. Social
- Neighbourhood exchange programme: Creating space and regular days for the exchange of good quality but no longer needed items (e.g. clothes, small household items, toys, etc.) or electronic equipment
- green initiatives: Introducing community gardens where residents can grow plants together, which promotes the use of organic waste as compost and creates a sustainable ecosystem.
- Incentive system: Introduce a reward system for residents actively participating in environmental activities, such as picking up more recycling materials or attending workshops.
- social enterprises - inclusive, e.g., socially excluded and specialised in the CE topics
6. Awareness
- 'Awareness that my actions as an individual make sense. Knowing that I am doing certain specific actions by practising a circular economy and that very low-quality products are being promoted on the internet from Chinese portals (fast-fashion), I lose the will to take further action.'
- greater transparency about the steps being taken towards a circular economy. As well as direct information on the actual action taken
- Information about the effects of processing secondary raw materials, the savings this entails, and the translation into impact on the community
7. Economic
- real economic benefits
- introducing tax breaks for individuals and companies actively participating in the circular economy, such as recycling, repairing, or using reusable products.
- reducing the cost of collecting segregated waste,
8. Legal
- transparency of legislation and, for some, its radicalisation to reduce waste production
9. Related to accessibility
- access to substitute products
- more information, courses, training, promotion of the CE
- better labelling of products and packaging
- More glass bottles can be ozoned and used instead of plastic everywhere.
- more good quality (durable) products that can be repaired if necessary. "Unfortunately, there are many poor-quality products that break down quickly and cannot be repaired or are not cost-effective, and such products are thrown away rather than repaired."
- greater availability of information on possible CE solutions
- greater availability of products in paper packaging rather than plastic - minimisation of waste in manufactured products (often products are packaged in 2 - 3 packs, and one would be enough)

Source: own study

The solutions proposed by the experts to support, and sometimes even induce, social engagement in CE were divided into nine main categories. Recommendations are therefore made in the area of:

– **infrastructure** - provide infrastructure to facilitate efficient, intuitive waste segregation. In addition, ensure there is dedicated space for this;

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- **service-oriented** - provide services that respond to the community's real needs (such as service and repair points), taking into account the context and conditions of the place. Such services should be accessible, relevant and encouraging (attractive in form and offer) to potential users
- **technological** - in an era of such accelerated technological changes, widespread use of mobile phones and the development of various applications, the development of technological facilities related to CE seems to be a natural step, also involving young people in CE activities; According to Report D7.1, example of an initiative - downloadable e-guide on composting and organic/wooden/paper/cardboard waste management; online platforms: description - creation of dedicated websites or social media platforms containing resources, articles and interactive tools that will help households implement circular practices, example of an initiative - 'EcoHomeHub' - an online community providing resources on sustainable living principles ;
- **educational** - it is important that respondents recognise the gaps, the need for educational activities, and the importance of building positive habits linked to CE. Often defined more broadly as principles and lifestyles in line with values of respect for natural resources. The proposal of promotion activities, reinforcing the understanding and implementation of CE, is considered necessary groundwork whose effects are postponed in time but are very important in shaping attitudes and beliefs. According to Report D7.1, the model of educational activities includes activities in the field of education of children and youth, activities in the area of educating local leaders, activities in the area of education of local government representatives, educational platforms - e-learning;
- **social** - the organisation of different types of good practice actions and events aimed at integration, social bonding and learning through observation and play. Initiatives carried out at the neighbourhood level especially seem to be important. This level of local initiatives, often also bottom-up, as the closest to the housing community, can effectively influence the dissemination of CE-related good practices. According to Report D7.1 - As part of the FrontSh1p project, a local microgrant program model was created to involve residents in independent projects in the circular economy area and strengthen circular behaviour.

Within the framework of formulating social recommendations, it should be noted that the functioning of social enterprises in the sphere of civic activity, which combines economic-business activity with public benefit activity, is also highly favourable for the residents. Those whose activities are linked to the GOZ are extremely inspiring for residents and naturally familiarise them with the subject of the GOZ. Such organisations must be accessible to residents in numbers that meet their needs and not just as a rare, symbolic creation. According to Report D7.1 - Most SE entities use the assumptions of the Circular Economy as a key principle in their activities. They successfully combine business activities with social and solidarity goals. Circular Economy is a key principle embedded in the assumptions of the Social and Solidarity Economy. The Circular Economy requires cooperation instead of competition, based on formal and informal multi-sector local partnerships between local governments and their units, enterprises, social enterprises, non-governmental organisations and other members of local communities. The growing influence of the social economy in the EU and its circular economy activities should be explored and disseminated in the future. The main, general recommendations in this area:

1. Acceptance of the multitude of legal forms that social economy entities may adopt, some of which are even innovative in relation to the legal traditions of individual Member States.

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2. Strengthening the fundamental importance of people, as well as social and/or ecological, carrying out activities in the interest of members/users ("collective interest") or society at large ("general interest") and democratic and/or participatory management.
3. Increasing the diversity of operating models available to entities' social economy (economic activity; interaction between work and volunteering); activities consisting solely in providing goods, money or services; reciprocity).
4. Guarantee of independence from public authorities, but without excluding forms of integration and partnership.

The experts interviewed clearly raised the need to build an effective system of incentives that could trigger and consolidate the desired CE behaviour. These incentives should be:

- visible (it is necessary to know that they exist and to be aware of the possibility of using them),
- readable (the catalogue of incentives should be structured, consistent and accessible),
- relevant to circumstances (in form and content - incentives should be dedicated to specific social groups, environments, etc.),
- expressed in the language of benefits,
- balanced in terms of the relationship between incentives and punishment (positive and negative reinforcement),
- constant monitoring (one should be aware of the "devaluation" of incentives, so there should be continuous monitoring of the effectiveness of incentives to update information on the system in place. "Habituation", familiarity with incentives can cause them to lose their attractiveness),

Ensure that the resident is ready to accept the incentive, i.e., that the incentive is understood correctly and made attractive.

- **Awareness -** in this aspect, widespread and transparent access to knowledge and information on CE should be available. More excellent knowledge increases awareness. It is about the assumptions and understanding of basic concepts relating to the circular economy and the determinants and consequences of specific consumer choices. It is also important to promote the positive effects of involvement in the CE (in both individual and community dimensions). Generally, social awareness can be understood as a set of commonly accepted beliefs, views and ideas in a community, which become norms of thought patterns instilled in its members and enforced by social pressures. The shaping of social awareness can be illustrated by disseminating ecological knowledge. Knowledge, in its broadest sense, can be regarded as a fundamental element in shaping a new social awareness of sustainable development (environmental awareness). Gaining it, processing it and using it in various projects is the basis for the actions of a rational subject. When it comes to education for sustainable development, it is important to bear in mind the need to educate not only children and young people but also adults. Education in this area should be carried out by properly prepared groups of educators and be contained in a well-thought-out system that includes cooperation with schools and NGOs. Environmental education can only fulfil its established tasks if it covers every scope and all formal and informal education levels. Above all, this education should be interdisciplinary and, more importantly, intergenerational (A. Hłobił, 2010, p. 87). According to Report 7.1, a

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model of information campaigns involving residents in the circular economy, including general campaigns informing what circular economy is, information campaigns regarding citizens engagement regarding specific wastes that are the subject of the Frontsh1p project, information campaigns about the "circular commune" and "circular household" models.

- **Economic** - according to the experts interviewed, providing (proposing or demonstrating) real financial benefits (or savings) to the resident is necessary. This type of reward can potentially trigger or reinforce social engagement with CE effectively.
- **Legal -** legal solutions with less dispersion and adaptation to reality are recommended, but some respondents also indicate the need to radicalise legislation to reduce waste production.
- **Related to accessibility** - respondents know gaps at all eight levels analysed above. It is important that they perceive the need to change and fill the gaps that block engagement in CE. They need access to knowledge, information, solutions, services and products. Challenges defined in this way are answered, for example: online platforms that bring together knowledge resources.

Following Report D7.1, it is recommended that the proposed instruments be implemented. These instruments can, therefore, be treated as systems of influences external to households, which serve to reorient their behaviours and practices to those that were identified in the course of previous research and development work under the FrontSh1p project and were indicated as recommended for citizens to undertake under the individual CSSs

These instruments, which can potentially support the involvement of households in circular practices and counteract behaviour inconsistent with the idea of circular management, include:

1. Promotional activities/initiatives circular economy practices among households.
2. Educational activities/initiatives in society (in particular, people covered by general compulsory education - i.e., those of school age) concerned with the necessity/needs and possibilities of taking action in the field of the circular economy.
3. Information activities and consulting to facilitate the introduction of circular economy solutions by households;
4. Financial incentives (positive and negative) change, first of all, the financial framework of household operations in such a way as to provide economic incentives to undertake circular practices and discourage activities that are inconsistent with the idea of circular management.
5. Legal and administrative regulations (compulsory measures) creating a formal framework for undertaking circular practices by households, including in particular orders and prohibitions of specific behaviours, subject to enforcement mechanisms;
6. Co-creating solutions by households themselves, primarily in cooperation with other (external) entities (local governments, private entities, non-governmental organizations), but also as part of the self-organization of collaboration between households forming a specific territorial community - serving the dissemination of circular economy practices (in the form of consultations, workshops, forums, referenda, co-governance / co-management);

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7. Self-regulation (regulations and voluntary actions) – bottom-up creation and introduction of circular practices/solutions by households in the form of "internal standards" covering a single household or a small group using a common property or infrastructure.

