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CURE+

CENTRES FOR URBAN RESOURCES, REUSE AND REMANUFACTURE

Roadmap for policy Recommendations

Deliverable 2: Activity V.3 – Policy Recommendations

The deliverable describes the methods and techniques applied for this activity, presents the results and builds the policy recommendations at both the national and municipal levels.

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Abbreviations

Abbreviation	Meaning
BAU	Business As Usual
C&D	Construction & Demolition
CDW	Construction and Demolition Waste
CE	Circular Economy
CEAP	EU Circular Economy Action Plan
DRS	Deposit Refund System
ECESP	European Circular Economy Stakeholder Platform
ELECTRE	Elimination Et Choix Traduisant la REalite
EPR	Extended Producer Responsibility
EUKI	European Climate Initiative
GHG	Greenhouse Gas
IoT	Internet of Things
KPI	Key Performance Indicators
MCDM	Multi Criteria Decision Making
NIV	Net Inferior Value
NSV	Net Superior Value
PAYT	Pay as You Throw
PPPs	Public Private Partnerships
QMS	Quality Management Systems
QR	Quick Response Codes
R&D	Research & Development
S&E	Society & Environment
SMEs	Small & Middle-sized Enterprises
URC	Urban Resource Centers
WP	Work Package

1 Introduction

1.1 The CURE+ project

The **CURE+** project, initiated under the **European Climate Initiative** (EUKI), focuses on advancing **circular economy** (CE) practices in the **construction and demolition waste** (CDW) sector across four municipalities in the Baltic and Southern European regions, namely Riga, Tartu, Kavala, and Barcelona. The project's main goal is to reduce environmental impact by promoting innovative approaches such as reuse, remanufacture, and upcycling of CDW materials while addressing knowledge gaps, stakeholder engagement, and policy development. Through capacity building, co-creation workshops, and pilot projects, CURE+ aims to create community-centered business models and sustainable urban resource centers (URCs). The project emphasizes collaboration among municipal authorities, local stakeholders, and academic institutions to achieve improved CDW management, climate mitigation, and long-term environmental benefits, such as reduced raw material usage and lower CO_2 emissions.

1.2 Aim of the deliverable

.This deliverable, part of Work Package 5: Policy recommendations, provides a comprehensive policy recommendation report addressing regulatory improvements as well as complementary measures to enhance the implementation of CE measures. For this reason, we have already described during WP2 but also in WP5 the possible gaps, mismatches, or challenges that all 4 countries face. Once the gaps were identified, we proceeded with an ELECTRE method to rank the best scenarios for each country and city in order to provide tailored policy recommendations. Based on the scenarios and criteria, partners joined their forces in a participatory workshop during the visit to Tartu on 28-29 October in order to justify them and to proceed with the ELECTRE questionnaires to all stakeholders.

The results of the ELECTRE and the policy recommendations for each city and country were discusses in an online workshop on the 12th of December 2024. During the participatory workshop, we discussed the new possibilities and policy recommendations in the field of climate neutrality and, more specifically, the role of CE as a cross-cutting strategy that does not serve as an isolated approach but as a catalyst to achieve climate neutrality. Then the present document was finalised.

1.3 Identified Gaps

Based on the literature review at the country level, the gaps and the opportunities for policy recommendations are described below. The analysis and detailed presentantion is on the first part of this report.

Table 1 In between counties gaps in policies

Country	Key Gaps	Opportunities
Greece	- Lack of DRS - Weak enforcement of recycling targets - Low landfill taxes - No PAYT or compost QMS - Low circular material use rate	- Introduce DRS and PAYT - Increase landfill/incineration taxes - Develop compost QMS - Strengthen CE measures

Country	Key Gaps	Opportunities
Spain	- Partial DRS implementation - PAYT only in select regions - Low awareness of recycling programs in some areas	- Expand DRS and PAYT nationwide - Strengthen public awareness campaigns
Estonia	- Needs improved selective demolition guidelines - Low quality of CDW recycling	- Improve CDW recycling quality and guidelines - Enhance QMS for recycled materials
Latvia	- Circular economy principles not fully integrated in the construction sector	- Improve CE integration in construction

Based on the base line studies in between cities policies gaps, Table 2 provides a comparative overview of the main policy and infrastructure gaps related to circular economy and construction and demolition waste (CDW) management across four cities: Tartu, Riga, Kavala, and Barcelona. It was developed to capture critical weaknesses in areas such as Deposit Refund Systems (DRS), landfill and incineration taxes, Extended Producer Responsibility (EPR), separate collection systems, material reuse, and CDW management efficiency. The gaps reveal uneven progress and implementation challenges, particularly in cities like Kavala, Tartu, and Riga, where circular practices for CDW remain underdeveloped or poorly enforced. In contrast, Barcelona demonstrates more advanced systems, particularly in EPR and innovation, though gaps persist in fully integrating CDW into circular flows.

While the table primarily focuses on construction and demolition waste, it also includes references to bio-waste collection systems as a complementary indicator of broader waste management capacity. In several cities, such as Tartu and Riga, bio-waste systems are still developing, which may reflect wider challenges in establishing consistent and well-separated waste streams. Including bio-waste helps provide context on the overall readiness of cities to implement more specialized CDW practices, highlighting opportunities for integrated improvements across different waste categories. Those kinds of gaps, are presented here, but it doesnt be used later, since the main focus of the deliverable is CDW.

