D6.1 Workshop report including local CE conditions analysis

WP6 Exploitation, replication and transferable practices

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Acronyms and abbreviations

Acronym	Full name
BT	Business Tampere
CDP	Communication and Dissemination Plan
CCRI	Circular Cities and Regions Initiative
CCRI-CSO	Circular Cities and Regions Initiative - Coordination and Support Office
CE	Circular Economy
CLIC	CLIC Innovation Ltd
D	Deliverable report
DMP	Data Management Plan
ECO	ECO STOR AS
EKOF	Ekokumppanit Oy (EcoFellows)
EVs	Electric vehicles
FAIR	Findable, Accessible, Interoperable and Reusable
Frstad	Fredrikstad kommune
FVH	Forum Virium Helsinki Oy
GA	Grant Agreement
GD	GreenDelta GMBH
GDPR	General Data Protection Regulation
Innowo	Instytut Innowacji i Odpowiedzialnego Rozwoju
KVC	Key value chain
KVC-DEMO	Key value chain demonstration
MTK	The Central Union of Agricultural Producers and Forest Owners
PF	Polyfuels Group AB (Previously known as Green Ideas Group GIG)
SDU	Syddansk Universitet
SE	Stakeholder engagement
SE-DEMO	Stakeholder engagement demonstration
SINTEF	SINTEF AS / SINTEF Energy
TalTech	Tallinna Tehnikaülikool
TARTU	Tartu Linn (Tartu City)
TLN	Tallinna Linn (City of Tallinn)
TOPSOE	Topsoe AS
VIKEN	Viken Fylkeskommune
VTT	VTT Technical Research Centre of Finland Ltd

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Executive Summary

The objective of this report is to provide an overview of the status of local conditions and regional specialties of practices and policies of the circular economy, especially in the selected waste streams: bio-waste, plastic, and batteries. The report screens replication target areas in the replication countries to explore possibilities for gaining public and private funding, enhancing small and medium enterprises (SME) participation, and including other industry value chains related to the circular economy (CE).

The report includes conclusions from Task 6.1 and findings from various workshops and events held in Finland and the targeted replication countries: Estonia, Latvia, Lithuania, Poland, and Northern Germany. In addition to that, the financial conditions of the CE have been studied and presented in Finland and Estonia. The City of Tartu organized a workshop on the local repair and fixing network. The focus of the local replication workshops was to collect local needs and challenges to use as guidelines and input, for example, for the Replication Handbook, and to gather insights for other work packages. Furthermore, workshops organized with organizations outside the project consortium expanded the potential effectiveness of the project's further activities. These events also enhanced CCRI's targets to promote and encourage the regional circular economy.

In conclusion, the inputs from workshops on the CE in the replication areas can be summarized as follows: social factors impacting the circular economy face common challenges across countries; awareness campaigns on recycled plastics and sorting are important in different countries; biobased side and waste streams require awareness and communication on separate collection and bio-waste use; safety of batteries and repurposing are key concerns; political and economic factors include deposit systems, regulation in the battery industry, and financial incentives like subsidies and taxes; technological development is needed for better collection, sorting, and eco-design in plastic waste, as well as improved performance and lifecycle of EV batteries; legal factors support circular practices, flexibility, and innovation. Environmental factors were not extensively discussed, except for the potential cost-effectiveness of recycling lithium.

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1 INTRODUCTION

The transition to a circular economy (CE) is crucial in addressing the growing challenges posed by increased greenhouse gas (GHG) emissions, resource depletion, and climate change. The TREASoURcE project (2022-2026) aims to drive systemic change by developing CE solutions for underutilized or unused plastic waste, electric vehicle batteries (EV-batteries), and bio-based waste and side streams in cities and regions. This project aims to significantly enhance production and material circulation in the Nordic and Baltic Sea Regions.

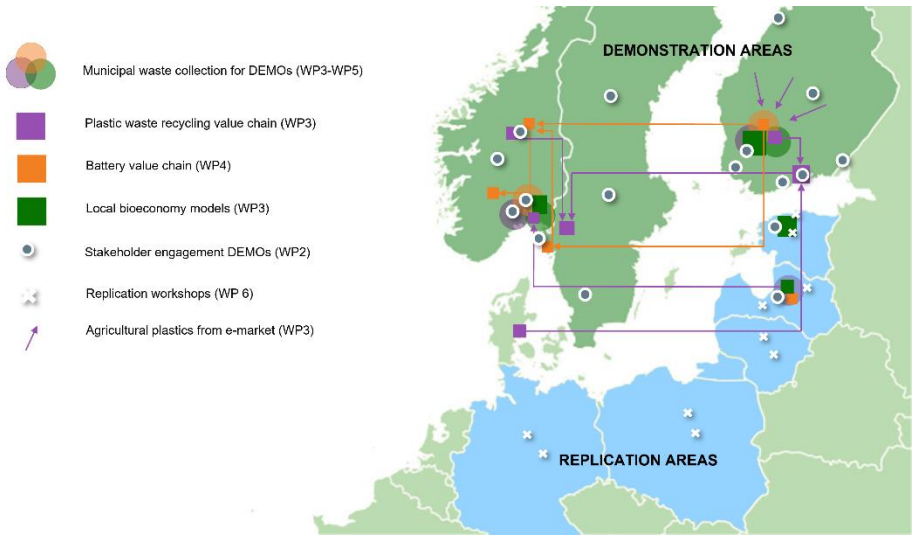

Figure 1. TREASoURcE Demo and Replication Areas

The systemic CE solutions valorise local resources beyond state-of-the-art waste management of currently non-reused and non-recycled products and materials. TREASoURcE focuses on demonstrating the CE solutions and replicating them in the Baltics (Estonia, Latvia, Lithuania) and Poland and Germany of the Baltic Sea Region.

1.1 Description of the Work Package 6

WP6 is a horizontal WPs and it analyses and models the transferrable practices created and developed in the project. They are deployed during the CE demonstrations of the project. The replication scenario will be created and formed as a handbook, an accumulated material collection in a digital platform.

The assumed target area's replication process is finetuned with a series of local workshops, a co-creation methodology with relevant target specific stakeholders. To ensure successful deployment and matching to the target environment, there are a series of measures and data, results and models, defined in the WP7, that will be considered. The performance of replications can be measured with handbook guidelines. The handbook will cover demonstrations of transferrable CE activities KVC-

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DEMOs (Key Value Chain Demos) in WP3-5 and SE-DEMOs (Stakeholder Engagement Demos) in WP2, which includes essential guidance to the public and most prominent private-sector financial support tools.

WP1 (Formulating the CE framework for the cities and regions) and WP2 (Stakeholder identification, collaboration and involvement activities) learnings are used to create an implication model for the analysis of target areas. The utilization of the CE data, from demos and learning outcomes, will be guided carefully for replication by WP6.

Roadmaps and CE strategies will be created with multi-stakeholder partners. The replication and transferrable practices modelling include consumer, SME, and CE industry dimensions, and connectivity to venture capital companies, SME incubators & accelerators, public sector procurement officers and other relevant parties. Replication primarily targets the Nordic and Baltic regions but also assess and evaluate potential replication in other EU regions.

Objectives and main activities

- Interpret stakeholder and other relevant analysis results of KVCs and SE-demos to realise critical and necessary factors to be taken into consideration in the process to create a replication plan for different target areas.
- Screening of replication target area's possibilities to gain public and private funding, enhance SME participation, and include other industry value chains related to CE.
- Increase understanding of the created models' scalability to other CE purposes.
- Case study that includes plans for establishing local plastic waste collection system in the pilot city.

Main outcomes

- A compilation of best replicable CE practices.
- Roadmaps, CE strategies and CE business plans according to the local conditions.
- Logistics and spatial optimisation with adjusted solution for each area.
- TREASoURcE Replication Handbook or replication localisation modelling: a living digital document and guide for public use.

Expected impact

Active collaboration with interested external stakeholders will assure a widespread transfer of information and good practices as well as their uptake throughout TREASoURcE regions and beyond. TREASoURcE demos are all open access and developed so that they are within the project designed, tested and validated and then conceptualised for efficient replication.

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1.2 Description of the Task 6.1

The task is connected to KVC- and SE-demos outcomes and will refine selected results. Local workshops will be arranged to co-create modelling and gather local, regional specialties in CE practices and policies. Activities include:

1) use WP1 analysis as workshop setup data
2) Execute local workshops (1-2 per country in Estonia, Latvia, Lithuania, Poland, Northern Germany) to refine and add-on previous findings to create three-level target adaptation levels of replication models (socio-economic perspective)
3) analyse financial support elements in public and private operational environments, the operation performed with workshop data as a supportive element
4) explore possible CE ecosystem potential & acceptance to regions via workshops
5) map Tartu's local conditions for Tartu's network.

2 METHODOLOGY

2.1 Analysis and models of transferrable practices

As TREASoURcE consortium has identified replicability and knowledge sharing as a very important part of the project, WP6 has dedicated resources to support widespread uptake within the territories, but also disseminate the results. Local workshops in the replication areas have multiple purposes: Find and connect different CE stakeholders to the project, analyse the local CE conditions and collect information and feedback to define needs for the replication handbook preparation.

The series of the local workshops were arranged with the local organisation in Latvia, Lithuania and Poland. In addition to these three separate workshops were held in Estonia by the project partners. The co-organisers had a significant role to help organise and invite stakeholders to the events.

2.2 Workshop Execution Method

Workshops was held in local language when possible to get more insight from the participant. However, some workshops were held in English. Depending on local co-organiser and other conditions the execution model (webinar or face-to-face) and the main target areas (all KVCs or one stream) varied case by case. However, the ideas and challenges were collected with group works and information of the current CE status of the replication area.