A complex elaboration of the above 7 points with examples and the application of the related tools is provided in Report D7.1.

The second part of the discussion corresponds to understanding social engagement from an individual (psychological) perspective. Social engagement is then looked at through the prism of observable behaviour and its causes and motivations - i.e., often unconscious factors. Social engagement is either led to by an incentive or blocked by a barrier. The skilful management of incentives and barriers models the attitudes of social actors. According to Wojciszke (2003, p. 236), an attitude can be defined as a relatively stable tendency for a person to take a positive or negative stance towards a given object. The concept of the term attitude clearly defines it as a specific mechanism regulating human behaviour and action. Attitudes are reinforced by beliefs (cognitive component), are usually associated with strong feelings (emotional component) and generate specific behaviours (behavioural component, in other words, the tendency to act component).

Beliefs are thoughts that are believed strongly enough to be considered true. They are subconscious thought processes built on assumptions and interpretations of reality. It is important to note that people act on beliefs (these key beliefs are cognitive schemas), and their behaviours result from them. Beliefs are invisible, and their source is mainly socialisation. As a rule, they are strong and stable, making them difficult to change. It is important to discover and become aware of them, as they have either a supporting or limiting role (they can be positive or negative). Limiting beliefs can be a strong barrier (blocker) to practising circular economy principles daily.

The basis for formulating recommendations in this regard was, firstly, the research results carried out between March and June 2024. The research was qualitative. They were carried out using the technique of individual interviews with a standardised number of information sought. The methodology used was design thinking (technique: 'Keep an eye on ideas'). The aim was to provide expert knowledge on (1) the specifics and conditions of the effectiveness of incentives supporting attitudes of active CE implementation and (2) to reveal the barriers that effectively block this process. The respondents of the six expert interviews were professionals dealing with professional issues related to CE. In addition, a second type of qualitative research was carried out using the design thinking workshop technique. The respondents were 110 Spatial Economy and EcoCity students at the University of Lodz. The research revealed beliefs that strongly influence the whole attitude of the residents towards CE practices and, at the same time, have a limiting character. That is, they negatively affect the taking of CE actions: 'Being eco means more expensive', "One person won't change anything", "I'm too old/old to be eco", "Buying things (and/or replacing them) from second hand is a sign of poverty", "Eco - it's complicated", "CE problems are unimportant", "It's easier and cheaper to buy new than to repair the old".

Revealing and becoming aware of beliefs that reflect specific behaviours is key to working with negative beliefs.

Recommendations in this field were formulated by referring to the results of a survey carried out in April 2024 in Parzęczew. The survey was conducted on a group of 61 residents of Parzęczew. The

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group for the pilot was purposively selected as parents of school-aged children. The school environment was considered a potential source for disseminating and promoting attitudes in the local environment, such as pro-ecological attitudes and CE awareness. An online survey technique was used. Subsequently, respondents were asked to respond to beliefs already revealed and to reflect on the degree to which the respondent agreed with them (recognises them as their own).

Table 16. Respondents' support for empowering and limiting beliefs (n=61)

Content of belief	Number of people in favour ("tend to agree" and "strongly agree")	Number of people against ("tend to disagree" and "strongly disagree")
Reinforcing beliefs		
I have a real influence on the protection of the environment and the lives of future generations	53	8
Repairing or putting an item to another use is better than buying a new one	34	27
Segregating rubbish, for various reasons, makes sense	60	1
Saving water, energy, and electricity has an impact on the future of our planet	60	1
Buying good quality products, clothing and appliances is good for the environment	53	8
Paying attention to the packaging of the product you buy (e.g.: is it biodegradable) is important	55	6
Restrictive beliefs		
Living eco-friendly is much more expensive	28	33
Buying second-hand clothes is embarrassing	9	52
Buying and owning lots of things is a sign of prosperity	43	18
Buying new things is cheaper than repairing used things	19	42

Source: own study

Among the examples of beliefs cited in the table, it can be seen that those of a reinforcing nature are relatively well-established among the respondents surveyed. Two of them are particularly strongly internalised: 'Segregating rubbish, for various reasons, makes sense', and "Saving water, energy, and electricity has an impact on the future of our planet". It is, therefore, likely that segregating waste and saving water, energy, and electricity may become a natural habit, performed automatically based on a positive belief. In contrast, the most ambivalent belief is characterised by: 'Repairing or putting an item to another use is better than buying a new one'. This generally indicates an area that would need improvement. This belief touches on many complex issues. It refers both to the production of things and equipment of better quality, as well as to the creation of opportunities (e.g., by offering repair shops) to repair them if the eventuality arises. Buying things of better quality but less frequently also reduces consumption. In addition, intelligently designing a product so that its function can be changed (or using the expertise of a specialist in this area) would make it possible to take a reflexive approach to its use.

Regarding restrictive beliefs, they reveal more areas to reflect on (more significant disparity in respondents' answers). Pro-ecological solutions still appear more expensive and involve a potential financial loss. The lack of economic benefits is a significant barrier for many people when it comes to their daily shopping or service choices. This argument cannot be ignored, as the financial aspect indirectly rises in other beliefs, e.g., those relating to the repair of things and appliances. In addition,

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high consumption is still seen positively as a sign of prosperity. The beneficial effects of its reduction should be promoted to a greater extent.

In conclusion, there is no point in introducing new actions if you are sticking in old beliefs. It is challenging to expect certain activities if one has not previously considered the quality and reinforcing nature of the underlying beliefs. No new activity will be solid if one does not have a solid foundation. It is therefore necessary, first of all, to change the way you think, then the way you act will also change. This is neither easy nor simple, but without changing this thinking, there is nothing at all to implement and test new solutions. An important step along the way is to understand what this process is all about. Some important questions need to be answered, including: 'Which thoughts/beliefs should I part with and which should I say hello to?', "How do I change a given action or behaviour?". How do you start/stop doing something?' "What belief underlies this action?", 'Whose opinion is this? Who did you first hear it from?' 'What makes you feel it is true?' '' 'What does believing this belief do to you?'. Until limiting beliefs that do not serve you are overturned, it is difficult to introduce new, sustainable actions that bring real benefits. Following A. de Mello's thought: 'Nothing has changed except my attitude. Therefore, everything has changed'.

It is certainly a demanding and long-term process and, simultaneously, a challenge that educators (teachers, psychologists, animators, leaders, etc.) face at each formal and informal education stage. Beliefs are formed from childhood, so the earlier work on their construction begins, the better for a person's future. Access to knowledge, good examples, or simply developed social norms that become natural practices carried out daily foundations for the verificverifying

The study's results also point to other (besides beliefs) barriers/blockers that may inhibit the practice of the circular economy in everyday life. The research compared the perspectives of young people (students) and their parents. It was shown that the barriers mentioned were of two types - internal (related to the individual, or more precisely to their attitudes) and external (related to external conditions beyond the control of the individual). These are collective features, habits, patterns, lifestyles, needs, fears, feelings, gaps, and behaviours:

- Low awareness and lack of knowledge of CE;
- Laziness, convenience, lack of time, lack of desire (and creativity);
- Widespread consumerism (including compulsive shopping) results from relative prosperity. This generates side-effects in the form of living for a show (dominance of status indicators, mainly material things), an increasing need to own things, attachment to things (also in the form of hoarding: "This will come in handy");
- Established habits and routines, but also negative thought patterns: stereotypes and prejudices;
- reproduced cultural patterns (post-socialist mentality still alive), and the lack of positive eco role models from the socialisation period;
- Lack of environmental sensitivity and interest in the needs of future generations - diffuse responsibility syndrome;
- Fear of missing out;
- Fear of change/innovation/ novelty, but also often no need for change;
- Lack of trust in the new, e.g., in the quality of eco,

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- Lack of a sense of empowerment (the effects of CE actions are deferred), belief in conspiracy theories;
- Shame;
- No sense of purpose;
- Perception of lack of good example;
- The growing trend of fast fashion;
- Need for novelty;
- Perceived lack of money;
- Lack of interest in the consequences of one's behaviour;
- Impact of media and advertising;
- Ignorance;
- Absence of incentives.