Table 2 Gaps in Circular Economy (CE) and CDW Management Between Cities

Criteria/Gap	Tartu	Riga	Kavala	Barcelona
DRS (Deposit Refund System)	Not implemented for construction waste; only basic for packaging (beverage packing | Container deposit schemes)	NO CDW.	No DRS for CDW.	DRS for some waste categories, but not fully implemented for CDW
Landfill and Incineration Tax Levels	Limited and relatively low landfill taxes	low landfill tax; no incineration tax.	Landfill tax in place, but low.	Higher landfill fees, but varies between regions
EPR (Extended Producer Responsibility)	Not well developed for CDW.		Weak EPR systems .	Well developed EPR, especially in packaging
Separate Collection Systems	Incomplete for bio-waste and hazardous CDW	Limited bio-waste collection.	Weak enforcement of separate collection.	Comprehensive system in place
Circular Material Use Rate	Low use of recycled materials	Very low circular material use .	Very low rate of material reuse .	Higher circular material use, but challenges remain

CDW Management Efficiency	Lack of data and infrastructure for CDW	Inconsistent tracking and low recycling .	Limited capacity to manage CDW .	Better tracking and recycling infrastructure
Incentives and Economic Support	Limited government incentives	Minimal financial support for CE	Few financial incentives .	More subsidies and grants available for CE initiatives
Innovation and R&D in CDW	Limited innovation and R&D	Few innovative projects	Little innovation in CDW management	Many innovative practices and R&D centers
Barriers to Implementation	Lack of data and infrastructure	Financial and regulatory challenges .	Political and financial barriers .	Strict regulations on recycled aggregates

2 Methodology & Data

2.1 ELECTRE: Concepts and Definitions

The ELECTRE method uses, in addition to the indifference and preference thresholds, a veto threshold, which means that if the difference in performance between two options exceeds a certain threshold, the subordinate option must not. Introducing a denial threshold is also the main difference between the ELECTRE Method and the PROMETHEE Method. Preference, indifference and veto thresholds are introduced regardless of the type of criterion as in the case of the PROMETHEE Method.

The solution to the multi-criteria problem with these methods follows the following successive steps:

Stage 1: First, the criteria are selected, which should cover all aspects of the problem under consideration and be able to be graded on an appropriate scale.

Stage 2: The importance of all evaluation criteria is determined using appropriate weights. The sum of the weighting factors for the criteria is 100%.

Stage 3: Each individual criterion's alternatives are analyzed, and the alternatives are quantified based on a scale, e.g., 1-10, where the lowest values refer to the criterion's most difficult performances and the highest values to the most favourable ones (thus covering all possible cases).

Stage 4: Initially, each sub-criterion for each alternative scenario are recorded and after comparing them with the scale developed in the 3rd stage, it receives a specific performance value on the defined scale.

Stage 5: Application of the Multi-Criteria Analysis Model.

It is obvious that there are no better or worse multi-criteria methods; there are just more and less suitable methods according to each application. The issue in this deliverable is the selection of the best rehabilitation scenario. ELECTRE was considered the most appropriate Multi-Criteria method for this problem. The reasons that led to this preference are varied and consistent - as noted by the advantages of the chosen method. More specifically:

- One of the most obvious reasons for preferring ELECTRE III and PROMETHEE is its large and successful number of international applications to date.
- A very important advantage of the ELECTRE III method over the other methods is its usefulness in the examination of environmental problems (Rogers and Bruen, 1998).
- In addition, ELECTRE III and PROMETHHE have the potential to include a fairly large number of criteria for evaluating alternative rehabilitation scenarios, combined with the potential for a large number of decision-makers (Wang and Triantaphyllou, 2014)

In many cases, due to the possible inaccuracy and uncertainty of some available data, there is a high risk of being led to completely wrong conclusions when using any method. The decision maker should take into account the possibility of having uncertain data and information. ELECTRE can better adapt to such circumstances by drawing more valid and effective conclusions, always in comparison with other methods. Also, for verification purposes, the PROMETHE method was used.

The method makes use of the limits of preference and indifference, while including an additional parameter, the concept of denial. Using these parameters, the method examines not only the two ends of the problem, strong and weak but also an entire family of intermediate levels, from the totally strong to the totally weak. The process is achieved by grading, comparing and finalizing the various remedies. This analysis is able, as far as possible and desirable, to attribute to the criteria either quantitative or qualitative, the application to be studied.

The ELECTRE Method demonstrates a very good adaptation of data to such applications. For all the above reasons, in the context of the present work, ELECTRE III is selected as the basic method for solving the multi-criteria problem of finding the best solution for the rehabilitation scenario. In this deliverable, an ELECTRE application was applied in order to prioritize the alternative scenarios for the CURE+ policy recommendations roadmap. The main idea behind this solution is that the ELECTRE method gives better results and is easier to implement.

2.2 Approach and techniques for conducting the study: Outranking Approach

The outranking approach is based on the pairwise comparison of options to each criterion based on their performance and the decision-maker's intracritical preferences, as expressed by the thresholds of indifference and / or preference. A characteristic of the outranking methods is that the comparison is made on the initial performance measurement scale (quantitative or qualitative) without reduction to the interval [0,1]. The index resulting from the comparison by criteria is then synthesised into a total binary index taking into account the weighting factors of the criteria (Achillas *et al.*, 2013; Mary and Suganya, 2016; Vučijak, Kurtagić and Silajdžić, 2016; Broniewicz and Ogrodnik, 2020).