The workshops were targeted widely to the different stakeholder groups: Citizen organisations or associations, companies, cities & municipalities relevant to the location and academia.

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Three in Estonia, one in Latvia, Lithuania, Poland, in March – June 2023. The Germany workshop had to be cancelled due to no registrations, interviews were conducted instead.

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3 WORKSHOPS

Table 1 presents the overview of all conducted workshops in Task 6.1. The focus of workshops differed to some extent based on locally identified specificities like depending on the participants interest areas as well as on the overall status of circular economy in the replication target area. In some workshops the discussions generated input which focused more on the challenges and barriers in the field of circular economy rather than on solutions.

Table 1. List of conducted workshops and events in replication target areas (March 2023-June 2023)

Date	Title of the workshop	Task	Organiser	Location
24.03.2023	Biowaste Valorisation	6.1.2.	TLN & TalTech	Tallinn, Estonia
25.04.2023	Workshop for repair and fixing network	6.1.5.	TARTU	Tartu, Estonia
03.05.2023	Plastics and EV-Batteries: Searching for Solutions	6.1.2.	TalTech	Tallinn, Estonia
12.5.2023	Analyse financial support elements in Finland (In Finnish)	6.1.3.	FVH & BT	hybrid
19.05.2023	Workshop of the systemic circular economy solutions in the future - Potential, interest, needs & challenges of the circular economy	6.1.2.	FVH in partnership with Riga Technical University	Riga, Latvia
23.05.2023	Circular Economy in Practice	6.1.2.	TLN in partnership with Kaunas University of Technology	Kaunas, Lithuania
26.5.2023	Deep dive into European circular economy ecosystems	6.1.4.	FVH & CLIC	webinar
31.05.2023	Online workshop on implementing and replication of systemic circular economy solutions - CANCELLED	6.1.2.	VTT in partnership with Berlin Senate Department for Mobility, Transport, Climate Protection and the Environment, Division for Circular Economy, Resource Efficiency, Green Public Procurement and Street Cleaning	Online, Berlin area
20.06.2023	Local Circular Potential: Plastic Waste, Bio-based Streams, and Electric Vehicle Batteries	6.1.2.	VTT in partnership with Innowo	Warsaw, Poland

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It must be noted that the report at hand provides a more detailed presentation of Estonian workshops, including workshop on biowaste valorisation. There are two reasons for that: firstly, Estonia is currently the only partner from replication target areas that is represented in the project. As the project implementation continues, we will form fruitful partnerships in other replication countries. Secondly, as Tallinn City is participating in the project and biowaste topic is the prioritized one for this municipality, the report dived into this topic with higher level of details comparing to other descriptions.

3.1 Estonia

3.1.1 Tallinn: Biowaste

Table 2. General concept of biowaste WS in Tallinn (24.03.2023)

Title of the event	Biowaste valorisation
Focus	Biowaste
Time & Location	24 March 2023, TalTech premises
General concept	The aim of the workshop was to bring together representatives of biowaste producers, companies dealing with biowaste recycling, local governments, and state authorities to discuss what support private enterprises need to reduce the generation of biowaste in their production processes or to successfully sell the resulting by-products to the market. The workshop aimed to investigate the solutions that are already used by companies and the support measures that are expected from local governments and the state authorities.
Questions to address	How to reduce the production of biowaste? How to recycle biowaste and increase its reuse? What financial instruments could be helpful to use in biowaste value chain?
Participants	18 (city and state level authorities, recycling organisations, private companies, associations)

Technical details of the workshop

As Tallinn will replicate the urban rural symbiosis model for biowaste, which is developed and demonstrated in the project, a separate workshop on the topic of biowaste was organised. The focus of the 2,5 hour workshop was biowaste, so the invitees were stakeholders who produce or use biowaste in their business. The workshop was held in Estonian and facilitated by the Head of Partnerships and Strategy of FinEst Centre for Smart Cities (TalTech). The structure of the workshop included two brief presentations by external experts on the following themes: best practices in biowaste prevention, collection, recycling, and financing and compost certification. These short presentations were aimed to provide background information on the topic as well as to facilitate further discussion in groups.

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Description of the workshop

The workshop opened with a presentation of TREASoURcE project. This was followed by a presentation by the representative of Estonian Biogas Association on best practices in biowaste prevention, collection, recycling, and financing.

The final presentation was on the compost certification process, led by the head of Tallinn Waste Centre, encouraging more organisations to apply for the certificate by sharing details of the process.

After the presentations, the workshop continued using the world café method because it is a simple and welcoming format to explore a complex issue. According to the method the participants were divided into three groups at round tables. Each group had at least one project representative that facilitated the discussion, making sure that everybody could express their thoughts, and captured the main ideas. All groups were given the same three topics to tackle:

- How to reduce the production of biowaste?
- How to recycle biowaste and increase its reuse?
- What financial instruments could be helpful to use in biowaste value chain?

Each topic was discussed during one round lasting for about 15-20 minutes. In total, the discussions in groups lasted for approximately 45-50 minutes. Each group was provided with an A0 white sheet of paper, sticky notes, and markers to record and present their discussions afterwards. After all the three topics were discussed a representative of the group presented the group's ideas to the whole auditorium.

Key findings from the discussions

How to reduce the production of biowaste?

The results of a study conducted by Stockholm Environment Centre Tallinn in 2020 show that approximately 167,000 tons of food waste is generated in Estonia annually. Almost half of food waste is generated in households, 19% in the food industry, 14% in primary production, 12% in trade and 6% in the catering sector. Vegetables and vegetables were thrown away the most in households as food waste (32%). A relatively large part of the food waste was also prepared food leftovers (23%), fruits and berries (18%) and dairy products, including milk (13%). In the catering establishments that participated in the study, the main cause of food loss was leftovers from customers' plates (on average 71% food waste). Another reason was that more food was prepared than needed (on average 18% of food waste). Due to spoilage only a small amount was thrown away in catering (only 4% of food waste). Approximately half (49%) of the unsold food in stores was fruit and vegetables (27% of fruit and 22% of vegetables separately). The proportion of bakery products was also relatively high (16% on average). In the total amount of food products written off, the share of ready-made food was 13%, the share of meat products was 11% and the share of dairy products was 8%. Based on the data obtained

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in the study, it can be concluded that about 12% of unsold food is donated. The two main causes of food waste in stores are insufficient sales planning and forecasting (e.g., too much ordered, as a result of which the food spoils, exceeds the shelf life, etc.) and consumers' shopping preferences and behavioural habits. (1) This study highlights the need to find solutions to reduce the amount of biowaste.

During the workshop many coinciding ideas from the three groups on how to reduce the production of biowaste were presented. The participants all agreed that the most important challenge to overcome is raising public awareness on food waste. This should not only involve reducing food scraps and leftovers at home, but also planning portions ahead, encouraging people to purchase close-to-expiring food and imperfect produce such as irregular looking fruits and vegetables.

Several ideas considered how to effectively reuse close-to-expiring food products. There are already existing public food share pantries operated by FudLoop in Estonia, but it was mentioned by the participants that it would be beneficial to have a simple guide on how to use and manage the food share pantries, especially regarding food hygiene. In addition, an idea was proposed whereby there would be soup kitchens/cafés that prepare food from ingredients that are close-to-expiring.

The discount of close-to-expiring food in shops should increase from 30% to 50% to encourage shoppers to buy those products. Even more close-to-expiring food from shops should be donated. Currently in Estonia Toidupank (Food Bank) is collecting donations from some supermarkets, but not all of the food is donated (data is lacking). Many businesses are already focusing on reducing food waste, e.g., ResQ Club, a food app that helps the user to find close-to-expiring food from cafés and shops or Sumena[1], a shop that only sells close-to-expiring food or batches of products that have been written off by the producer/shop.

Garden waste forms almost 30% of all the biowaste collected in the City of Tallinn. Therefore, it is also important to reduce the amount of leaves and grass cuttings by mowing less often or using robot lawn mowers that mow frequently and make it possible to leave grass cuttings to decompose and supply the soil with nutrients. Moreover, instead of raking and collecting leaves in autumn, garden owners could use lawn mowers to crush the leaves and leave them onto the grass to decompose.

How to recycle biowaste and increase its reuse?

The participants of the workshop agreed that the two treatment options mainly used today for biowaste recycling – composting and anaerobic digestion with biogas production – are a great way to recycle biowaste. Some more innovative approaches were also mentioned such as producing biofertilizers from biowaste, using hay rolls for heat generation and biowaste pyrolysis, which produces biochar, bio-oil and combustible gas as end products.