Barriers defined in this way, which have the character of deeply internalised, established patterns of action, additionally strongly linked to mentalities (also culturally conditioned), can only be overcome as a long-term process. In addition, their multifaceted, complex nature can be seen, which means the proposed solutions should also take this form. It is recommended that, first of all, surveys of the inhabitants' awareness be carried out to diagnose the current state and areas requiring support, intervention, and improvement. Research of a quantitative nature will provide knowledge about the scale of the phenomenon, and research of a qualitative nature - nuanced knowledge about individuals' insights, motivations, and beliefs. People's awareness of the implementation of the circular economy should be systematically raised (through diverse forms: training, debates, conferences, study tours, good practices, organisation of festivals of 'circular' events, creation of knowledge exchange platforms, etc.). But above all, make the circular economy a way of life, introducing relevant content from the earliest stages of education while shaping the desired competencies and skills of individuals and a responsible attitude to the use of resources. Educational tools should be innovative, interactive and age-appropriate for the individual, and their use should result in naturally implanted beliefs, which will consequently translate into desirable behaviours.

The most crucial thing in building a citizen's daily engagement in the CE is the daily micro-practices they undertake. When talking about daily practices, these are understood as small decisions (so-called drop decisions) taken at the household level, which, in general - build up the circularity of the household (e.g., Do I separate my rubbish? Do I use reusable packaging? Do I collect rainwater? Do I repair things? Do I travel by shared transport? Do I waste food? Do I use the library?) These seemingly insignificant daily decisions form an important link to CE in accumulation. Many of these are in the form of habit, and since this is the case - it means that through awareness and work, negative habits can be transformed into positive ones, building a new quality of daily life following CE principles.

A habit is a custom, an action performed regularly, an automatic response to a particular situation, or a behaviour repeated so often that it has become a reflex. The actual purpose of habits is to solve problems with as little energy and effort as possible. Habits can accumulate to the benefit of or against the individual. The concept of habits is more about the system (the processes - the micro-activities) and not the goal itself. But most importantly, habits reflect identity and can change an individual's thinking about themselves. For example, The goal is not to separate waste. The goal is to become a human being living according to CE principles.

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In the case of habit building, there are said to be three layers of behavioural change: outcome change (concerned with specific outcomes), process change (smaller habits and systems), and identity change (belief change).

Every habit can be reduced to a feedback loop consisting of four stages: signal, desire, response and reward, so the four laws of behaviour change are a simple set of rules for creating better habits. Here are these laws (Clear: 2019):

1. Make it obvious,
2. Make it attractive,
3. Make it easy,
4. Make it rewarding.

The process of changing habits begins with awareness. "With a sufficiently substantial why, anyhow can be overcome" (F. Nietzsche). Even a difficult action can be undertaken by developing a sufficiently strong motivation. It is the actions, therefore, that reveal the true motives.

Table 17. Steps to develop a good habit (using the example of building the habit of drinking tap water instead of bottled water)

First law	Make it obvious
1.1	Complete the habit scoring table. Write down current habits to make yourself aware of them
1.2	Use the intention implementation method: "I will be [behaviour] at [time] in [place]". (I will be drinking water from the tap at 1 pm at work during my lunch break)
1.3	Use habit stacking: [current habit] is followed by [new habit] (When I drink tap water, I will enter the amount of water I drink into an app that reminds me and counts the amount of water I drink per day)
1.4	Adapt the environment to ensure that signals triggering good habits are exposed (I will put an empty glass on my desk at work)
Second law	Make it attractive
2.1	Take advantage of combining temptations. Combine the action you want to do with the action you need to do (Drinking water while working on the computer)
2.2	Join a culture where your expected behaviour is normal (Joining a group on a social networking site on the topics of adequate hydration and reducing plastic waste)
2.3	Create a motivational ritual. Do something nice before embarking on a difficult habit (Mark on a whiteboard on your desk the number of plastic bottles that have not been bought and then - after emptying - thrown in the rubbish)
Third law	Make it easy
3.1	Reduce resistance. Reduce the number of obstacles separating you from a good habit (Don't shop before work to avoid buying bottled water)
3.2	Adapt your surroundings. Prepare the surroundings to facilitate future activities (Have in your room at work a large water pot)
3.3	Keep an eye on the decisive moments. Make good, small choices that produce above-average results (Instead of buying bottled water - buy an apple, and take less with you - a bidon)
3.4	Use the two-minute rule. Simplify your habits until you can fit them into two minutes at most (Fill up your water bottle every time you go to the kitchen)
3.5	Automate habits. Invest in technology and disposable purchases that will guarantee a certain behaviour in the future (Install an app to measure the water you drink per day and one that reports financial savings and plastic reduction if you choose bottled water over tap water)
Fourth law	Make it rewarding
4.1	Use positive reinforcement. When you act on a habit, reward yourself immediately (Saying a compliment to yourself after drinking a glass of tap water)
4.2	Proceed in such a way that not doing something makes it enjoyable. Recognise the benefits of avoiding a bad habit (Recognise the financial savings from not buying bottled water)
4.3	Use the habit tracking diagram. Keep an eye on the chain of habits and try not to break the chain (Counting the amount of water drunk per day/per week)

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4.4	Never give up twice in a row. If you forget to follow a habit, make sure you get back on track as soon as possible (Replenishing a missed glass of water)

Source: own compilation based on: Clear J., 2019, Atomowe nawyki. Drobne zmiany, niezwykłe efekty, OZGraf S.A., Łódź, s. 194-195

The above overview shows how, systemically and effectively, to build positive habits. Using this knowledge, educators can model, shape, sustain and consolidate desirable, positive, everyday habits related to CE.

To conclude this section of the report, the complexity and multifaceted nature of the concept of community engagement should be strongly emphasised once again. The combination of psychological and sociological aspects makes it possible to look at human engagement in the CE as more than just observable behaviour, putting the phenomenon in a much broader context.

5.2. Social recommendations based on the retraining model, including labour market innovations

The development of the circular economy will change the employment sector and impact labour markets: while some jobs will disappear or change, new 'circular jobs' will emerge. Certain combinations of skills will become more important, and workers and employers will be required to develop new mindsets and skills to adapt to changing environments.

The transition from a linear to a more closed-loop economy will involve significant system change and the introduction of various innovations (e.g. technological, process, social, etc.) A suitably prepared, qualified and informed human resource will be needed to meet the challenges. Human resources can perform very simple and specialised waste management and recycling work - in planning, analysis and management. Thanks to the CE, up to 700,000 new jobs could be created by 2023 (data from the European Parliament).

Changes like production and the maintenance of raw material values over time will impact the shaping of demand and supply. This will cause shifts in the labour market. On the one hand, skilled workers will be needed in the areas of repair, recycling, and bioeconomy. On the other hand, the demand for workers in trade may decrease. However, it is estimated that the net changes will be in favour of employees - in Poland, this could be up to 124,000 new jobs (Sustainability Insights (1/2018)

Implementing the circular economy should be seen as an opportunity, not a restriction. We have the chance to restructure labour markets in ways that improve the quality of work, promote inclusive workplaces and provide workers with continuous learning and upskilling opportunities so that they can adapt to the changing demands that come with innovation and business models.This change process should be analysed to build the resilience of the labour market and its adaptation to a changing reality (responding to these changes triggered by global threats and depleting resources). This process should be seen as unavoidable and progressive.

The quantity and quality of jobs created are influenced by innovation, which triggers a phenomenon known as ‘creative destruction’ (meaning that innovation destroys jobs on the one hand and makes them on the other). Innovation forces the adaptation of all elements of the economic structure, including the labour market. The innovation should be considered the main determinant of changes in

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the labour market through its direct impact on the volume and structure of labour demand. In turn, changes in the structure of labour demand require adjustments on the labour supply side. The analysis of the impact of innovation on the size and structure of employment requires the consideration of several important factors, the most important of which are the type of innovation implemented, the use of existing technologies in new areas, intersectoral linkages, knowledge creation and diffusion (Szuklaski, 2001, s.43, Kabaj 2005, s. 22-23).

Technological innovation and social change bring both opportunities and challenges. On the one hand, new technologies open up new possibilities previously unknown to employees and companies. On the other hand, they involve adapting to new conditions, which can be difficult, especially for those who cannot keep up with the rapid speed of change. The future of work will require the employee to be more flexible, ready to learn continuously and able to manage change. Integrating new technologies with traditional work values such as commitment, loyalty, and work ethic will also be key to success.

The vision of a circular economy brings the opportunity to remove the structural mismatch between young people's education and the market's actual needs. Secondary assembly, recycling and the bioeconomy sector create numerous employment opportunities in occupations requiring higher education and less skilled occupations - especially in crafts and related professions. This will also enable employment to be more evenly spread geographically. While new service-related jobs will continue to be concentrated in cities, technology-related jobs may create new opportunities for people living in non-urbanised areas (Sustainability Insights (1/2018).

According to the document Circular Jobs, the circular job is any occupation that directly involves or indirectly supports one of the strategies of the circular economy. We differentiate between three types of circular jobs: core, enabling and indirectly circular jobs.