The binary indices characterise pairs of options (A, B) and determine in the interval [0,1] the degree to which the hypothesis holds: *solution A is at least as good as solution B*. Depending on the method and the exact way they are calculated, these indicators are called preference indicators or agreement indicators (as the case may be). A solution *A* that shows high values of preference indices about the other alternatives is characterised by a relative *superiority*. On the contrary, other solutions that do not confirm the hypothesis to a significant degree are considered *inferior*.

Therefore, the final stage in the methods of superiority is the elaboration of the binary indicators so that relations of superiority emerge and the final ranking of the alternatives (Roy, 1993). The most well-known outranking methods are the group of ELECTRE and PROMETHEE.

2.3 Operationalisation for the CURE+ project

To promote policymaking based on the current status of Greece, Spain, Estonia and Latvia on CDW, powerful decision-making tools can be employed. ELECTRE (Elimination Et Choix Traduisant la REalite) is a non-compensatory, outranking family of MCDM techniques, which allows for the direct comparison of alternatives based on criteria. The method considers decision-makers' preferences and importance and generates a ranking of the other options based on their relative strengths and weaknesses (Taherdoost and Madanchian, 2023). Outranking procedures involve comparing alternatives in a pairwise fashion, which are characterised by the limited degree to which advantages on other viewpoints may compensate a disadvantage on a particular viewpoint. Natural resources and environmental management are by far the most popular application area for ELECTRE methods, and **ELECTRE III** is the most popular ELECTRE version in this category (Govindan and Jepsen, 2016). The particular method has proven fairly insusceptible to variations in data and related parameters. Thus, an adequate amount of reliability can be expected of analyses carried out by means of it (Hokkanen and Salminen, 1997).

The method's function is described by Banias et al. (2010). ELECTRE III uses three pseudocriteria in order to represent all the different aspects of the problem and starts by comparing each location action with each of the others about each criterion. It aggregates the results of all the comparisons and builds the model for the fuzzy outranking relation according to the notion of concordance and discordance. In the second phase of fuzzy relation exploitation, the method constructs two classifications (complete pre-orders) through a descending and an ascending distillation procedure. A final classification of the actions is elaborated as the intersection of the two complete pre-orders. A sensitivity analysis tests the result by varying the values of the main parameters and observing the effect on the final outcome. The comparative analysis of the classifications leads to a final robust result or to a model re-analysis.

Objective: The objective of the **ELECTRE III** analysis will be to determine existing gaps on CDW management policies between the Netherlands, Greece, Spain, Estonia and Latvia.

2.4 Decision Matrix and Criteria

In the context of the present deliverable, the weights of each criterion are determined by the experts of the bodies involved in the research. In particular, each respective expert was required to attach a score of importance (scale 1 to 10) to each criterion according to their personal opinion. During the process, a **table** was formed whose rows consisted of the alternative scenarios for the promotion of CDW management in the pilot cities, while its columns were from the criteria based on which experts scored these scenarios.

This table was completed by experts and people who live in the municipality and are related to the CDW management or project implementation or work in the industry so that the scoring of the scenarios is as objective as possible and is presented in Table 3:

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Table 3 Weights table of alternative scenarios | City Level

	Criteria										
	Economic			**Social**		**Environmental**			**Technical**		
	E1	**E2**	**E3**	**S1**	**S2**	**EV1**	**EV2**	**EV3**	**T1**	**T2**	T3
	Recycling and Circular Material Use Rate	Investment Cost for CE Infrastructure	Profitability from Circular Economy Initiatives	Public Acceptance of CE Policies	Job Creation through Circular Economy	Contribution to Climate Change Mitigation	Impact on Ecosystem Services	Pollution Reduction	Feasibility of Implementing CE Solutions	DRS (Deposit Refund System) Effectiveness	Infrastructure and Innovation in Waste Management
P1-BAU											
P2											
P3											
P4											
Score for Cireteria											

Table 4 Weights table of alternative scenarios | Country Level

	Criteria										
	Economic			Social		Environmental			Technical		
	E1	E2	E3	S1	S2	EV1	EV2	EV3	T1	T2	T3
	Effectiveness of DRS Implementation	Increase in Landfill and Incineration Taxes	Expansion of EPR Systems	Public Acceptance of CE Policies	Job Creation from CE Initiatives	Improvement of Separate Collection Systems	Boosting Circular Material Use	Development of Quality Management Systems (QMS)	Technological Feasibility	Innovation in Waste Management Technologies	Infrastructure and Innovation in Waste Management
P1-BAU											
P2											
P3											
P4											
Score for Cireteria											

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The evaluation criteria of the alternative scenarios were selected based on similar studies and are presented in detail in the following sub-chapters (Govindan and Jepsen, 2016; Goulart Coelho, Lange and Coelho, 2017; Environment, 2019; Biluca, de Aguiar and Trojan, 2020; Zhang *et al.*, 2020; Iodice *et al.*, 2021; D'Adamo *et al.*, 2022; Boonkanit and Suthiluck, 2023; Colmenero Fonseca *et al.*, 2023; Moschen-Schimek, Kasper and Huber-Humer, 2023; Rayhan and Bhuiyan, 2024a). The expert panels in each pilot case consisted by people working in the municipalities. Three persons from Kavala, 2 persons for Barcelona, three persons for Riga, and five persons from Tartu.

2.4.1 Criteria for country level

The criteria we will use for evaluating the scenarios are depicted in Table 5.