However, currently in Tallinn the biggest issue is how to recover the biowaste, as biowaste accounts for more than 34% of the municipal solid waste generated. Mandatory separate biowaste collection

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for all households and businesses was launched in Tallinn from 1 June 2023. This is an important step to increase the level of collecting and hence recycling of biowaste, but participants agreed that communication on why people should collect their biowaste separately needs to be improved. There needs to be a general awareness that biowaste is a resource that can produce valuable compost and biogas. This notion has also been stated in a study conducted by the World Bank in Estonia, where participants in the study suggested that it is important to inform people of reasons to separate waste and signal that it is not pointless. The results also demonstrate that one of the main reasons that would motivate people to sort biowaste (more than 50% of respondents) is knowing that the organic waste would be composted or used for biogas production. (2)

Some ideas to increase the separate collection of biowaste presented included using the (carrot and stick' method, for example rewarding households and buildings that collect biowaste separately or creating a barter transaction between the homeowners' association and the municipality where the homeowners for giving away their biowaste get compost in return. A study conducted in Keila (a small town near Tallinn) in 2020 concluded that it does not make sense to use fines, but the focus should be on positively inspiring people. 89% of the companies participating in the study thought that the separate collection of biowaste could be increased by making the system more transparent and sharing information about biowaste processing methods. This study also stated that local governments should offer additional information and tools for biowaste composting on-site as a first option. If residents can choose between composting and collection, the sense of responsibility associated with personal choice arises. Freedom of choice is the best method to achieve the activity and quality of separate collection of biowaste and to ensure people's satisfaction at the same time. In Tallinn the choice between composting and collection is, however, possible only for private houses.(3)

The circular economy white paper of Estonia states that different members of society have different roles and responsibilities in developing the circular economy and ensuring its effective functioning: The task of the public sector is to create the necessary legal, economic, social, and environmental preconditions and legal framework for the promotion and functioning of the circular economy. The local government creates the prerequisites for their implementation and directs activities in the local community. The role of entrepreneurs is to create products and services responsibly, ensuring minimal environmental impact in their activities. Individuals are responsible for ensuring that their activities do not harm the environment, that consumption is based on needs, and that choices and decisions are sustainable. This distribution of responsibilities applies also to recycling of biowaste, where the (local) government sets the legal framework and businesses can design better services to ensure that individuals have the means to make sustainable consumption decisions. (4)

What financial instruments could be helpful to use in biowaste value chain?

Regarding financial instruments that would incentivize the valorisation of biowaste, the 'polluter pays' principle was mentioned several times. This principle would include applications such as more efficient monitoring; pollution charges when disposing of mixed municipal (unsorted) waste, and fining facilities,

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who do not sort their biowaste. However, studies have pointed out that fining is in fact not an efficient means to increase the sorting of biowaste, whereas raising pollution charges is more efficient. The new government of Estonia will most probably raise the pollution charge for municipal waste disposal fee, which would provide an economic incentive for people to sort their waste. (5)

Several ideas on building a scheme to valorise biowaste were proposed. For instance, the public sector as the responsible party to collect biowaste provides the waste stream for biowaste, and private sector provides funding and opportunities for recycling of the biowaste. Also, to encourage biowaste separation among residents, the municipality could offer them a discount voucher for sorting biowaste, which can be used in shops or in public transport.

The importance of public procurement was also mentioned by the participants as until now these have supported the market failure, whereby the environmental externalities caused by great amounts of unsorted waste are not internalised. In addition, direct financial support from the national government to local governments for better waste management was mentioned as well.

Table 3. Input generated in biowaste WS in Tallinn (24.03.2023)

Main findings and conclusions - Biowaste	
How to reduce the production of biowaste?	- raising public awareness on food waste - reducing food scraps and left overs at home - planning portions ahead - encouraging people to purchase close-to-expiring food and imperfect produce such as irregular looking fruits and vegetables - public food share pantries - soup kitchens / cafés that prepare food from ingredients that are close-to-expiring - discount of close-to-expiring food in shops should increase from 30% to 50% - reduce the amount of leaves and grass cuttings by mowing less often or using robot lawn mowers that mow frequently - use lawn mowers to crush the leaves
How to recycle biowaste and increase its reuse?	- producing biofertilizers from biowaste - using hay rolls for heat generation - biowaste pyrolysis - communication on why people should collect their biowaste separately needs to be improved. - using the carrot and stick method, for example rewarding households and buildings that collect biowaste separately. - creating a barter transaction between the homeowners' association and the municipality where the homeowners for giving away their biowaste get compost in return
What financial instruments could be helpful to use in biowaste value chain?	- polluter pays principle - more efficient monitoring - pollution charges when disposing of mixed municipal (unsorted) waste - fining facilities, who do not sort their biowaste - encourage biowaste separation among residents, the municipality could offer them a discount voucher for sorting biowaste, which can be used in shops or in public transport - direct financial support from the national government to local governments for better waste management

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	- importance of public procurements

3.1.2 Tallinn: Plastics and EV-Batteries

Table 4. General concept of plastics and EV-batteries WS in Tallinn (3.05.2023)

Title of the event	Plastics and EV-Batteries: Searching for Solutions
Focus	Plastics and EV batteries
Time & Location	3.5.2023, Tallinn, TalTech
General concept	TalTech international students (master's degree students studying environmental technologies) were asked to participate in the workshop focusing on two waste streams – plastics and EV-batteries. Before the workshop, students had to listen to the webinar (available at: https://TREASoURcE.eu/the-first-TREASoURcE-results-discussed-in-a-webinar/). Concrete challenges in every waste stream presented in the webinar had to be identified and noted by students themselves. Workshop focused on finding solutions to the identified challenges via group work. Each group had to take 2-3 challenges and focus on finding solutions to them.
Participants	16 (students)

On 03.05.2023 FinEst Centre for Smart Cities (TalTech) in collaboration with Water and Environmental Engineering Research Group of Department of Civil Engineering and Architecture (TalTech) conducted the workshop "Plastics and EV-Batteries: Searching for Solutions". Students studying environmental technologies were invited to brainstorm about solutions to the challenges in these two waste streams: plastics recycling and repurposing of EV-Batteries. TREASoURcE webinar formed the basis for outlining the challenges and barriers in these realms. In total 16 students participated in the workshop, which lasted approximately 2,5h.

Participants were firstly given the overview of TREASoURcE project and a quick summary of challenges, which was followed by individual, and group works using Miro Board online tool. During **individual work** students were asked to imagine the ideal future of a circular economy for different stakeholders (households, companies, public sector). The following question was raised:

- What if we lived in an ideal world where circular economy works? How would this world look like?

Many different ideas were noted by the students, both in the area of technology development as well as change in societal attitudes. As mentioned, following **group work** focused on plastics recycling and repurposing of EV-batteries. 2-3 challenges from the presented list had to be picked up. Students formed 4 groups and worked on finding the answers to following questions:

- What could be the solutions to identified challenges?
- What actions should be taken to tackle the problems?
- Who should take these actions? Identify stakeholders!

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In plastics section, participants focused on the problems of diversity of waste management, lack of separate collection, lack of design for recycling, unwillingness of manufacturers to increase uptake of recycled plastic, uncertainties in ownership of plastics and preference of virgin plastic over recycled one. EV-batteries topic perceived to be a bit more challenging. Following barriers to repurposing were discussed: variable EV-design, lack of information for repurposing operator, consumer preferences towards new batteries.

Tables 5 and 6 summarize the input from participants with relevant edits by authors of this report for the sake of clarity and correction of typos. Following sections will briefly present the ideas.

Key Findings

Ideal World of Circular Economy

During individual work students were asked to imagine the ideal future of a circular economy for different stakeholders (households, companies, public sector). In addition to futuristic thinking, this task was also seen as a warming-up or setting-the-scene exercise for participants to get ready for the group work.

While some of the ideas were already focusing on problem-solving and are hence presented in the next sections of this report, several thoughts were indeed futuristic. A lot of ideas were focusing on the ban of plastic products. For instance, participants imagined that fossil-based plastics are totally banned in future and companies manufacture only bioplastics made of renewable feedstock. As a result, public institutions do not deal with elimination of plastic waste as this is not a problem anymore and in general, people are interested in saving the planet. Also, in future overall consumption of households and companies is decreasing; all problematic plastic items and multi-packaging items are not used, but only recyclable ones. Plastic is used only in areas where it is necessary (i.e. medicine, science), but households have different solutions (e.g., metal, glass); each household sorts waste with great accuracy.

On the larger scale, a complete transition from take-make-design methodologies to reuse and recycles structures was imagined. Also, a more structured approach to refurbishing and remanufacturing EEE waste is developed. In the ideal world people know the true value of all materials and resources and rare materials are 100% circulated.

Also, thoughts on EV-batteries were generated. Participants imagined that in the ideal world when a person purchases an electric car, he or she gets the manual on how one can use the battery afterwards - what repurposing operator to turn to, how the risk of fire is minimised etc. Ideas about EV-batteries design standardization, improved safety and increase durability were generated. These were more thoroughly addressed in the subsequent group work.

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Recycling of Plastics

As mentioned earlier participants of the workshop were presented challenges in the plastics waste stream based on the finding of the project. Altogether 7 challenges were presented and 6 of them were discussed during the workshop (see Table 5).

To tackle the problem of lack of separate collection, workshop participants proposed the development of new technologies, such as optical sorting, where the sorter would differentiate between different types of plastics as well as could monitor its quality. This idea also involved the concept of sorting and recycling as close to waste generation as possible: centralized recycling stations in big apartment houses. Next, the ideas on getting the real-time information of plastic waste streams throughout the whole supply chain were proposed: the information on type, quality, stock, recycling processes. This would enable to shift to just-in-time production and consequently reduce unnecessary waste. Also, companies should be incentivized to share information about the quantities produced and distributed between countries. Another proposal on maximizing efficiency of waste management was suggested: establishing one register of plastics products that would include information on their types, usage area, the final state. Stakeholders at different governmental levels and from different sectors must be involved: state level, municipal level, production companies, waste management companies.

Furthermore, private sector incentivization in terms of packaging and preference of virgin plastic over recycled one was discussed. Stick and carrot method was proposed: financial incentives for companies that simplify the packaging (or substitute plastics packaging for more recyclable materials) and extra taxes for those that do not abide the regulations of simplified packaging (e.g. imported goods). Also, the ban on multi-material packaging was suggested (in cases where mono-material packaging can be used) and avoidance of code 7 plastics (unknown and difficult to recycle). Likewise, taxes and subsidies were offered as a solution to motivate companies to use recycled plastic instead of virgin plastic. In addition to that, education and awareness rising campaigns about the economic and environmental benefits of reused plastic for both public and private sectors could be beneficial.