- **Core circular jobs** are all jobs that ensure the closure of raw material cycles, including jobs in repair, renewable energy, waste and resource management. They form the core of the circular economy.
- **Enabling circular jobs** are jobs that remove barriers and help accelerate and upscale core circular activities, including jobs that arise in leasing, education, design, and digital technology. They form the supporting shell of the circular economy.
- **Indirect circular jobs** are jobs that indirectly uphold the circular economy. These jobs occur in other sectors that do not play a direct role in furthering the transition to the circular economy but can still adopt circular strategies. They include jobs that provide services to core circular strategies, including jobs in information services, logistics and the public sector.

The trend of new occupations directly and indirectly related to CE is already visible in the labour market and is seen as strongly growing.

The surveyed expert respondents were asked, ‘When you hear the terms closed loop economy or circular economy, do you think of new professions in the labour market that could be related to these concepts?’. Just over half of the respondents answered in the affirmative, pointing to the following professions that could be derived from implementing the circular economy in the future. Some of the professions were provided with additional explanations:

Table 18. Circular professions of the future

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Name of circular job	Core circular job	Enabling circular job	Indirect circular job
Auditor CE		X	
Designer of CE-compliant products		X	
Specialist in waste processing machinery	x		
PSZOK employee		X	
Photovoltaic panel builder	x		
Specialist for recycling/reusing used items or giving them new functions	x		
Repairer		X	
Educator		X	
Environmental educator (role focused on educating communities, businesses and individuals about the principles and benefits of the circular economy)		X	
CE teacher		X	
Occupation related to CE infrastructure		X	
Sustainability specialist (a person who develops and implements sustainability strategies in companies, taking into account the principles of the circular economy)	x		
Recycling and reuse manager (person responsible for managing the company's recycling processes and developing programmes for the reuse of raw materials)		X	
Circular product designer (a professional who designs products so that they can be easily disassembled, repaired and recycled at the end of their life cycle)		X	
Circular economy consultant (person who advises companies on the implementation of circular economy solutions, including audits and waste minimisation strategies)	x		
Life cycle analyst: (a professional who analyses the environmental impact of products throughout their life cycle, helping to identify areas for improvement from a circularity perspective).	x		
Circular project coordinator (person who manages projects related to introducing and developing circular solutions in the practice of companies and organisations).		X	
Circular product manager		X	
Circularity manager	x		
Circularity advisor		X	
Developer of new technologies compatible with CE (packaging, textiles, etc.).		X	
CE promoter		X	
Environmental urbanist		X	

Source: own study

In the in-depth interview on this topic, there were also responses from the experts interviewed:

„*Thinking about the future, if consumption were reduced and minimised, this would have an impact on the development of demand and supply, as well as on the labour market, e.g., on the employment structure. Completely different professions will be important; after all, some may naturally disappear or transform themselves into others, improve themselves in a world, and adapt to the changing reality. Sometimes it will be more beneficial to retrain an employee than to dismiss them. Logically, these so-called "green professions" will be closely linked to environmental protection and ecology, e.g. specialists dealing with renewable energy sources (e.g., related engineering), or in general - the type of specialists will grow in strength.*"

„*For me personally, the future lies in using artificial intelligence. Those professions where employees can effectively handle artificial intelligence and use its potential will survive. Especially in the field of modern technology. I see no reason why this should not also apply to the circular economy.*"

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„You have to think more broadly when you talk about the circular economy because this is a very broad area. Modern agriculture - that is sustainable, eco - is included here, so we have a whole spectrum of professions in this department. Additionally, green, sustainable urban management - generates another demand for specialists. For example, at the University of Łódź, there is such a course as Ekomiasto. This is in terms of such hard skills, and in terms of soft skills - social skills - we are talking about all professions related to education and raising people's awareness. I'm talking about ecological animators, educators, promoters of the idea of taking care of the environment by reusing waste."

Respondents see the possibility and the need for new GOZ professions. They are able to list them, accurately recognising the accompanying processes. Mainly enabling circular jobs, less often core circular jobs, and no indirect circular jobs were mentioned.

Respondents were also asked what new competencies and skills of an employee will be needed in the future in the circular economy labour market. The following responses emerged:

Table 19. New workforce competencies and skills related to CE divided in hard and soft resources

Name and description of the new workforce competence and skills linked to CE	Hard resources	Soft resources
analytical skills	X	
design skills	X	X
ability to work in multidisciplinary teams		X
knowledge of the product life cycle	X	
understanding of processes		X
ability to repair things	X	
knowledge of CE	X	
knowledge and understanding of sorting (into individual fractions), knowledge of the composition of separated raw materials	X	
operation of recycling machines	X	
specialised knowledge of recycling and zero-waste principles	X	
ability to manage existing resources		X
ability to prevent and deal with the consequences of natural disasters	X	X
establishment and management of systems for monitoring the status of individual pollutants and the environment	X	
designing products with an extended life cycle (skills in creating modular, repairable, reusable or recyclable products will become key).	X	
ability to educate others		X
knowing how to make something, for example, from a used car battery		
creativity		X
analytical thinking	X	X
visioning		X
imagination		X
precision	X	X
patience		X
technical skills	X	
knowledge about minimising waste, extending product life cycles and recovering raw materials	X	
resource and materials management (knowledge of sustainable resource management, including assessing the environmental impact of materials and using alternative, more sustainable raw materials).	X	X
life Cycle Analysis (LCA) (ability to perform a life cycle analysis of products to assess their environmental impact from production to disposal)	X	
technical skills related to recycling processes, material processing and recovery of secondary raw materials.	X	
reverse logistics (management of reverse logistics, i.e. transport of used products back to the manufacturer for repair, recycling or processing)	X	
digital and technological skills (workers will need skills in data analytics, artificial intelligence and other digital technologies that support process monitoring and optimisation)	X	

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change and sustainability management (ability to implement change in organisations, manage CE projects and promote a culture of sustainability.	X	X
knowledge of CE-related laws and regulations (knowledge of legislation on recycling, waste reduction and sustainable production and consumption).	X	
craftsmanship	X	
knowledge of the process for identifying circular areas	X	
ability to design processes	X	
competence in project implementation	X	X
The ability to communicate knowledge of CE		X

Source: own study

In the in-depth interview on this topic, there were also responses from the experts interviewed:

„I see it as a combination of hard and soft skills. On the one hand, specialist, expert knowledge, but on the other hand, being with people and supporting them on their way to closing the circuits."

„In my opinion, basically the same competencies and skills will be needed as now, only at a higher level, and sometimes more narrowly, or shared by all - e.g. related to natural care for the environment and choosing wisely, e.g. buying less, choosing more eco-friendly products or solutions."

„When I look at it, I think to myself that there is a lot of talk about specialists, technical and all that, and forget about the simpler professions like this, where people could work repairing something, making or improving some parts for specific things so that the equipment still works, or just cleaning. It is also possible that crafts will return to favour."

Professional competence is the set of hard and soft skills, knowledge, character features and other psychosocial abilities that make it possible to perform a profession's or job's tasks. Deepening hard and soft competencies is recommended in the circular professions, as they seem equally important. The diagnosis of new competencies and skills made by the surveyed experts expresses an accurate position and should be considered an important recommendation.

Reskilling and upskilling in the CE area can be viewed as a new approach to development management. Reskilling is an intra-organisational process in which employees acquire new or additional qualifications to perform tasks in a different position. Reskilling activities combine, in some cases, with a complete redeployment and, in some cases, with retraining for a different role. On the other hand, upskilling focuses on providing the employee with more advanced skills, broader knowledge, or experience in the job. These actions allow the employee to take on more responsibility or be promoted vertically. Sometimes, we see both reskilling and upskilling for the same person.

To ensure they have access to qualified staff, Circular companies should build an internal culture of continuous learning. Supporting their employees to follow a development plan by recognising their potential, as well as providing employees with the right tools and training, is a win-win solution in the long term. Examples of beneficial upskilling & reskilling practices:

– **Feedback 360-degree** - feedback between colleagues, customers or business partners. The feedback mechanism allows specific skills gaps to be identified, taking into account, for example, customers' point of view.

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- **In-house learning**, i.e., short forms of training, is conducted in-house. Employees share their notes and files in the cloud and share the knowledge gained from external training with other employees who, for various reasons, could not attend training courses. This creates a flow of knowledge between teams. In addition, there is an incentive for those employees who have attended external training to pass on their new knowledge to others regularly.
- **Digital library of business knowledge** – it is worth taking care to create a place of digital learning resources in the company. A good practice is to prepare a repository of online educational resources available to all employees (e.g., in the cloud). This way, accessing source materials (presentations, articles, white papers or business cases) is possible even when working from home. In addition, it avoids the duplication of files and saves time in the search for relevant learning materials;
- **E-learning and digital learning** – developing staff competencies through various accessible forms of digital education. One example is **Bite-sized learning -** a set of engaging online lessons. These are short, highly focused content based on a single topic or business problem (www.humanpartner.pl).