Table 5 Criteria description by category (country level)

	Criteria	Description
Economic	**E1: Effectiveness of DRS Implementation**	Measures how well the scenario introduces or improves DRS systems to increase recycling rates. should assess the extent of DRS implementation under each scenario, such as whether DRS is applied to a broader range of products and how it contributes to higher recycling rates.
Economic	**E2: Increase in Landfill and Incineration Taxes**	Evaluates the effectiveness of increasing landfill and incineration taxes to promote recycling.
Economic	**E3: Expansion of EPR Systems**	Assesses the expansion of EPR systems, making producers responsible for end-of-life product recycling.
Environmental	**EV1: Improvement of Separate Collection Systems**	Assesses improvements in waste collection infrastructure for recyclable materials like plastics, paper, etc.
Environmental	**EV2: Boosting Circular Material Use**	Evaluates the increase in material reuse and recycling in the economy.
Environmental	**EV3: Development of Quality Management Systems (QMS)**	Assesses the establishment of QMS to ensure the quality of recycled materials and compost.
Social	**S1: Public Acceptance of CE Policies**	Measures public support and compliance with circular economy policies.
Social	**S2: Job Creation from CE Initiatives**	Assesses the scenario's potential for creating new jobs in recycling, waste management, and repair services.
Technological	**T1: Technological Feasibility**	Evaluates how easily required technologies can be implemented, considering local infrastructure and expertise.
Technological	**T2: Innovation in Waste Management Technologies**	Assesses the potential for technological innovation in waste management and circular economy practices.

2.4.2 Criteria for the city level

The criteria can be categorised into 4 basic pillars, economic, social, environmental and technical. Below is the presentation of the criteria (Table 6).

Table 6 Criteria description by category

Category	Criteria	Description	The actual question
Economic	E1: Recycling and Circular Material Use Rate	Measures how much the scenario improves the rate of recycling and reusing materials, contributing to a circular economy	assess whether the policies help reduce emissions from waste management (e.g., through recycling, reduced landfilling) and contribute to climate resilience
	E2: Investment Cost for CE Infrastructure	Assesses the financial investment required to build and maintain circular economy infrastructure (recycling facilities, etc.).	consider the capital expenses and operating costs associated with setting up and maintaining the infrastructure necessary for the circular economy
	E3: Profitability from Circular Economy Initiatives	Evaluates how profitable the circular economy initiatives will be under each scenario (in terms of savings, revenue generation, etc.).	consider how much economic gain is expected from circular economy practices (e.g., selling recycled materials or reducing waste disposal costs)
Social	S1: Public acceptance of CE policies	Considers how well the public is likely to accept and support the policies, including behavior changes (e.g., recycling habits).	assess whether the policies will be easily accepted by the public or if there may be resistance or challenges in achieving widespread adoption
	S2: Job creation through circular economy	Assesses the potential for creating new jobs and employment opportunities through circular economy practices.	evaluate how the scenario will contribute to creating sustainable jobs in industries related to recycling, upcycling, and CE practices.
Environmental	EV1: Contribution to climate change mitigation	Evaluates how well the scenario helps reduce greenhouse gas emissions and aligns with climate goals.	assess whether the policies help reduce emissions from waste management (e.g., through recycling, reduced landfilling) and contribute to climate resilience.
	EV2: Impact on ecosystem services	Measures the positive or negative impact of the scenario on ecosystems (e.g., reducing waste, protecting biodiversity).	assess whether the scenario improves ecosystem health, conserves natural resources, and protects biodiversity.
	EV3: Pollution Reduction	Assesses the extent to which the scenario reduces pollution (e.g., air, water, and soil) through better waste management.	assess how the scenario decreases environmental pollutants and improves public health through better waste management.
Technical	T1: Feasibility of Implementing CE Solutions	Evaluates how easy or difficult it will be to implement the circular economy solutions, considering local conditions.	evaluate whether the policies can be realistically implemented in the given context, or if they require significant changes to existing infrastructure or processes.
	T2: DRS (Deposit Refund System) Effectiveness	Measures the effectiveness of the DRS in promoting recycling and reducing waste.	assess how well the scenario supports the introduction or improvement of DRS and its impact on recycling rates.
	T3: Infrastructure and Innovation in Waste Management	Evaluates how well the scenario supports infrastructure development and innovation for circular economy practices.	assess whether the scenario fosters innovation and builds the necessary infrastructure for a circular economy

2.5 Scenarios

2.5.1 Scenarios Country level

In this phase, we will assess how well each country (Greece, Spain, Estonia, Latvia) addresses these gaps and supports circular economy goals and how well it addresses the existing policy gaps (policies, criteria). For this reason, we provide a detailed description of each scenario at the country level relevant to circular economy policies, the use of extended producer responsibility (EPR), deposit return systems (DRS), and sector-specific reforms.

Scenario 1: Business as Usual (Minimal Structural Change). Minor adjustments to current policies with little structural change.In this scenario, the country maintains its current circular economy policies with only minor adjustments, such as small increases in waste management fees or limited public awareness campaigns. Landfill taxes remain low or nonexistent, and Extended Producer Responsibility schemes are not substantially expanded to new sectors. Although this approach avoids the political and economic challenges of large-scale reforms, it risks stagnation in circular economy progress and may fail to meet future EU waste reduction targets or climate resilience goal (Kirchherr, Reike and Hekkert, 2017; De Schoenmakere *et al.*, 2019).