Leasing/pawning idea of plastic packaging was proposed underlying the fact that the manufacturers is the owner of the plastic product rather than the consumer. This system is currently working to a limited extent in Estonia (6) In case of international trade, the responsibility and cost would be on the suppliers per packaging report. This may incentivize suppliers to choose local producers.

Table 5. Input generated in WS in Tallinn – focus on plastics (3.05.2023)

Main findings and conclusions - Plastics	
Challenges	**Ideas**
1. Lack of separate collection	- Optical sorting at source: big apartment houses could have centralized recycling where optical sorter would differentiate between different types of plastics. The optical sensor could also monitor the quality of plastic so that high quality plastic and dirty plastic would not be mixed.

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2. Diversity of waste management	- Real-time information of plastic waste streams throughout the whole supply chain (information on type, quality, stock, recycling processes), so that possible uses can clearly be defined, and we could shift into just-in-time production. - Stakeholders that need to be involved: state level, municipal level, production companies, waste management companies. - Government should focus on the exact approach for waste management hierarchy and subsidize institutions, that will perform the required research for making the best approach. The mechanism should make companies share the information about quantities produced and distributed within countries. - Plastic manufactures should label their products by unique codes, that address the origin of the material (PP, PVC, PLA, PBS etc)
3. Lack of design for recycling	- Financial incentives to companies that simplify the packaging. - Substituting plastic packaging for other, easier to recycle materials, would be rewarded. - Introducing an extra tax in imports that do not abide by the rules of simplified packaging. - Multi-material packaging should be banned in applications where mono-material packaging can be used. - Avoiding code 7 plastic, unknown and difficult to recycle - regulators, manufacturers.
4. Uncertainties in ownership	- Companies which use plastic (virgin or recycled) are owners of those plastic. They are therefore in charge of collecting them after use. - Each country has its own amount of plastic and is 100% responsible for it (cannot trade of plastic with other countries) - Instead of consumer being the owner of plastic packaging, it should be the manufacturer. The system should function on leasing/pawning and returns instead of consumers owning the packaging. - In case of international trade, the responsibility and cost will be on the suppliers per packaging report. This may incentivize suppliers to choose local producers. Scale: EU Stakeholders: consumers, manufacturers, suppliers, local authorities (Environmental Board)
5. Preference of virgin plastic over recycled plastic	- Recycle companies should implement tests for recycled plastic materials so that the buyers get the info of the properties. - Sticker that can be on the recycled items so that people can identify the recycled ones. - Taxes on companies which prefer to use virgin plastic, to incite those to change their design chain.
6. Unwillingness of manufacturers to increase uptake of recycled plastics	- Incentivization such as tax credits and subsidies for companies looking to increase uptake and recycled plastic. - Stable supply chain facilitated by recyclers, manufacturers, the government and other stakeholders. - Education campaign and awareness about the economic and environmental benefits of reused plastic. - Create a real big market for reusable plastic, to further improve the supply chain. - As we talk about the waste management in general, to start with a respective authority responsible for waste handling that should establish one register of plastic products, their types, usage area, the final state; that will help to plan waste

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	management accordingly, to make it as one big process, minimizing costs, maximizing efficiency. This also will help to impose fair taxes, fees on consumers, etc. - Stakeholders: Government to impose national policy, National waste handling authority, private/business consumers, local municipalities.

Repurposing of EV-Batteries

In the second session which focused on EV-batteries participants were presented 8 challenges/barriers to repurposing of EV-batteries. Overall, 5 of them were picked by the participants for discussion.

One of the important challenges in repurposing of EV-batteries is the variable design of these batteries, implying that to repurpose a battery, a repurposing operator must find a unique way to do that depending on the battery at hand. This results in the absence of the automated repurposing process and eventually, in the cost of the second-life battery. Workshop participants discussed the need for standardization of battery designs across and within manufacturers; however, without the risk of inhibiting innovation in this realm.

May ideas concentrated on the creation of a product passport/ID number/QR codes/labels that would be beneficial for the consumers of the SLB as well as repurposing operators. It was discussed that such a passport would provide an easy access to the information regarding the type of the battery, its current capacity (incl. its lifetime), possible applications/use cases (car/household appliances, household backup, power grid backup, charging stations etc.), data addressing safety concerns with clear explanations on testing approach. It must be noted that the Battery Management System (BMS) and battery passport is addressed in the upcoming EU regulatory framework – EU Battery Regulation. According to regulation, from 1st of January 2027 batteries should be marked with a label containing information on lifetime, charging capacity, separate collection requirements, the presence of hazardous substances and safety risks. QR code is also addressed in the Regulation. Furthermore, it is stated that BMS should be accessible to battery owners and independent operators acting on their behalf. By 1 January 2026, an electronic exchange system for battery information, with the creation of a battery passport (i.e. electronic record) is expected to be executed (7).

Furthermore, pilot projects with municipalities as EVB consumers were suggested since they can set an example for other consumers as well as have possible repurposing locations. In addition, to tackle the challenge of customer preferences for new products, it was proposed that customers could have guarantees in case of SLB failure, e.g., they will get another one cost free. Rising awareness campaigns were also suggested that would address safety concerns, environmental consequences, benefits of using SLBs etc. Subsidies and incentives to balance competition with new batteries were seen as necessary to help to initiate market for SLBs (e.g., adopters would get extended warranties).

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Table 6. Input generated in WS in Tallinn – focus on EV-batteries (3.05.2023)

Main findings and conclusions – EV Batteries	
Challenges	**Ideas**
1. Variable EVB design	- The design of batteries should be standardized to allow interchangeability and repurposing. This should not inhibit innovation: companies can have different technologies, only the box (dimensions, inlets/outlets) and safety requirements should be fixed. - Regulation of design: modular design for batteries so that they can be used in multiple applications; this would create free market for used batteries and make repurposing easier; batteries across manufacturers can be combined to one purpose; requires standardization of design on a higher level
2. Lack of information	- Inform the public about repurposing; have an application that public can scan (a QR code), so the person knows about the lifetime of a batterie. - Product passport to map possible uses for the battery; would help with the safety issues; must be regulated by the governments
3. Safety concerns	- Improve lithium-ion battery recycling, making it safer. - Make batteries more durable and improve their functionality so when they expire, they would not be so high in safety risk.
4. Repurposing vs recycling	- Customers could have guarantees if the SLB fails they will get another cost-free - Incentives can help to initiate market for SLBs and later incentives can be lifted; stakeholders would include car-owners and retailers, repairers. - We think that when we talk about EV batteries, we cannot separate repurpose from recycle as they go together one after another. We think the process should be planned from the very beginning with all batteries having an ID number and a small digital panel indicating current capacity and possible application according to that (car-household appliances - household backup, power grid backup, charging stations). The ID number works as the right to own and use, which should be strongly regulated with taxes and fines, etc. ID number should be searchable, so any user can look it up on a common system and find points of reuse/recycle, etc.
5. Consumer preferences	- Starting pilot projects with municipalities as EVB consumers. They have different possible repurposing locations and high demand. Municipalities can set an example for other consumers. - Labelling and product description that clearly describes battery type, previous use case (if admissible), and estimated lifetime, such that users can choose what suits their purpose. - Should be possible to confirm the source of SLBs with unique identifiers. - Price point: subsidies should exist to balance competition with new products. Adopters get incentives and extended warranties. - Campaign: people will always question why to choose old over new. Hence, campaigns must address safety concerns, environmental consequences, benefits, etc. - Labels for lifespan and potential use cases: e.g., if it was formerly for EVs, it could be perfect for street lighting or other low-energy consumption devices.

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	- Data based approach to addressing safety concerns: clear explanation of testing approach and certifications, reference to existing use cases. In this case, it is mostly B2C relationship. So, the manufacturer takes the lead.

3.1.3 Tartu: Fixing and Repair Network

Table 7. General concept of WS in Tartu

Title of the event	Fixing and repair stations network development
Focus	Fixing and repair stations network development
Time & Location	25.04.2023, Tartu, Kastani 42 (Paranduskelder)
General concept	The aim of the workshop was to look into consumption habits of the residents and their attitude towards the repair and recycling of objects. Group work searched for the answers to questions about the necessity of fixing and repair stations and expectations for the services provided in them. Introduction to the current situation and bottlenecks in the collection and recycling of plastic, used batteries and biowaste in the Tartu region.
Questions to address	Necessity of fixing and repair stations and expectations for the services provided in them.
Participants	18 (universities, local municipalities, businesses, community associations, NGOs, Estonian Environmental Investment Center, etc.)

On 25th of April City of Tartu in cooperation with NGO Paranduskelder (fixing and repair center), conducted a workshop for community fixing and repair network development. Aim of the workshop was to share ideas of how to make community fixing and repair centers more popular and more accessible for all citizens, but also to find possible economic models. A total of 18 participants from different interest groups (universities, local municipalities, businesses, community associations, NGOs, Estonian Environmental Investment Center, etc.) participated in the event.

First, representatives of Paranduskelder presented the summary of a previously conducted survey, which investigated people's awareness and attitude towards consumption and repairment of goods in Tartu. After that examples of fixing and repair centers from other countries were presented.

Presentations were followed by a group work. During the group work, a total of three questions were asked, and the participants had the opportunity to move freely between different groups and discuss those topics. Questions asked were as follows:

- What could be the ideal day-to-day functioning of fixing and repair centers?
- What examples confirm that community fixing, and repair centers are necessary for the city?
- How to ensure the economic sustainability of fixing and repair centers?