The respondents were also asked to express their opinions on the changes they currently observe in the labour market about the development of CE. According to 2/3 of the respondents, CE-related professions are neither better paid than non-CE professions nor more available. On the other hand, 1/3 think they are more financially favourable. Also as many respondents consider these professions to be more available on the labour market. Almost 2/3 of the respondents believe the professions connected with CE to be rather good quality professions, while the rest do not. On the other hand, all respondents stated that these professions have and will have a long-term character. In addition, almost ¾ of the respondents think that the occupations connected with CE are those of a specialised nature. In contrast, ¼ of the respondents believe that the professions associated with CE are the basic ones. 2/3 of the respondents considered that new jobs are created thanks to CE, while the remaining 1/3 of experts disagree.

As a result of the slow but noticeable changes in the labour market as a result of the implementation of the CE, care should be taken to better visibility and accessibility of these occupations, as well as their payment, especially when it comes to specialised occupations, often requiring employees to have expertise covering a narrow area. As changes related to the CE are inevitable, adapting already existing professions (supplementing them with circular subcomponents) seems to be a natural consequence.

This raises the question of adapting the educational offer of secondary and higher education institutions to meet, among other things, market demand in occupations related to CE. As the only one in Poland, the University of Life Sciences in Lublin offers the following fields of study: Circular Economy at the Faculty of Production Engineering (engineering studies) in stationary and non-stationary form. '*Studies in Closed Circuit Economy are addressed to people who wish to become specialists in the circular economy. This philosophy aims to leave raw materials, materials, and products in use for as long as possible, with the resulting waste as secondary raw materials*. Qualification for the course takes place after calculating the results of the compulsory mathematics (basic level) and an additional subject at an extended level - a choice of mathematics, biology, chemistry, physics and computer science.

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This is the profile of the course graduate mentioned above and their career perspectives[1]. The graduate has knowledge and practical skills in, among others, efficiency of industrial production, minimisation of waste generation, renewable energy sources, management of natural resources, design of water and wastewater installations, waste management, use of appropriate recycling technologies and techniques for neutralisation of pollutants entering the environment, protection and monitoring of the natural environment (https://up.lublin.pl/rekrutacja/gospodarka-obiegu-zamknietego/).

Commissioned by the ORE (Centre for the Development of Education) in June 2024, Prof. Zbigniew Przygodzki prepared an education programme for the profession of Waste management technician[2].

The programme reviewer is Katarzyna Straszyńska-Pięta (employee of ZM Bzura). This is a new profession for which the National Teaching Framework has recently been developed. Hence, the ORE has developed a model curriculum so technicians can open classes of this type.

It should be highlighted that the programme has been prepared based on a set of learning outcomes relating to occupational characteristics of level 4 of the Polish Qualification Framework. It is PQF level 4 that has defined the professional tasks and work environment of a waste management technician. A person holding this qualification is an independent worker or supervises a small team of people. They cooperate in a group to perform professional tasks together and take care of their work safety and the work safety of their co-workers. A waste management technician's professional tasks are storage, logistics management, and waste documentation and reporting. A waste management technician can be an employee of waste processing companies and companies in various industries that practice closed-loop resource management and reduce waste production in an industrial symbiosis. The economy's ongoing transformation from a linear model (take - use - throw away) to a circular model promoting zero waste requires a change in the awareness of residents, entrepreneurs, authorities and scientists. From the perspective of the labour market, it requires, above all, complex

[1] Employment opportunities for circular economy graduates include:

- municipal management facilities (municipal waste management plants, wastewater treatment plants)
- state and local administration (ministries, regional offices, municipal offices, marshal offices, provincial offices)
- research institutes and universities dealing with waste utilisation and management issues
- biogas plants, plants producing electricity and heat from energy crops, agri-food waste, waste streams from animal husbandry
- research, development and consulting companies preparing technologies and equipment for the CE
- institutions responsible for technology development and transfer
- business incubators
- design and construction offices
- manufacturing and trading companies
- industrial and hazardous waste management facilities.

[2] A waste management technician is concerned with organising and supervising waste management work and carrying out operational activities related to waste management in a company to prepare it for reuse and integration into the raw material cycle and to reduce its negative impact on the environment.
The tasks of a waste management technician include: organising and supervising work associated with collecting and transporting waste, collecting and processing waste, preparing waste for reuse, organising and supervising the circulation of materials, carrying out work associated with classifying, recording and sorting waste, keeping records of waste, reporting and other documentation associated with waste management, and monitoring the environmental impact of waste management activities, as well as carrying out work associated with operating machinery and equipment for transporting and processing waste. A waste management technician can work in municipal service facilities, landfills, regional municipal waste treatment facilities, raw material processing plants, mining companies, service and production facilities, and administrative, research, scientific and other units.

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knowledge and skills on how to take care of raw materials and reuse them again and again in production processes. Considering this definition, a programme was constructed consisting of learning outcomes containing knowledge, skills and personal and social competencies concerning these areas of waste management.'

'The syllabus for the profession of waste management technician for a post-primary school is aimed at people with primary education. It makes it possible to obtain a certificate of vocational qualifications after passing examinations in qualifications CHM.07 and CHM.09. The curriculum in question has a spiral structure, where the teaching material has been arranged from the simplest to the more complex, which makes it possible to return to the content covered at the beginning of post-primary school education to broaden it in subsequent years of schooling, to develop the ability to perform activities related to the implementation of occupational tasks. In addition, the spiral structure makes it possible to consolidate previously learnt content and makes it easier to pass occupational qualification examinations. Contents correlate within subjects and are implemented as theoretical and practical training. Programme duration - 5 years - 10 semesters'.

The above two examples of educational offers formulated for two specific professions are a good step and model practice towards introducing CE-related professions into the labour market. It is recommended to increase the pool of circular professions and to adapt the offer of secondary and higher schools to a greater extent to the new market requirements (with particular attention to markets and local conditions). Green occupations supporting global sustainable development goals such as reducing greenhouse gas emissions, protecting biodiversity or ensuring sustainable management of natural resources should be widely promoted. Such activities attract investors to local markets, strengthening cooperation between science and business. Creating connections between business and science already at the level of educational offerings (internships, apprenticeships, exchanges) creates a cumulative effect of mutual benefits.
For the new circular professions, working conditions are also necessary. In this area, attention to employee wellbeing, occupational safety, the convergence of the company's mission with GOZ and the possible presence of green infrastructure are particularly important.

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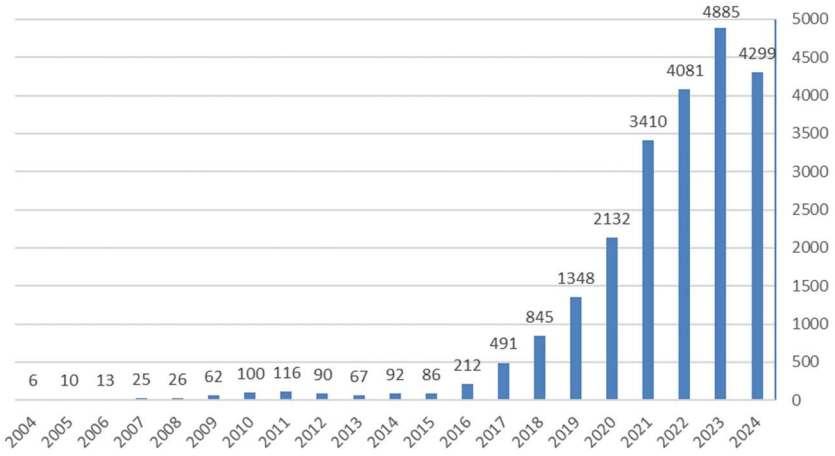
6. Environmental recommendations with a life cycle and circular approach

6.1. Circular economy and the environment – general recommendations

The circular economy is a part of the world around us. From the perspective of post-communist countries like Poland, it is necessary to recognize a certain return to the past, where waste was often treated as a resource. This often formed the basis for homegrown inventors who repaired and recovered materials for reuse. It resulted from poverty and the unavailability of many things on the market. The circular model allows actions that reduce waste production and use resources in circulation within the economy. The rapid increase in academic interest reflects a growing awareness of the need for sustainable practices in the global economy. However, it is crucial to note that this surge in theoretical discourse does not necessarily equate to the widespread implementation of circular economy principles in practice. Many industries and governments are still struggling with transitioning from a linear "take-make-dispose" model to a more sustainable circular approach.

It should be acknowledged that we increasingly talk about circularity in the world around us, but this does not always result in its application. The basis for this statement is the popularity of the term "circular economy" among keywords. In Scopus databases, this term has been searched since the early 1980s (the first occurrence was in 1983). However, by 2003, only seven of these concepts had occurred in the literature. Changes became evident only in 2004 when this term appeared six times in Scopus databases within a year. Since 2022, the number of articles containing the keyword "circular economy" has exceeded four thousand, and it is highly likely that this number will surpass five thousand in the current year (Fig. 10).

Figure 10. Number of keywords “circular economy” in Scopus database



Source: Scopus database, accessed 18/09/2024.

A similar trend can be observed when analysing the terms "circular economy" and "environment." However, the number of documents available from the cross-analysis of these two terms is more than twenty times lower (Fig. 11).