Scenario 2: Incremental Improvement with Collaboration. This scenario emphasises incremental policy enhancements and collaborative approaches. Governments, municipalities, and industry stakeholders work together to gradually increase landfill fees, introduce partial DRS in select sectors, and extend EPR requirements where politically feasible. Modest innovation funding and public-private partnerships support steady improvements in recycling infrastructure and the quality of recovered materials. Such a measured approach may be politically easier to implement, reduce industry resistance, and provide time for stakeholders to adapt.[1] However, progress is slower, and targets may take longer than the aggressive scenario. (Ghisellini, Cialani and Ulgiati, 2016; Blomsma and Brennan, 2017)

Scenario 3: Aggressive Circular Economy Push. A highly ambitious approach with significant policy reforms, including high landfill taxes, full DRS implementation, and expanded EPR. Under this scenario, the country adopts a bold set of policy reforms designed to transition toward a circular economy rapidly. High landfill and incineration taxes make disposal prohibitively expensive, incentivising materials recovery and recycling. A fully integrated Deposit Return System (DRS) covers diverse product streams, including packaging, electronics, and certain construction materials. Robust EPR schemes hold producers accountable for end-of-life management, encouraging them to design more durable, repairable, and recyclable products. The government allocates substantial funding to innovation hubs, pilot projects, and R&D to accelerate the development of new circular business models and material recovery technologies. (Ghisellini, Cialani and Ulgiati, 2016; Stahel, 2016; Blomsma and Brennan, 2017)

Scenario 4: Sector-Specific Reforms. Targeted reforms focusing on key sectors such as construction and packaging. This scenario targets key sectors—such as construction, packaging, or electronics—that contribute disproportionately to waste streams and resource consumption.

[1] European Commission. (2020). “A new Circular Economy Action Plan For a cleaner and more competitive Europe.” [https://eur-lex.europa.eu/resource.html?uri=cellar:9903b325-6387-11ea-b735-01aa75ed71a1.0003.02/DOC_1&format=PDF]

Governments introduce selective demolition guidelines and strengthen standards for recycled content in construction materials, while urban resource centers and specialized repair hubs focus on increasing high-quality recycling and material reuse within targeted industries. By concentrating efforts on priority sectors, improvements can be more visible and cost-effective, though other sectors may continue to lag behind. This approach can be a stepping stone toward broader circular economy reforms (Piñones, Derpich and Venegas, 2023; Soto-Paz et al., 2023; Rayhan and Bhuiyan, 2024b).

2.5.2 Scenarios at city level

Scenario 1: Business as Usual: Each city continues its current policies with no significant changes. Cities like Tartu, Kavala, and Riga would continue to struggle, with slow progress toward CE targets.

- **Landfill taxes** remain low or nonexistent.
- **No improvement** in DRS systems for construction waste.
- **Weak EPR** expansion, with no significant updates for CDW.
- **Minimal financial incentives** to promote the circular economy.

Scenario 2: Moderate Policy Enhancements Cities make **incremental improvements** to existing policies, focusing on compliance with minimum EU circular economy requirements. There is some progress in circular material use and CDW recycling rates, but significant gaps remain in full CE adoption.

- **There is a slight increase in landfill taxes and the** introduction of basic incineration fees in cities like Riga and Kavala.
- **Gradual expansion of DRS** for packaging waste but limited to some sectors.
- **Improved EPR systems** in cities like Riga and Tartu, particularly for high-waste sectors like construction.
- **Small-scale public-private initiatives** for innovation and upcycling.

Scenario 3: Aggressive Circular Economy Push This scenario represents a **high-level intervention**, with governments and cities aggressively pushing CE adoption through regulatory changes, incentives, and innovation. There would be a rapid increase in CE compliance across all cities. Cities like Barcelona would become models for others, while towns like Tartu and Kavala would see significant improvements in CDW management and CE integration.

- **High landfill taxes** across all cities to incentivise recycling (following the example of Spain).
- **Nationwide DRS implementation** in all countries, covering packaging and construction materials.
- **Expansive EPR** systems across multiple sectors, pushing producers to take responsibility for the end-of-life management of products (especially for construction and electronics).
- **Significant government subsidies** for innovation, upcycling, and CE-based business models.

Scenario 4: Sector-Specific Targeted Policies This scenario focuses on sector-specific policy reforms, with different cities targeting their **largest waste-producing sectors**. This scenario would result in more localised improvements, with each city focusing on its waste challenges.

- **Construction sector**: Selective demolition guidelines in Tartu and Kavala mandating using recycled materials in public projects.
- **Packaging and urban waste**: Focus on implementing **DRS** and separate collection systems in cities like Riga and Barcelona.

- **EPR for high-impact sectors** like electronics and vehicles in cities where recycling lags.
- **Innovation hubs**: Establishment of **URCs and prototyping hubs** in urban areas, especially in cities like Barcelona, to foster a circular economy.