Main findings were that an ideal fixing and repair center could be considered a facility that offers mobile fixing and repair services, open workshops in different neighborhoods, service-based fixing and repair, and a social aspect where people can learn new skills and build a shared community. Fixing and repair stations also provide several benefits to the city, including social, environmental, educational, and economic benefits that contribute to the better well-being of residents and community development.

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To ensure the economic sustainability of fixing and repair centers, it is important to find several sources of income, and finding systemic solutions is of decisive importance.

Eventually current situation and bottlenecks in the collection and recycling of plastic, used batteries and biowaste in the Tartu region was introduced.

Table 8. Input generated in Tartu WS (25.04.2023)

Main findings and conclusions	
Challenges	**Ideas**
Day-to-day functioning of fixing and repair centers could be better	- Mobile repair service could be a part of the daily operation of the fixing and repair centers, which would allow larger items to be transported from home to the centers and to receive a consultation in advance regarding the repairability of the item. - Location: fixing and repair centers could be in every part of the city, and they should be in a visible place. Centers could also be open 7 days a week at times convenient for people. - Ticket fee could be charged for attending the fixing and repair center. - Marketing efforts could involve public figures spreading the message that tinkering is a cool and stress-relieving hobby. - Service-based repair where people leave things for repair by masters, including items received from companies. - Fixing and repair centers could have a social aspect that involves community building and helping and teaching people.
Low awareness of necessity of fixing and repair centers for community	- Social well-being: People can form social connections that help reduce loneliness, especially among older people. This contributes to better social well-being and reduces the negative effects of loneliness. - A sense of accomplishment: A successful repair gives people a sense of accomplishment that boosts self-confidence and motivation. It helps people develop a positive attitude towards problem solving and coping. - An interest in mending clothes: Especially mothers of young children and single men can find mending clothes an interesting activity that helps them develop their skills and pass the time. - Green way of thinking: People can learn about green way of thinking and integrate it into their consumption habits, helping to reduce the use of resources and the generation of waste. - Providing content and program to the city: The existence of fixing and repair centers creates activities that provide added value to the city, contributing to the education, experience, and sense of community of the residents. - Good examples across the Europe: There are several positive examples in Europe where the state supports social initiatives, including fixing and repair centers. These examples can inspire other cities and countries to create and support similar initiatives.

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	- Empowering communities: Communities can make better use of their resources and skills, helping to create more resilient and sustainable living environments.
Fixing and repair centers are economically unsustainable	- Finding systemic solutions that are nationally organized is crucial to help ensure the economic sustainability of correctional institutions. - Different sources of income: Since there are no systematic solutions at the moment, it is important to find several sources of income, such as funding from the city government and the provision of services. - Price differentiation: pricing could take into account the ability of different customers to pay. - Critical mass of people: Creating marketing strategies and education programs to find enough people interested in improvement. - Cooperation with companies: to work with various companies and explore sponsorship opportunities to support the economic sustainability.

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3.2 Lithuania

Table 9. General concept of WS in Kaunas (23.05.2023)

Title of the event	Circular Economy in Practice
Focus	Bio-based waste, plastics and EV-batteries
Time & Location	23.5.2023, Kaunas, Lithuania
General concept	Workshop
Questions to address	Actions/solutions that could help overcome identified barriers
Participants	16 (students)

Table 10. Input generated in Kaunas WS (23.05.2023)

Main findings and conclusions	
Bio-based side and waste streams	Most difficult is the actual collection of biowaste from households. More efficient means of recycling would be community-based projects where a neighbourhood sets up a small-scale anaerobic biogas production to lower energy prices and recycle their biowaste.
Plastic waste streams	Plastic should also be collected separately by different types. Reduce composite packaging.
EV batteries	Low battery performance Safety issues Battery design for easy recycling or dismantling

Technical details of the workshop

The workshop in Lithuania was held on 23 May 2023 online via Zoom. The workshop was organised in cooperation with Kaunas University of Technology. The facilitator of the workshop was a professor in the Kaunas University of Technology.

There were 16 participants in the workshop. Participants were MSc and PhD students from Lithuania, France, and the UK mostly from environmental engineering but also circular economy and management. The workshop was held in English.

Invitations were sent via e-mail 3 weeks before the workshop with a personal reminder 1 day prior to the event. The students were also encouraged to listen to the TREASoURcE webinar before the workshop to get more acquainted with the topic and prepared for discussions.

Description of the workshop

The workshop was opened by the general presentation of TREASoURcE project. Group discussions in 3 topics followed. First the topic was explained shortly by the facilitator. Then the participants were split into breakout rooms and each topic was discussed during one round lasting for about 20-25 minutes. In total, the discussions in groups lasted for approximately 45-50 minutes. For recording of the group's ideas Word documents and PowerPoint presentations were used. After each topic a representative of the group

presented the group's ideas to the whole auditorium. In the end a summary and conclusions by the professor from the Department of Environmental Technology in Kaunas University of Technology were made, emphasizing the need to move from linear to circular economy. Discussion with students about the major obstacles in the transition to circular economy was held. It was mentioned that investments to new technologies to improve recycling are needed. Also, we need to move away from the economic model where economy is monopolised by few large companies and allow communities to be more involved in supply chains. There should be more awareness in the industry and consumers on circular economy. Governments should be supporting the companies, who want to switch to circular economy. In conclusion, students estimated that for big economies such as the UK and France it is very difficult to transition to circular economy by 2050. For Lithuania, which is a smaller country and awareness is raising, this is more probable.

Key findings from the discussions

Bio-based side and waste streams

An overview of the main problems related to biobased side and waste streams recycling was presented. During the workshop it was mentioned that the main recycling methods for biowaste are still composting and anaerobic digestion for production of biogas. It was suggested that a more efficient means of recycling would be community-based projects where a neighbourhood sets up a small-scale anaerobic biogas production to lower energy prices and recycle their biowaste. However, it was also pointed out that most difficult is the actual collection of biowaste from households. It was suggested that take an example from South Korea, where food waste must be collected separately, or the household gets fined. However, it is also important to note, that South Korea has a highly disciplined society.

More state-ot-the-art technologies include using food and agricultural waste to extract phenols and flavonoids for nanoparticles synthesis.

Plastic waste streams

The facilitator gave an overview of the main problems with plastics and its recycling.
During the discussion it was pointed out that plastic consists of very different polymers, meaning that plastic should also be collected separately different types (separate containers for different plastics). Optimisation of plastic collection was also mentioned. For example, the most problematic plastic is arguably PVC due to chlorine. It was also mentioned several times that redesign is an important aspect that the industry should start considering when producing plastic products. Mono-plastic packaging should be the default setting (unless it's for medical or other area). It should also be banned or taxed to produce composite packaging, which is in most cases impossible to recycle. Standards should be set for utilization of recycled plastic in new products, e.g., set minimum content of recycled plastic in a product.

Deposit systems are instruments that work well to increase recycling of plastic. More types of packaging should be included to the deposit system. Some countries are implementing taxes on non-recycled, virgin

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plastic (e.g., UK and Spain) to force the producers to use recycled plastic in production. This should be common practice across the board. Taxing single use plastics is another financial instrument that helps to reduce plastic waste.

Plastics can be recycled to create products with added value such as furniture, in the textile industry or as a filler in construction. As a last resort energy recovery can be considered for non-recyclable plastics (more state-of-the-art processes such as pyrolysis, gasification).

There are also difficulties in recycling plastic. Recycled plastic product may not have same engineering properties as virgin plastics. There is also the aspect of cost efficiency in recycling of plastic waste.

It is also important to educate consumers via educational programmes and awareness raising campaigns on the use of plastics and how to reuse it. For example, it might be possible to repurpose some plastic for another application. Also, there are difficulties in correct collection and separation of different plastic waste. It is important to motivate both consumers as well as industry to recycle plastic in order to reduce reliance on fossil fuels.

EV batteries

The facilitator gave an overview of the main problems with EV batteries and its recycling.
In the EU there is a supply risk of raw materials for key technologies. EV batteries contain many such critical raw materials. Therefore, it is important to recycle those materials. Recycling technologies for mechanical separation for EV batteries exist and are in use. The battery is dismantled into plastic, Al, black mass, including metals (Ni, Mn, Co, Li). Recycling batteries reduces the need for critical raw material extraction and helps to reduce dependency on third countries. It also reduces the environmental footprint of the battery production. Today the material recovery is a complex and difficult process, which increases costs. But in the future, lithium will be cheaper to recycle than to mine it as a raw material. This is already the case for cobalt. For now, imported virgin Li, Co could be made expensive via tax to force more recycled materials to be used.

However, repurposing EV batteries as stationary storage units for home or grid-scale storage systems would drive down the cost for energy storage system, which would lead to the electricity price reduction.

The challenges with repurposing are mainly to do with low battery performance and safety. There is little information on whether it is safe for people or safe for the environment. Economic viability and high costs for repurposing is also an important aspect.

Industry should be regulated to produce batteries that are designed to be easily recycled or dismantled. There is research on redesigning batteries with no lithium and cobalt, which would ease the dependence on critical raw materials.

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3.3 Latvia

A physical workshop held in Riga focused on all TREASoURcE KVCs. The event was organised by FVH and TalTech in co-operation with Riga Technical University.