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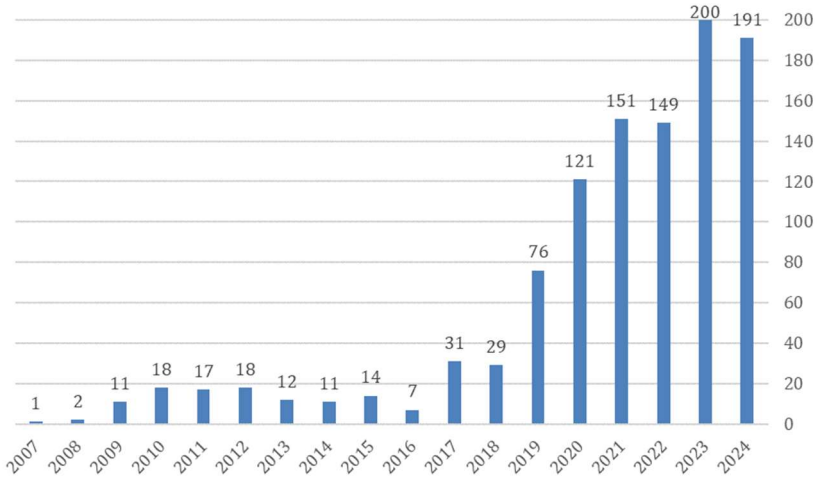
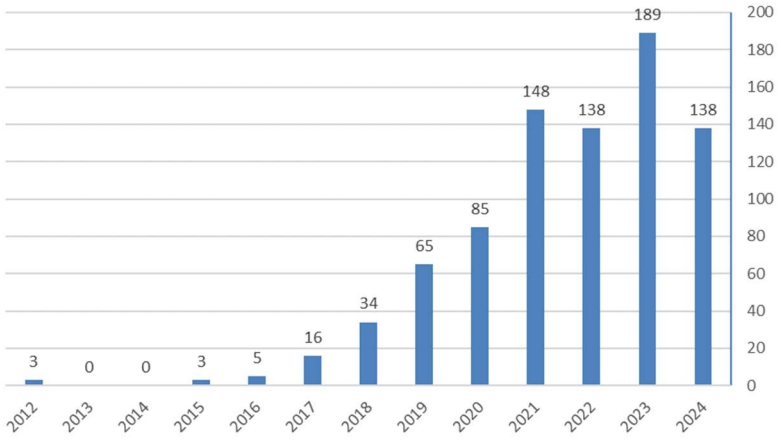
Figure 11. Number of keywords “circular economy” and “environment” in Scopus database



Source: Scopus database, accessed 18/09/2024.

Considering the country of authors' affiliation allows one to state that interest in the circular economy in Poland occurred with nearly a ten-year delay in global trends. This is because articles with affiliations from Poland began to appear only in 2012. Taking this date as a cutoff, it should be noted that 3.7% of publications related to the circular economy were associated with authors from Poland. The highest share of authors with Polish affiliation regarding circularity occurred between 2018 and 2021, reaching at least 4% of scientific publications related to this topic. Although in 2023, the number of articles on circular economy authored by Polish researchers is the highest in the analysed period, their share in the scientific community is below 4%. Moreover, 2024, which refers to less than three full quarters of the year, is characterised by an even lower proportion of such publications (Figure 12). Analysis of the databases shows that for authors with a Polish affiliation, a significant proportion of publications (78.8%) are also on environmental topics.

Figure 12. Number of keywords “circular economy” in Scopus database – authors with Poland affiliation



Source: Scopus database, accessed 18/09/2024.

Referring to authors affiliated with the Łódź academic centre, it should be emphasised that since 2012, fifty-two papers have been published, with only one appearing before 2018. This also indicates the need

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for action within the academic community, which remains a trendsetter for other local actors, particularly in the business world.

The number of scientific studies being prepared also reflects the creation of networks related to circular economy and environment with other keywords. The product life cycle concept emerges in both cases, whether concerning authors from abroad or those affiliated in Poland. Steps should also be taken to make research findings accessible to a broader audience, which can be linked to connecting the subject of circular economy with issues highlighted in global trends, such as waste management and recycling.

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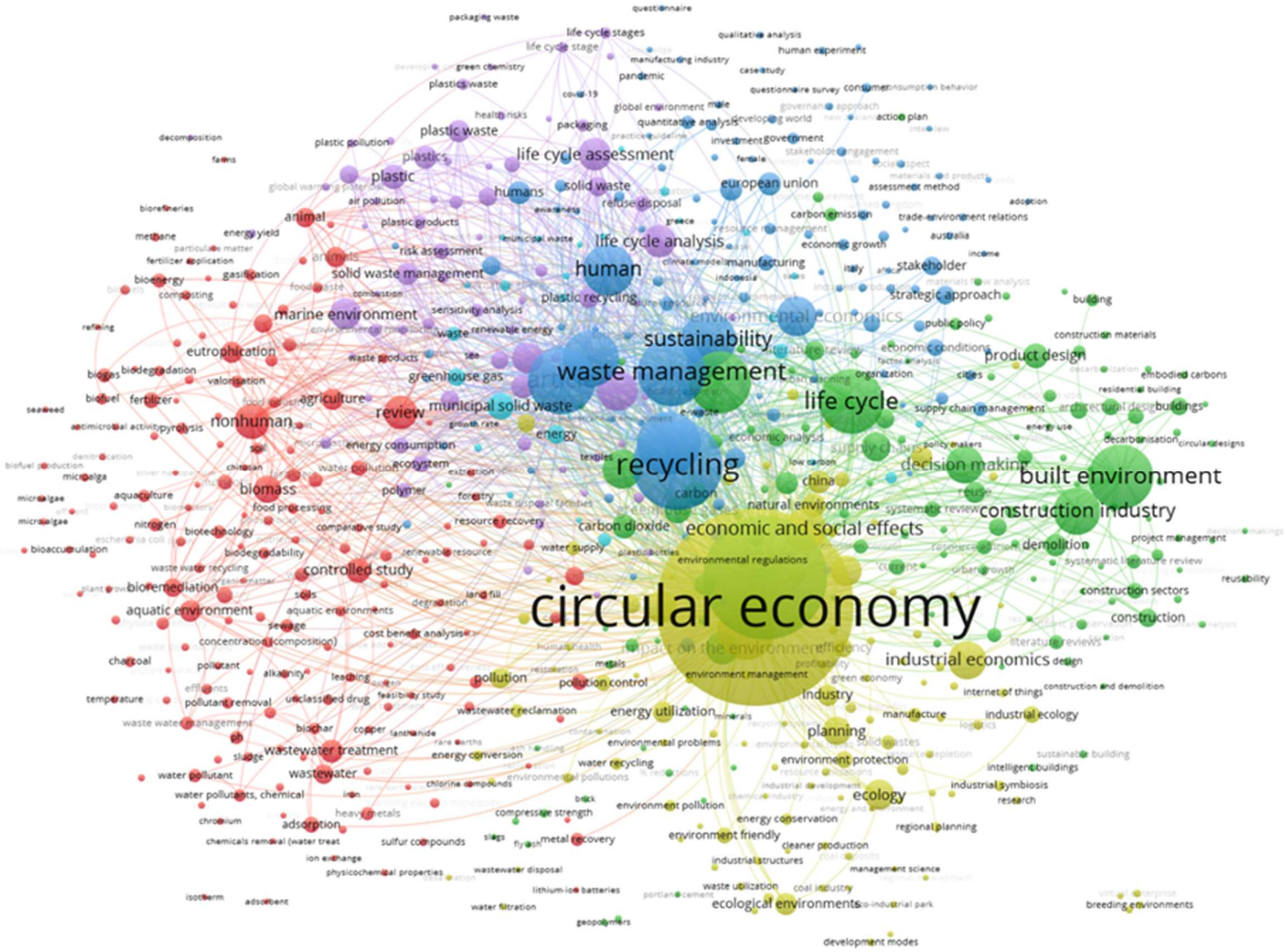
Figure 13. Keywords clustering “circular economy” and “environment” in Scopus database – world and Polish affiliation