Figure 1 Range of criteria evaluation at countries' level

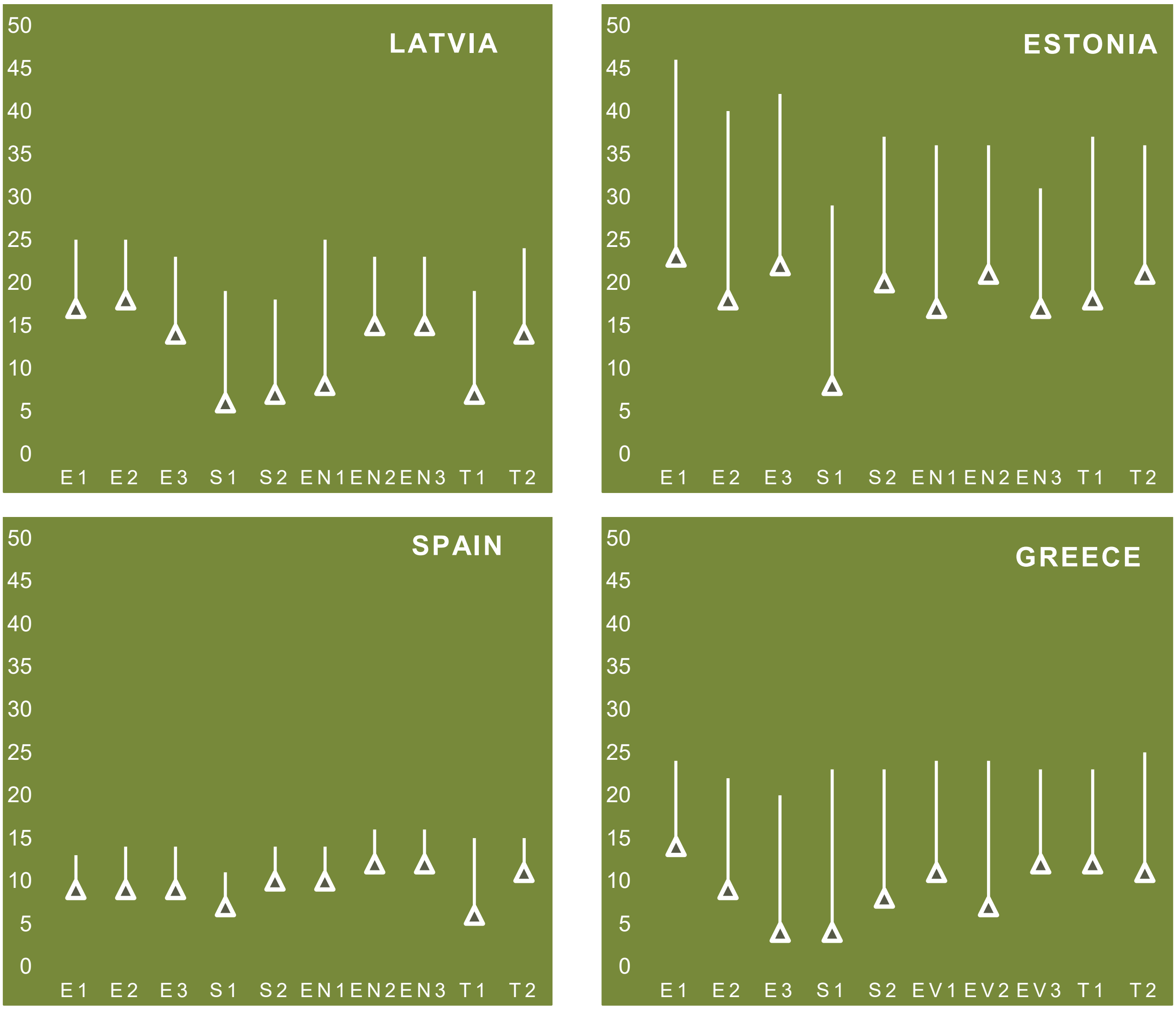
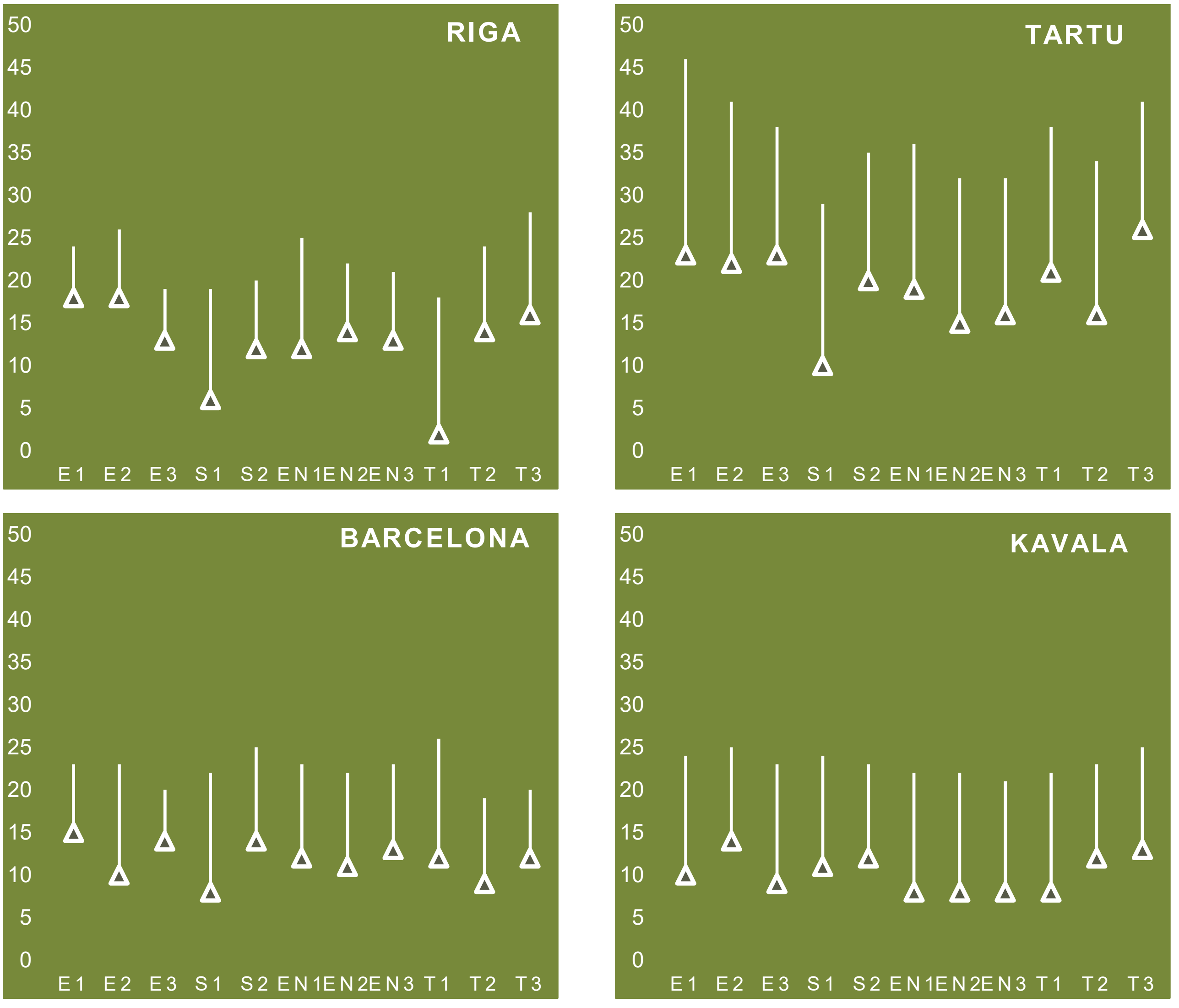