Table 11. General concept of WS in Riga (19.05.2023)

Title of the event	**Workshop of the systemic circular economy solutions in the future**
Focus	All KVCs
Time & Location	19.5.2023, Riga Technical University
General concept	The workshop was focus on all three value chains and the aim was to bring together different kind of actors and get wide range of opinions. The main language of the workshop was English.
Questions to address	Potential, interest, needs & challenges of the circular economy in Latvia
Participants	16 (students, municipality/policy makers, researchers, companies)

Key findings of the workshop

Table 12. Input generated in WS in Riga (19.05.2023)

Main findings and conclusions	
Ideal situation in the future	- Laws and regulations support well the CE needs. - There is no more need for landfills. - Citizens know how to recycle different waste streams. - Materials are designed as environmentally friendly as possible (reused, recycled, energy efficient) - Cheap technologies to ensure the circularity is available. - Small self-sustaining systems on sub municipal level reduce the need for unnecessary logistics. - A universal plastic deposit system for Baltic countries.
Plastics – identified problems	- Knowledge level of plastics and recycling is low. - Administration and e.g. procurers need to be more open on new material usage (though they are more expensive or there is no experience of them) - Enabling conditions are not ready and legal framework and municipalities don't support recycling enough. - Media does not support recycling narrative, easy to finding excuses why sorting is not done (in households) - Public, e.g. EU funds are not used because not enough information or it's too bureaucratic. - More co-operation between industry, research and government needed.
Bio-waste recycling of households – identified problems	- Need to have space for bio-waste sorting at home (e.g. branches from a garden can be too big to standard size containers or should they be burned). - The laws and regulations should have more flexibility for innovative circularity initiatives. - Municipalities should offer small composters for the households. - More collaboration between science and business and municipalities - Government have a bigger picture and municipalities must deal with that. - It is still cheaper to collect mixed waste, than sort the waste in different streams.
Batteries - identified problems	- Not enough cars for the industrial scale reuse. - It's not that easy to repurpose a battery. - Users do not trust used batteries, 2/3 want a new battery - Not enough funding for repurposing

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The workshop was organised in co-operation with Riga Technical University in their premises and they sent the invitation to approximately 200 potential contacts. The number of participants was small, but they presented various target groups: students, companies, academia, and decision makers. The purpose of the workshop was to identify the challenges or needs regarding circular economy in Latvia and for which TREASoURcE can offer solutions and share experiences.

Before the workshop session professor from Institute of Energy Systems and Environment (RTU, Latvia) held a presentation “Circular economy in Latvia from the perspective of health care waste management”. The presentation gave an overview of the recycling in the healthcare and medical sector where the risks and standards are higher when materials are recycled.

In the workshop the groups discussed about the challenges of plastics and bio-waste and the re-use of the batteries was discussed as a one group in the end of the event.
The questions of the group works were same than in the second Estonian workshop:

- What if we lived in an ideal world where circular economy works? How would this world look like?
- What could be the solutions to identified challenges?
- What actions should be taken to tackle the problems?
- Who should take these actions? Identify stakeholders!

The first task of the participant was to imagine the ideal situation of the waste management and circularity in the future and those notes and as well the identified challenges are presented in the table above.

The overall conclusion and the finding of the workshop was that in Latvia that a lot has been done to support the circularity, as well in legislation and regulation but also in the municipality level, but the general level of knowledge about the circulating possibilities is deficient and there is need to increase the information specially for the citizen level. The improvement of the material design and the improvements of supportive applications were mentioned. The better co-operation between research, administration and CE industry was seen a way to speed up the progress of the waste management and recycling. Also, the importance of the legal framework and rules and the role of the administration were listed. The participants saw that the economic incentives or payments affect e.g. households' willingness to recycle or compost the bio-waste.

The re-use of EV batteries is new in Latvia and the participants had no experience due to still small amount of the EV cars and recyclable batteries. However, the battery industry is growing in Latvia.

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3.4 Germany

An online event was targeted to Berlin area stakeholders to have discussion on identifying local needs, challenges, and motives to take up developed open access systemic circular economy solutions. A connection to local stakeholders was established via the Circular Cities and Regions Initiative (CCRI).

Table 13. General concept of WS in Berlin (31.05.2023)

Title of the event	**Implementing and replication of systemic circular economy solutions targeted for local Berlin area stakeholders**
Focus	Plastics, batteries, bio-based side & waste streams
Time & Location	31 May 2023, on-line, cancelled
General concept	The aim of the workshop was to bring together local stakeholders from the Berlin area, like municipality and regional representatives, industry dealing or interested in these streams, as well as supportive stakeholders like policy makers and funding parties and to take part in the interactive open discussion on identifying local needs, challenges, and motives to take up developed open access systemic circular economy solutions.
Questions to address	Questions regarding to all three selected streams: plastics, batteries, bio-based side & waste streams
Participants	Workshop was cancelled due to the lack of the registered participants

Despite various efforts, the workshop was cancelled because there were no registered participants. Direct invitations were sent via e-mail (by Berlin area contact: Senate Department for Mobility, Transport, Climate Protection and the Environment, Division for Circular Economy, Resource Efficiency, Green Public Procurement and Street Cleaning). In addition, promotion was done via the project's website, LinkedIn (additionally promoted by project and project workers) and in addition, one project partner also promoted the event in their local networks.

One reason why relevant stakeholders were not interested, could be that certain circular area solutions are already well established in the Berlin area. Based on discussions in with local stakeholders, there is interest in the outputs of the project. Particularly, the rural-urban symbiosis model and tool as well as the stakeholder engagement demonstration concepts were seen as interesting.

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3.5 Poland

VTT organised a live workshop in Warsaw, Poland, together with the local partner Innowo (Instytut Innowacji i Odpowiedzialnego Rozwoju). Innowo is a Think To Do Thank, an NGO that supports the development of innovation and the implementation of systemic changes to promote sustainable socio-economic development. Innowo is also a member of the European Circular Economy Stakeholder Forum.

Table 14. General concept of WS in Warsaw (20.06.2023)

Title of the event	**Local Circular Potential: Plastic Waste, Bio-based Streams, and Electric Vehicle Batteries**
Focus	All KVCs: Plastics, batteries, bio-based side & waste streams
Time & Location	20 June 2023, Warsaw University of Technology premises
General concept	The workshop aims to gather insights on the key factors that need to be considered when implementing circular solutions in the Warsaw area. It also aims to identify interests, needs, and potential challenges related to plastic waste recycling, utilization of bio-based side and waste streams for biogas and composting, as well as repurposing electric vehicle batteries as stationary energy storage systems.
Questions to address	What is your take on circular economy? Is it a familiar topic, what is your interest level in engaging more in it? Are the identified challenges same or different in your experience? What affects most the transition to circularity in your area? How would you imagine the future, what would be the ideal and/or best possible CE scenario? This can include elements from the presentations or totally different perspectives, concepts and solutions. What are the necessary actions that would need to be taken towards the identified vision? Who should take these actions? Identify stakeholders! Who are the necessary stakeholders to reach the set CE visions? How to engage with them? Think from public-private-people perspective.
Participants	58 (companies, municipalities, academia, consultancy)

Key findings of the workshop

Table 15. Input generated in WS in Warsaw (20.06.2023)

Main findings and conclusions	**Plastic waste recycling**	**Electric vehicle batteries as stationary energy storage systems**	**Utilization of bio-based side and waste streams for biogas and composting**
Challenges/Barriers	- Missing collection and pre-sorting system that makes plastic ends up in incineration or landfill - Lack of regulation in favour of recycled plastic	- In Poland the use electric vehicles is still very limited and not seen to increase in the near future due to high price of electric vehicles (EVs).	- Strict regulations and bureaucracy hindering technological innovations - Lack of holistic view and system thinking in

	- Lack of design for recycling - Lack of infrastructure for technological adoption - Need systemic organisation of plastic waste management	- Major barrier lies in the safety issues – are the lithium batteries safe enough to be used, especially in the case of used EVs. - Expected life span of used batteries	circular value chain development - Need more financial incentives and investments for infrastructure
Vision of ideal circular economy future	- Eco-design on plastic product - 100% plastic collected for recycling - No single-use plastic - High quality recycling process to ensure circularity efficiency - Market of "waste" instead of landfill	In 2050, a systemic circular value chain of electric vehicle battery is adopted with longer battery lifecycle and cascading values for sharing, reusing, repurposing, and recycling.	- 100% selective biobased-side and waste stream collection - 0 waste, only resources
Actions towards vision	- Regulations facilitating extended producer responsibility, financial incentive, and eco-design standard - Education program to raise awareness - Develop innovative technologies for both plastic recycling and production - Promoting biopolymer and sustainable material	- Education and knowledge sharing - Targeted holistic regulation to create the market - Investing in technology and science - Create certification and standardization without hindering innovation for battery use, reuse, repurposing, and recycling	- Simplify and harmonize regulations - Create market and build platform to connect stakeholders - Apply pay as you throw scheme to reduce waste production - Establish ecosystem/industrial symbiosis for circular bioeconomy - Hierarchical waste management system for resource recovery - Education to raise awareness - Continuous invention, R&D
Stakeholder engagement	Financial institutions, administration at all levels (European, national, local), citizen, customers, research and education, industry, business	Industry, policy makers in national and local levels, NGOs, academia, citizens, and consumers	- Public sector creates opportunities and environment for circular bioeconomy development (green public transportation, public procurement, impactful regulation, finance) - Private sector changes from linear to circular business model, finds the harmonization between economic and environment benefits - People adopt the sustainable consumption, put pressure on public and private sectors for circular economy

Technical details of the workshop

Workshop was held at Warsaw University of Technology premises on June 20th, 2023. TREASoURcE project coordinator Anna Tenhunen-Lunkka (VTT) opened the event, and she explained the purpose

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of the workshop and presented the project in a nutshell. She also talked about the European Commission's Circular Cities and Regions Initiative (CCRI), in special about CCRI and funding opportunities for regional circular economy. CCRI Coordination and Support Office representative talked about European Commission's Circular Cities and Regions Initiative, especially about CCRI and funding opportunities for regional circular economy. Innowo representative gave a presentation about the recently published Circularity Gap Report Poland. Three parallel sessions to discuss and map activity on demonstrations and replication potential, interest, needs, challenges were held. Sessions were about plastic waste recycling, electric vehicle batteries as stationary energy storage systems and utilization of bio-based side and waste streams for biogas and composting. After the discussion the sessions were wrapped up the event was closed. VTT and Innowo persons acted as facilitators in the event.