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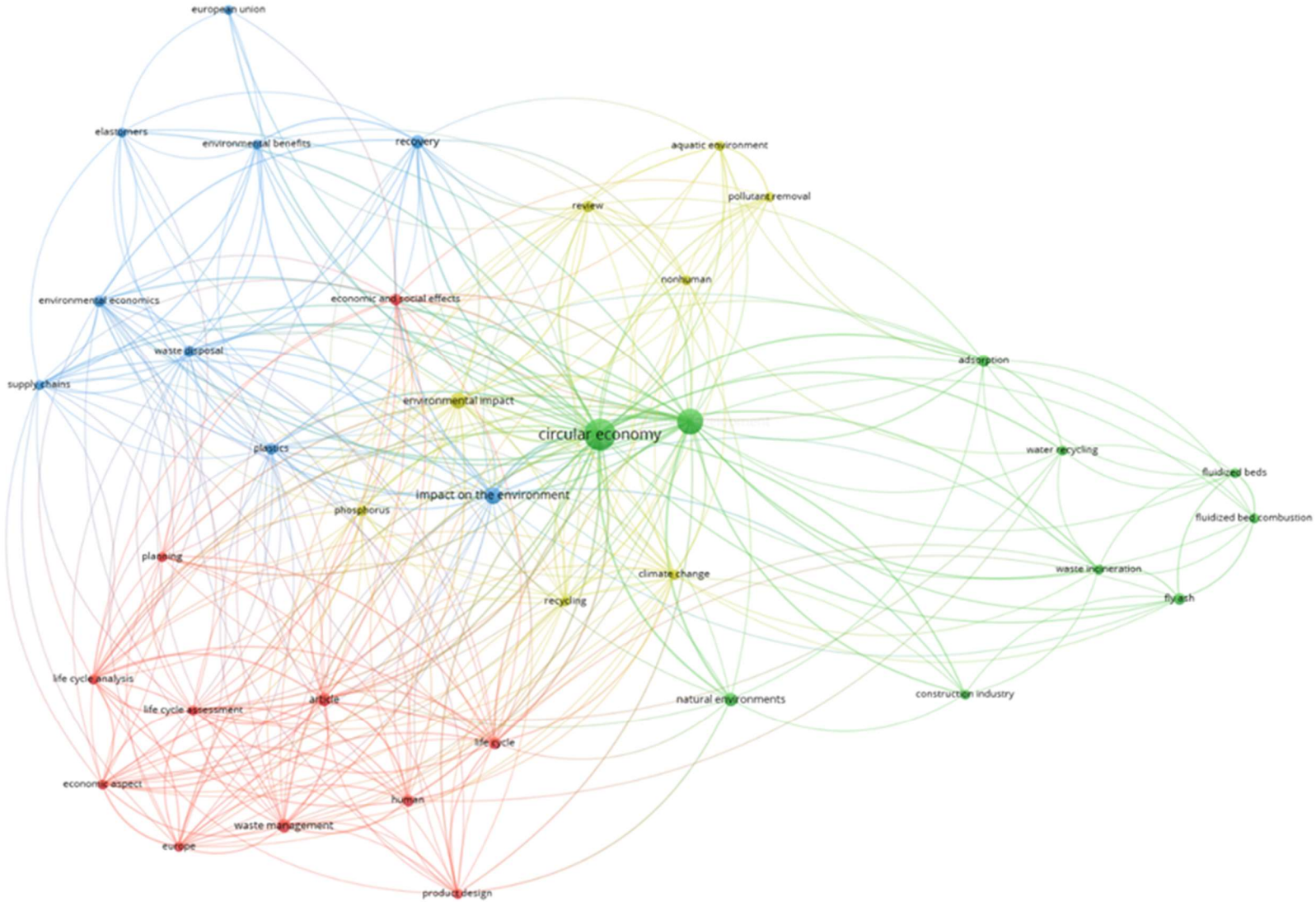

Source: Scopus database, accessed 18/09/2024, prepared in VOSviewer software.

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6.2. Recommendations for strengthening the circular economy and life cycle issues

Considering the relationships between circular economy and product life cycle management in the context of environmental impact, it should be noted that bibliographic analyses show feedback loops between these issues. However, based on the construction of product cycles in various areas of local actors' operations, it must be acknowledged that the basis for this process is the data contained in statistics and data from individual entities (Notarnicola et al., 2024). This is essential for finding an initial life cycle assessment. Such actions should be undertaken in collaboration between entities working on changes and scientists, enhancing these processes' effectiveness.

Actions taken to enhance the product lifecycle should also focus on expanding the spectrum of existing databases, allowing for a comprehensive approach to this topic. This will lead to better design of closed-loop products, enabling faster implementation of improvements. This applies to all CSSs involved in the project but is also relevant in other areas of economic functioning and daily life (Nordahl & Scown, 2024). The actions undertaken will serve as a foundation for building the technological maturity of various industries that create closed-loop systems (Arvidsson et al., 2024).

The life cycle assessment is intended to influence a sustainable approach to the actions taken by all local actors, particularly businesses, which should engage in circular processes. It forces them to conduct audits in this area, which should lead to advancing to higher levels of circular decision-making, namely in organization and management (Rigamonti & Mancini, 2021).

The methods used in life cycle activities, such as life cycle assessment (LCA) and life cycle costing (LCC), should be permanently integrated into production processes and reflected in environmentally conscious household thinking. Implementing such recommendations and achieving broader impact effects can take up to a decade, contributing to resilience building (De Laurentiis et al., 2024).

Actions related to the product life cycle should also lead to using secondary raw materials derived from product recycling within a given industry (Gallo et al., 2024). It also becomes important to use secondary raw materials in inter-industry relationships. In this case, building open information databases about individual secondary raw materials that can be used in other production cycles becomes essential.

An essential recommendation for Poland regarding the circular economy is simplifying the laws and procedures associated with it to enhance the efficiency of all entities operating within the national ecosystem. This will also enable large players and local communities, which also impact the environment, to engage in circularity and support the foundational development of a circular and sustainable society.

Considering the local and regional community, it is essential to introduce facilitation measures for implementing projects that enable the closure of loops in households and among entrepreneurs, particularly related to the use of rainwater. This will reduce the load on transmission networks and wastewater disposal systems, including rainwater, thereby reducing the carbon footprint associated with their disposal. Implementing such measures could include incentives like tax breaks or subsidies for installing rainwater harvesting systems and educational programs to raise awareness about the benefits of water reuse. Moreover, by encouraging the adoption of these practices at both household

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and business levels, communities can foster a culture of water conservation that extends beyond individual actions, ultimately contributing to a more resilient and sustainable local water ecosystem.

Considering plastic waste, a key recommendation is diversifying the types of plastics collected selectively. It should be linked to waste collection entities, which should diversify the types of plastics they handle. This diversification can facilitate the inclusion of these resources into the logistic chains of businesses. Consequently, this will reduce the environmental load and improve waste management. To achieve this, investing in advanced sorting technologies that can accurately identify and separate different types of plastics is crucial, ensuring higher quality recycled materials that meet industry standards. Furthermore, collaboration between waste management companies, plastic manufacturers, and end-users is essential to create a robust market for recycled plastics, incentivising the collection and processing of a broader range of plastic types.

Actions related to the circular economy should be supported at the European Union, national, and regional levels. This is inherently linked to funding streams, often from public sources and can constitute barriers. However, fostering innovation in higher education institutions that use public funds reflects initiatives within open science. Such an approach enables external entities to employ these solutions in laboratory settings and everyday operations. It should also be viewed as both a challenge and a recommendation to ensure that circular solutions impacting the economy are not undermined by lobbyists whose areas of operation are affected.

Public funds should also be directed to enterprises so that R&D teams can implement environmentally friendly solutions at various stages of the production cycle. These actions should encompass different entities in terms of employment size. As a recommendation, it should be emphasised that medium and small enterprises should also adopt solutions that enhance their environmental management. Regardless of the size of the entities, collaboration should be pursued with local governments, NGOs, universities, and society at large. This aims to ensure the sustainability of the implemented solutions.

6.3. Recommendations for the symbiosis of the environment with the circular economy

Recommendations found in the literature are also confirmed by research conducted within the Fronth1p project. According to the presented approach, local and regional actors should strive for an ideal point (benchmark) across various areas of activity. This multifaceted approach recognises that achieving circularity requires simultaneous progress in different sectors, such as waste management, energy efficiency, and sustainable production. The Fronth1p project's findings emphasise the importance of tailoring circular economy strategies to local contexts while fostering stakeholder collaboration to create synergies and maximise impact.

The availability and use of technology determine human impact on the environment. The technologies used in different areas of social and economic life can minimise or determine the anthropopressure. In this perspective, academics and scientists working in research institutions and businesses create a new reality. Scientists are generally responsible for supplying environmentally friendly and desired technologies. Therefore, in formulating recommendations in the area of the environment, the opinions of scientists were primarily used as respondents to the survey. Scientists associated with the Lodzkie region and knowledgeable about the region, ecosystem needs and services were invited to participate in the study.

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In the adopted scale, the benchmark value is set at five. The ex-ante studies conducted in the project's initial phase and the first ongoing studies in September 2024 indicate that a range of actions related to environmental impact is essential for Polish entities. This necessity arises because none of the analysed areas exceeded a value of 3.2 points on the established scale in the conducted study.