Figure 2 Range of criteria evaluation at cities' level



3 Results and Discussion

3.1 Results at the national level

In this chapter, the **results from ELECTRE II analysis** are presented along with the tailored recommendations.

3.1.1 Estonia

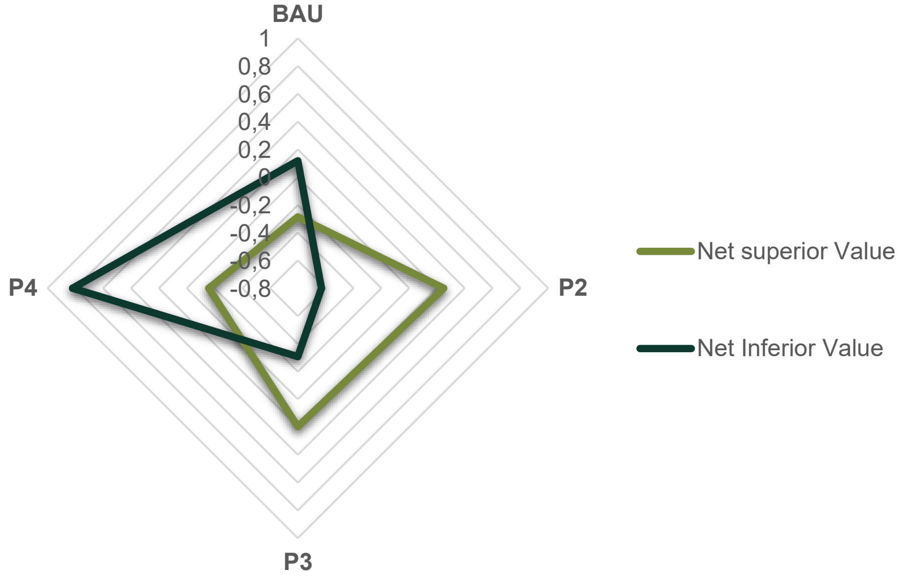
Figure 3 shows two sets of metrics (Net Superior Value and Net Inferior Value) for four different scenarios: BAU (Business As Usual), P2, P3, and P4 applied in the case of Estonia. Each scenario is assigned a value for both metrics, as well as a rank indicating their relative performance.

The Net Superior Value (NSV) reflects how positively each scenario performs based on a certain set of criteria. Higher NSV indicates better performance. In Estonia, the prevalent scenario is P2, which has the highest NSV (0.2486 (Rank 1)), suggesting it offers the most benefit or the best positive impact compared to the others. The next scenario is P3 (0.1971 (Rank 2)), which also performs well, though slightly less beneficial than P2.

On the other hand, the **Net Inferior Value (NIV)** appears to measure negative outcomes or drawbacks. A higher NIV might indicate more significant negative impacts, whereas a lower (possibly more negative) NIV could suggest fewer negative impacts. P4 has the highest NIV (0.8201 (Rank 1)), which might mean it has the most significant negative impacts among the scenarios. P2 has the lowest (most negative) NIV value (-0.6306 (Rank 4)), which suggests it significantly reduces or avoids the negative impacts measured by this metric. In other words, P2 not only provides the most positive benefits (as shown by NSV) but also minimises drawbacks most effectively, if a negative NIV indeed represents reduced negative impacts.

To conclude **P2** stands out as strong on both fronts. Overall, P2 seems to provide the greatest positive benefits while minimising negative impacts. **P3** offers good positive outcomes and keeps negative impacts relatively low. It’s not as optimal as P2, but still better than BAU and P4. **P4** has a slightly better NSV rank than BAU, but its NIV is the highest, suggesting it has a strong downside or more negative impacts than other scenarios. This might mean that although P4 offers some improvements, these come with significant trade-offs. **BAU** ranks poorly on the positive benefits (lowest NSV) while having moderate negative impacts (NIV rank 2). Essentially, doing nothing new (business as usual) is neither delivering strong benefits nor minimising negative outcomes.