The workshop was promoted in the TREASoURcE webpage and LinkedIn. Innowo advertised the event on their webpage and social media accounts, and they sent direct invitation e-mails, too.

In the registration form name, title and organization details were asked. In addition, selection between three different value chains (Recycling plastics - thermochemical and mechanical recycling of challenging streams, repurposing electric vehicle end-of-life batteries as stationary energy storage systems or Utilization and matchmaking for biobased side and waste streams for biogas and circular nutrients) for the discussion part was made.

Initial interest to engagement stakeholder demonstrations (Engaging with consumers, engaging with communities and citizens, Procurement (public and private), Industrial value chain building, ecosystems and Circular economy practices in events) was mapped. In addition, following questions were asked: “What is your main interest with circular economy and how do you seek to advance it in your work or local area?” and “Expectations for the workshop?”. Willingness to subscribe TREASoURcE newsletter and wish to receive project news was monitored. Final question related to the GDPR issues; it was asked if a participant gives a permission to publish general photos from the event (no identification, faces etc.).

Description of the workshop

The workshop started with the plenary presentations. For the parallel workshops, the participants were divided to three smaller groups. Each session was introduced in English by a facilitator from VTT. After that, language was changed to Polish and Innowo persons facilitated the discussions. Totally 58 participants participated, and they selected for the session they were interested to join (Biowaste 14, Plastic 18, Batteries 10, Interested in more than one topic 16).

Key findings of the workshop

In Poland, plastic waste recycling challenges include the absence of a comprehensive collection system, pre-sorting, and systemic organization of plastic waste management, resulting in plastic ending

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up in incineration or landfills. In addition, there is a lack of regulations favouring recycled plastic, insufficient design for recycling, limited infrastructure for technological adoption. The vision for an ideal circular plastic future involves eco-designing plastic products, achieving 100% collection for recycling, eliminating single-use plastics, ensuring quality standards for recycling to enable circularity, and establishing a market for recycled plastics. To realize this vision, several actions are necessary. These include implementing regulations that facilitate extended producer responsibility, financial incentives, and eco-design standards. Education programs are also needed to raise awareness among the public about the importance of plastic recycling. Furthermore, innovative technologies should be developed both for plastic recycling and production, promoting sustainable practices throughout the value chain. Stakeholder engagement is critical in driving the transition towards a circular economy for plastics. This engagement should involve financial institutions, administrations at all levels (European, national, and local), citizens, customers, research, and educational institutions, as well as industries and businesses.

The use of EVs in Poland is still very limited and the increase in number will be slow. The main reason lies in the high price of new EVs. The market of used EV batteries is depending on the safety and life span of the used batteries. Safety is one of the main issues to be tackled through a reliable certification and standardization system. The repurposing of the used EV batteries was supported by the stakeholders. The role of Poland in the repurposing business remains unclear as Poland does not possess manufacturing activities in the field. The ideal circular economy future 2050 envisions a systemic circular loop where electric vehicle battery is adopted with longer battery lifecycle and cascading of value for sharing, reusing, repurposing and recycling. The actions needed for the achievement of the vision include seamless policy actions together with market creation, education, and investments in research, development, and innovation. The credible certification and standardization procedures accelerate the market uptake and the citizen engagement. The engagement of stakeholders such as policy makers, industry, academia, NGOs and consumers is crucial.

The utilization of bio-based side and waste streams for biogas and composting is a viable approach for Polish circular bioeconomy. However, challenges such as strict regulations and bureaucracy, lack of holistic approach on value chain creation, and insufficient financial incentives hinder the circular transition progress. The ideal circular bioeconomy future envisions the 100% selective collection of bio-based side and waste streams, with zero waste and only resource recovery. To achieve this, actions such as simplifying regulations, creating a market and stakeholder platform, implementing waste reduction schemes and hierarchical waste management system, promoting ecosystem and industrial symbiosis, raising awareness through education, and investing in research and development are necessary. Stakeholder engagement is crucial, with the public sector creating opportunities and an enabling environment, the private sector adopting technological innovation for circular business models, and individuals embracing sustainable consumption and advocating for the circular bioeconomy. Overall, collaboration and active engagement from all stakeholders are essential for the successful implementation of a circular bioeconomy.

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4 OTHER EVENTS

In addition to the local workshops, two other events were held: one locally in Finland and one international webinar. The aim of these events was to collect insights and inputs for the preparation of the Replication Handbook, similar to the replication workshops.

4.1.1 Financing options of CE in Finland

An event was organized in Finland with a focus on exploring financial opportunities to foster the development of the circular economy in the country. T he event was organized together with Forum Virium and Business Tampere. The Helsinki-Uusimaa Circular Valley, which is a regional initiative that aims to take the Helsinki-Uusimaa Region and Finland to the pinnacle of circular economy and Circular Economy Pirkanmaa concept were presented along with national and regional presentations regarding funding possibilities and related advisory services. Business Finland presented the business fostering activities in the national level and Business Tampere and Business Helsinki in the city level.

Table 16. General concept of the webinar in Finland (12.05.2023)

Title of the event	**Analyse financial support elements in Finland (in Finnish)**
Focus	Finance
Time & Location	12.5.2023, Business Helsinki office in Helsinki
General concept	A hybrid webinar
Questions to address	What kind of funding instruments are available for the circular economy business ideas
Participants	12 + 29 (online); Public sector, companies, NGOs

Table 17. Input generated in webinar in Finland (12.05.2023)

Main findings and conclusions	
The purpose of the event was to present public funding and supporting opportunities for the CE and find the bottlenecks of the funding. In the event was held five presentations and in the registration form was asked some questions participants' experiences about funding and the presenters were able to reflect the results in their presentations. The main findings of the questionnaire were the following, however the results fostered the existing knowledge and the number of the answers was limited.	
Public funding for CE	Received: 12 Not received: 1 Considered: 4
Used funding sources	- European Regional Development Fund - The Centres for Economic Development, Transport and the Environment (ELY Centres) - EU - Business Finland
The biggest challenges in applying for funding	- The process itself - Timetables and long preparation time - The low maximum amount of funding - The slowness of the financing decision - How to build the winning consortium

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Topics, which should be funded or hard to get funding	- Market entries of the developing markets - Ecosystem projects - Early-stage R&D projects - Project promoting CE (exploitation of the results)

4.1.2 Ecosystem creation

The purpose of this open webinar was to introduce ecosystem thinking and managing of ecosystems and Clic Innovation's ecosystem building model and present some examples of the existing CE ecosystems. Addition to that there were recap of the TREASoURcE master's thesis findings of the KVCs. Ecosystem examples were from Norway, Sweden and Denmark.

Table 18. General concept of the ecosystem webinar in Finland

Title of the event	**Deep dive into European circular economy ecosystems**
Title of the event	**Deep dive into European circular economy ecosystems**
Focus	CE Ecosystem
Time & Location	26.5.2023, online
General concept	Webinar
Questions to address	What's are the elements of the CE ecosystems and how to create them.
Participants	56 registrations (Project partners, universities and research centres, public sector/administration, companies)

Table 19. Input generated in ecosystem webinar in Finland (26.05.2023)

Main findings and conclusions	
The purpose of this open webinar was to introduce CLIC Innovation's ecosystem building model, ecosystem thinking and managing of ecosystems, and present some examples of the existing CE ecosystems. Addition to that there were recap of the TREASoURcE master's thesis findings of the KVCs. Here are some highlights from the presentations.	
Ecosystem thinking	CLIC Innovation has created Open Innovation Playbook which model will be used in TREASoURcE too. The basic definitions for ecosystems are: 1) Knowledge ecosystem - New research knowledge 2) Innovation ecosystem - New solutions for systemic challenges 3) Business ecosystem - New business solutions for systemic challenges 4) Business Networks - Efficient development and implementation process
Battery value chain	The Nordic region has key actors in all parts of the value chain but the competition is tight and the business environment is in constant change.
Plastic value chain	Challenges and gaps 1) Collection & pre-treatment - Waste management and its diversity - Collection 2) Supply and trade of feedstock - Feedstock acquisition

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	- Exports - Ownership of the waste - Price of recycled plastic vs. virgin plastic - Acceptance of recycled plastic 3) Recycling types - Mechanical recycling - Chemical recycling - Balance of mechanical and chemical recycling - Design for recycling 4) Production - Lack of capacity - Unawareness or lack of investments by converters, original equipment manufacturers or brand owners - Rejects or currently non-recycled plastic 5) Regulation gaps & policies These same issues were raised in the local replication workshops held in spring 2023.
Bio	- The efficient utilization of side streams has been slowed down by challenges related to profitability and logistics - On one farm, the amounts of side streams may be small, seasonal and no suitable buyers have been found - In the planning of circular economy entities, it is necessary to consider what kind of key players and regional characteristics are influencing the implemented solutions - The cooperative form is also available option to build common structures, e.g., for biogas production - Facilitated support is needed from the public sector on many levels
Denmark - bio-waste ecosystem	In Denmark, biogas plants are densely located, and the biogas grid covers the whole country. Each plant needs various stakeholders depending on the production method.
Circularity in Norway	A holistic understanding of the Circular Economy is as an economic system based on business models that replace the ‘end of life’ concept by maintaining and keeping living, technical, biological and financial resources in use at their highest societal value at all times for the benefits of future and current generations.