Table 20. Market failure in the environmental area

Research area:	**ENVIRONMENT**	**Data:**	**PL: 09.05.2022 PL: 14.09.2024**
Characteristics of the FGI research target group:	Scientists involved in the research of CE according to the CSS logic, specialising in environmental protection		
Type of failures	Question to identify failure in environmental area	Synthetic assessment of occurrence	
		2022	2024
Imperfect Competition	▪ competitiveness assessment of CE research ▪ participation of Circular Economy projects in the activities of the R&D units ▪ attractiveness R&D units for business	**2.3**	**3.1**
Public Goods	▪ crowding out of private finance by public funds ▪ the scope for commercialisation of research from public funds	**3.0**	**3.1**
Externalities	▪ formal barriers to the commercialisation process ▪ CE projects carried out in partnerships vs. individual projects ▪ synergy effects of partnership ▪ knowledge and technology transfer effectiveness ▪ profitability of CE projects ▪ staff transfer	**3.5**	**2.9**
Incompleteness of the market	▪ implementation possibilities of realised projects ▪ the level of interest and absorption of the proposed solutions on the regional market ▪ absorption of R&D's projects related to CE in the region	**3.3**	**3.1**
Information Asymmetry	▪ monitoring of market needs ▪ monitoring of business partners	**3.0**	**2.6**

Source: own study

Research at the beginning of the project exhibited more significant variability across different types of market failures in the environmental sector. The first ongoing study shows reduced variability among various market failures. However, this flattening did not correspond to an increase in the values of these measures. The most significant negative differences in results during the project's duration were related to external effects. The second largest decline was observed in information asymmetry. The smallest negative differences identified in the studies conducted during the project connected to market incompleteness. Positive differences were noted for public goods and imperfect competition in the environmental area, with a score increase of 0.8 points in the latter case (Tab. 20; Fig. 14).

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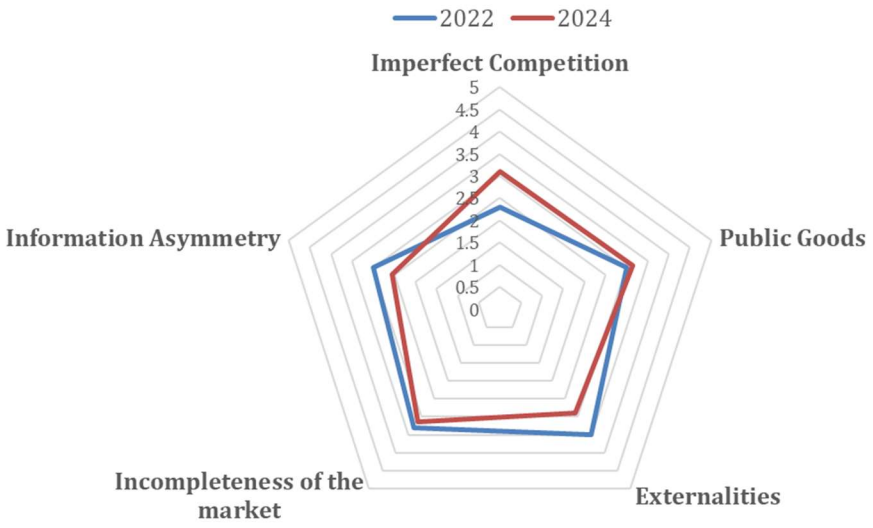
Figure 14. Benchmarking ex-ante and ongoing – recommendation



Source: own study

The results indicate that the synthetic assessments highlight areas for intervention and recommendations in the environmental sector. Regardless of the type of market failures, much work remains to be done. Expert assessments indicate the necessity of actions to enhance the competitiveness of scientific research related to the environment and circular economy. A general recommendation in this regard is to increase the availability of financial resources allocated for research, including projects associated with the circular economy. It is essential to improve the attractiveness of research institutions in their relationships with businesses. Of course, these recommendations also relate to economic entities, which often show little interest in innovation and collaboration. This is particularly significant from the perspective of small and medium-sized companies, which drive the Polish economy. It is also recommended that university actions regarding the commercialisation of research be adapted to current market conditions. This is crucial for the efficiency of university systems in commercialising solutions related to the environment. Often, this should be based on simplifying procedures undertaken in dedicated units within universities for this purpose. Commercialisation should particularly focus on projects largely relying on public funding.

Experts participating in the study recommend the necessity of intersectoral collaboration. This collaboration is essential for implementing solutions within the circular economy and, consequently, for environmental initiatives. It should also involve public administration entities, which, as managers of their territories, should become potential centres of knowledge about the resources in their areas. Such actions will enhance the scalability of outcomes, allowing them to have a greater impact on the territory and its economy while extending beyond their borders.

In the environmental sector, it is recommended that knowledge transfer be prioritised, which should also occur by moving the personnel who can apply solutions from other industries to the fields of environment and circular economy. To facilitate this, consideration should be given to creating cooperation programs focused on employee transfer. Furthermore, it should be noted that such projects have been implemented successfully in previous EU funding frameworks, enabling both the

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academic community and companies, including small and medium-sized companies, to engage in these types of initiatives.

Another recommendation is the necessity to promote solutions related to the circular economy in various environments. Equally important is promoting outcomes achieved in scientific projects to stimulate interest among economic entities and regional authorities regarding the results obtained. Promoting new solutions through circular festivals is also crucial, as it can help disseminate advanced knowledge to a broader audience. The concept of Circupuncture is also applicable here. Circupuncture is a method that uses integrated tools of interpersonal and collective communication, supported by ICT technologies, to facilitate small-scale investments when implementing a holistic vision of development is challenging. It promotes bottom-up actions initiated by stakeholders who are aware of the conditions and needs related to the circular economy, fostering collaboration among various entities. Additionally, it serves as a coordination mechanism that integrates multi-agency, sectoral, and cross-sectoral activities, ensuring the coexistence of social, economic, and natural spheres through principles of market logic, symbiosis, and sharing.

The recommendation with the broadest impact is the necessity of conducting market monitoring to assess its needs. This element received the lowest evaluation from the perspective of ongoing assessment. It requires the engagement of both the region and higher education institutions. A suitable action in this regard may also involve creating circular clusters, which would be platforms for knowledge exchange among the entities involved in their operation. They will become a signpost for monitoring market needs related to circularity.

The presented recommendations regarding the environment do not exhaust the range of recommendations of varying scales. However, their development is ongoing as the transition to a circular economy continues. It is also based on recognising the changes occurring in the environment, which can significantly influence the shifting priorities of individual recommendations.

6.4. Recommendations on the environmental impact of CSS' - potential in building a sustainable environment

In the research context, the experts involved were asked to evaluate which of the Circular Systemic Solutions (CSS) were the focus of the Frontsh1p project. Additionally, two CSS were divided into the feed and food subsectors for methodological reasons, and a similar approach was applied to plastics and rubber waste. As a result of this segmentation, the following sectors were assessed: Wood Packaging; Food Sector; Water and Nutrients; Plastics; Rubber Waste; Feed Sector.

Based on expert evaluations, average scores were determined regarding the environmental significance of actions within the specified CSS sectors. This allowed for pairwise assessments of individual elements, which constitutes the implementation of the Analytic Hierarchy Process (AHP) for estimating the weights of the various components.

Following the prepared evaluations, a pairwise comparison matrix was constructed based on information obtained from experts in environmental studies (Tab. 21). Based on the pairwise comparison matrix, it is possible to estimate the priority weights of the individual elements being evaluated. This aligns with the approach presented by Saaty (Saaty, 2007; Saaty & Kearns, 1985; Saaty & Vargas, 2013).

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Table 21. Environmental impact of CSS' - pairwise comparison matrix

	Wood Packaging	Food Sector	Water and Nutrients	Plastics	Rubber Waste	Feed Sector
Wood Packaging	1	0.5	0.25	0.5	2	1
Food Sector	2	1	0.33	1	3	2
Water and Nutrients	4	3	1	3	5	4
Plastics	2	1	0.33	1	3	2
Rubber Waste	0.5	0.33	0.2	0.33	1	0.5
Feed Sector	1	0.5	0.25	0.5	2	1

Source: Own study

The calculations enabled the creation of a ranking of the most desirable sectors regarding their environmental impact. According to the weight estimates, the Circular Systemic Solution (CSS) responsible for water and nutrients has the greatest potential for implementing circular economy solutions in the environmental sector, with a weight of 41%. Following this, the food sector and plastics were ranked second, weighing 17%. In the subsequent positions of the ranking, wooden packaging and the feed sector were placed, each receiving a weight of 9.6%. Lastly, rubber waste was ranked at the bottom, weighing 5.8%.

Table 22. Environmental impact of CSS' - priorities of CSS'

CSS	Priority [%]
Wood Packaging	9.6
Food Sector	17
Water and Nutrients	41
Plastics	17
Rubber Waste	5.8
Feed Sector	9.6

Source: Own study

Based on the weight mentioned above estimates, it can be concluded that among the identified Circular Systemic Solutions (CSS), the one related to water has the most significant potential for rapid development. However, it should be acknowledged that the other sectors require attention to enhance their competitiveness while reducing their environmental impact. This prioritisation of water-related solutions underscores the critical role of sustainable water management in achieving circular economy goals, particularly in regions facing water shortage or quality issues. Nevertheless, a holistic approach is essential, as improvements in water management can catalyse positive changes in interconnected sectors, creating a ripple effect that amplifies the overall impact of circular economy initiatives.

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