The presentations are available on the project website https://TREASoURcE.eu

5 DISCUSSION AND CONCLUSIONS

The overall conclusions and findings of all conducted workshops are collected and analysed utilising PESTLE framework (PESTLE stands for Political, Economic, Social, Technological, Legal, and Environmental factors that might have an impact on any organisation, company, or industry). (8) This analytical framework enables us to categorize the input we received during workshops and examine in which fields the change is expected to occur.

The general findings of the workshops can be summarized to the following high level challenge topics:

- ➔ Awareness raising & better communication
- ➔ Financial incentives & motivation (carrot & stick)
- ➔ Shared responsibilities (administration – companies – citizens)
- ➔ Regulation and policies to support circular practices
- ➔ Technological development and advancements

Table 20 summarizes all input generated during workshops in the target replication areas. We can observe that the category of **social factors** impacting circular economy has several common challenges among replication countries. **Awareness raising and educational campaigns** are perceived to be important for all three KVCs. Their focus might be slightly different when it comes to different countries: awareness on recycled plastics (EE) and plastic sorting (PL), on sorting and reuse in general (LV), on the reuse of plastics (LT). When it comes to biobased side and waste streams, both in Estonia as well as Poland raising awareness campaigns, improved communication on the importance of separate collection (EE) and on the potential of using biowaste (PL) was mentioned. Safety occurred to be the most popular topic of discussion on batteries: raising awareness on safety of SLBs (EE, LT) and on importance of repurposing (PL).

When it comes to **political and economic factors**, participants mentioned the importance of deposit systems for the reuse of plastic packaging (EE; LT), the need for regulation in the battery industry (EE, LT, PL) and simplifying regulations relating to biowaste. **Financial incentives** (both subsidies and taxes) were found to be common discussion points for all three KVCs: incentives to use recycled plastics (EE; PL) taxes on non-recycled and single-use plastics (LT), subsidies to balance competition with new batteries (EE), rewards (EE) and taxing (LT) of households to separate biowaste. Furthermore, establishing **regulations and policies** to support circular practices in general on the national and municipal level (LT, PL) and promoting green procurement (LV) was mentioned.

The needs for **technological development** and advancements were voiced in all replication countries. In the plastics waste streams, the development of new technologies for better collection, sorting and eco-design (EE, PL) was mentioned during workshops. Lithuanian workshop also outlined the necessity for separation of different types of plastics, whereas participants in Latvia were more concerned about the lack of solutions/applications to guide and support consumers' recycling behaviour. Participants in all workshops mentioned the need for improving performance, safety, and lifecycle of

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EV batteries (EE, LT, PL, LV) and the low demand on EV-cars was emphasized in Latvia. Continuous research and development for bio-recovery in the biowaste and side streams is needed (PL).

The legal factors affecting circular economy are closely related to political ones as presented above under 'political and economic factors' paragraph. Some aspects worth outlining concern all KVCs and the need for legislative acts to support the CE needs (LV) as well as to be more flexible for innovative circularity (LV, PL). The workshop in Poland emphasized the need for flexibility in laws considering bio-based side and waste streams circular innovation (PL). Specific environmental factors were not discussed much during conducted workshops apart from the workshop in Lithuania outlining the prospects of lithium to be cheaper to recycle than to mine as a raw material.

As mentioned in the introduction, the implementation of WP6 foresees the conduct of numerous workshops in the replication target areas. Our first round of workshops focused on getting to know the replication countries and some of the challenges and barriers can now be outlined. It is vital for the implementation of this WP to understand the relationship structure with the partners outside the TREASoURcE project to be able to deliver on the replication and transferable practices related targets, and in the bigger picture, create wider impact outside the project frame. Estonia is represented through several partners in the project and acts as, in a way, a flagship replication target area, which leads to having more insights and reflections from the Estonia at this point. This will be used to guide the project group in supporting replication throughout the target areas but across EU as well.

Key takeaways for the project group link also to language barriers, which was identified as one the challenges mentioned by partners in replication countries; future activities will take that into account. Project partners will work in future on finding the best data collection methods. One of these could be, for instance, interviews with relevant stakeholders.

Some of the conducted workshops included a session on imagining the ideal circular future. We conclude the report by presenting these futuristic thoughts. We think it is important to be able to look past the challenges of today and envision the possibilities of tomorrow.

The visions of ideal circular economy future by our participants in replication target areas:

- plastic is used as little as possible;
- the ownership of the plastic (and other raw materials) is rethought (e.g. leasing),
- cheap and easy technology to help citizens to recycle is available;
- real time information about plastics value chain is available to different stakeholders,
- market of 'waste' is existing; there are no landfills;
- more local recycling activities and local waste exploitation (bio-waste, composting, repairing),
- rules and laws but also incentives to activate different stakeholders are in place;
- overall consumption of households and companies is decreasing;
- each household is sorting waste with great accuracy;
- rare materials are 100% circulated.

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Table 20. PESTLE framework. Input generated in all replication target areas.

Political	Economic	Social	Technical	Legal	Environmental
Estonia					
- Ownership of plastics: leasing/pawning systems. - Establishing one register of plastic products. - The need for a big market for recycled plastics and stable supply chain. - A product passport/ID number/QR codes/labels on EV battery. - Pilot projects with municipalities as EVB consumers. - incentivisation of households to collect biowaste (rewards from municipality) -"polluter pays" principle (biowaste collection)	- Private sector financial incentivization to use recycled plastics (stick & carrot). - The need for a big market for recycled plastics and stable supply chain. - Subsidies and incentives to balance competition with new batteries. - utilisation of close-to-expiring food (e.g. food share pantries; soup kitchens) - Ticket fee, repair as a service, and price differentiation (Tartu) - Systematic solutions for economical sustainability (Tartu) - Cooperation with companies (Tartu)	- Raising awareness about the benefits of recycled plastics. - Raising awareness campaigns to address safety concerns, environmental consequences, benefits of using SLBs etc. - raising awareness on food waste- communication on the importance of separate collection of biowaste - Marketing efforts for fixing and repair centres (Tartu) - Fixing and repair centres as social gatherings, and empowered communities (Tartu) - A sense of accomplishment, an interest in mending clothes and green way of thinking (Tartu) - Providing content and program to the city (Tartu)	- Development of new technologies for better sorting of plastics. - Mobile service for fixing and repair centres (Tartu)	- A product passport/ID number/QR codes/labels on EV battery.	

Political	Economic	Social	Technical	Legal	Environmental
Latvia					
- Administration and e.g. procurers need to be more open on recycled materials and products - municipalities should support recycling more	- More information about public funding (EU) for environmental development projects	- Lack of knowledge and communication (sorting, reuse)	- Low demand on EV cars - lack of solutions to guide and support consumers' recycling manners.	- Existing laws don't support the circular economy needs - The laws and regulations should have more flexibility for innovative circularity	- Inadequate waste management logistics

Political	Economic	Social	Technical	Legal	Environmental
Lithuania					
- Mono-plastic packaging should be the default setting **- Enhance the recycling of key raw materials from EV batteries**	- Taxing of households that do not collect separately biowaste - implementing taxes on non-recycled, virgin plastic - Taxing single use plastics **- Imported raw materials are made expensive by taxing**	- community based projects where a neighbourhood sets up a small-scale anaerobic biogas production to lower energy prices and recycle their biowaste - educational programmes and awareness raising campaigns on the use of plastics and how to reuse it **- Worries about the safety of repurposing EV batteries for energy storage at home**	- Using food and agricultural waste to extract phenols and flavonoids for nanoparticles synthesis. - plastic should be collected separately different types - improving EV batteries performance and safety during reuse as energy storage - Recycled plastic product may not have same engineering properties as virgin plastics	- Deposit systems to increase recycling of plastic **- regulations to produce batteries that are designed to be easily recycled or dismantled**	**- in the future, lithium will be cheaper to recycle than to mine it as a raw material**

Political	Economic	Social	Technical	Legal	Environmental
Poland					
Establishment of regulation and policies to support the circular practices - Regulation promoting recycled plastic, eco-design, extended producer responsibility - Safety regulations and standardization for repurposing/recycling EV batteries - Simplification of regulations and bureaucracy for bio-based side and waste streams circulation	Financial incentives, investments and market creation for circular practices - Market creation and financial incentives can drive the demand for recycled plastics and encourage businesses to adopt circular business models. - Investments in research and innovation to support EV market growth and battery repurposing/recycling businesses. - Pay as you throw scheme to minimize biowaste, stakeholder platform development for circular bioeconomy collaboration and investment	Education and awareness raising program for circular practices. - Raise awareness about plastic sorting, recycling and the importance of reducing single-use plastics - Raise awareness about the benefits and importance of EV battery repurposing/recycling - Raise awareness about the benefits and potential of utilizing bio-based side and waste streams	Technological advancement and innovation for circular practices - Technological developments in collection system, presorting, plastic recycling and eco-design - Technological advancements to extend the lifecycle of EV batteries, for battery repurposing/recycling, safety - Continuous research and development for bio-recovery	Flexible legal requirements and actions supporting circular practices - Legal requirements and actions for extended producer responsibility and proper management of plastic waste - Ensuring EV battery safety through a reliable legal requirement system - More flexible legislations and laws considering the bio-based side and waste streams circular innovation	Reduction of waste generation, hierarchical waste management system for resource recovery - Eco-designing plastic products and systemic organization of plastic waste management - Adoption of longer battery lifecycles, repurposing practices before recycling - Selective collection and hierarchical recovery of biobased-side and waste streams

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