Figure 3 Estonia, Electre results



In Estonia, the P2 scenario is the most preferable, which means that the recommendations should depict incremental improvements with collaboration. In other words, the recommendations should promote moderate improvements across multiple areas, focusing on cooperation and gradual policy changes. For example, establishing and further promoting joint initiatives between municipalities, local businesses, and NGOs to pilot community-level recycling centres, shared composting facilities, and repair workshops. These moderate investments can yield improvements without complete structural overhauls. Also, selective EPR mandates on easily manageable product categories (e.g., electronics, plastic bottles) will be introduced, leveraging industry collaboration to improve product design and end-of-life management. Also, the government should develop more industry standards for packaging reduction and material reuse. Encourage businesses to adopt these standards through recognition programs, competitive grants, and other incentives.

The following tables present specific policy recommendations based on the prevalent P2 scenario for Estonia. It should be noted that those recommendations are only some proposals, and some are already implemented in some, if not all, EU countries. Those policies reflect moderate improvements across multiple areas, focusing on collaboration and gradual policy changes as directed by P2. Still, the identified gaps at national levels are improved selective demolition guidelines and better quality of Construction and Demolition Waste (CDW) recycling.

Table 7 Collaborative development of selective demolition guidelines

Gradual and participatory policy changes are key, emphasising joint efforts between government, industry, and civil society.		
Action 1	**Multi-stakeholder working groups**	This group should collaboratively draft updated selective demolition guidelines, ensuring they are practical, clear, and reflect current industry capabilities.
Action 2	**Pilot projects for demonstration**	Fund small-scale pilot projects that apply the new selective demolition guidelines in real-world scenarios (e.g., renovating public buildings or infrastructure). These pilots can serve as learning platforms to refine guidelines, reduce implementation risks, and provide case studies for broader adoption.

Action 3	**Voluntary accreditation and recognition programs:**	Establish an accreditation system or "Demolition Best Practice" label to encourage demolition contractors to adopt the new guidelines voluntarily. This will incentivise companies to comply, as recognised firms can market themselves as more sustainable, potentially gaining access to new clients or public tenders.

Table 8 presents specific actions for upgrading CDW sorting and processing infrastructure. The basic idea is to improve the quality of recycled CDW materials by using better sorting and processing technologies. In line with P2's incremental nature, improvements should be phased, focusing on collaborative investments and capacity-building rather than immediate large-scale infrastructure overhauls.

Table 8 Incremental upgrades to CDW sorting and processing infrastructure

2. Improvements should be phased, focusing on collaborative investments and capacity-building rather than immediate large-scale infrastructure overhauls.		
Action 2.1	**Public-Private Partnerships (PPPs) for upgraded facilities**	To support waste management companies in improving their sorting lines, screening equipment, and contamination reduction practices, financial support should be structured in two distinct ways: Low-interest loans can be provided to companies willing to invest in upgraded infrastructure. The loan could cover a specific percentage of the investment (e.g., X%), with repayment conditions designed to encourage long-term sustainability. Direct financial support can be offered under specific conditions, such as compliance with enhanced waste-sorting standards, integration of innovative screening technologies, and commitment to personnel training programs.
Action 2.2	**Regional CDW hubs and shared equipment**	Support the establishment of local CDW sorting centres, which combine several small and middle-sized enterprises (SMEs) with the S&E. Companies continue to reduce their own expenses, and firms improve the quality of recycled aggregates, wood, or metals, adding value for several players in the chain.

Table 9 presents some feasible enhancements in Quality Management Systems (QMS) for recycled materials. Ensure consistent, high-quality recycled materials, which is key to their market acceptance. Under the P2 scenario, policy changes should be collaborative, developing standards with industry input and focusing on practical improvements in QMS.

Table 9 Enhanced Quality Management Systems (QMS) for Recycled Materials

Under the P2 scenario, policy changes should be collaborative, developing standards with industry input and focusing on practical improvements in QMS.		
Action 3.1	**Voluntary standards and industry-led certification**	Work alongside industry organisations and certification bodies in elaborating optional QMS standards for the materials derived from the recycling of CDW. Assist and conduct workshops regarding the QMS, which aid the recyclers in at least complying with the QMS, stressing the need for improved contamination checks and standardisation of testing.
Action 3.2	**Technical guidance and training programs**	Collaborate with colleges, polytechnics, and professional bodies to develop and provide short modules and training on best practices on QMS. These could be sampling marks, lab analysis,

		and data documentation aading recyclers and demolition contractors to advance their quality assurance aspects continuously.

The following strategy can be the strengthening of public procurements. In P2 for moderate improvements can be driven by creating reliable demand for recycled CDW materials. Moderate policy shifts in public procurement can nudge the market toward higher-quality outputs and better demolition practices without mandating drastic changes (Table 10).

Table 10 Strengthened Public Procurement and Market Signals

Moderate policy shifts in public procurement can nudge the market toward higher-quality outputs and better demolition practices without mandating drastic changes.		
Action 4.1	**Preferential procurement guidelines**	Introduce optional public procurement guidelines that encourage, rather than mandate, a certain percentage of recycled content in public construction projects. By keeping targets flexible and phased, the approach remains collaborative and non-punitive, allowing suppliers and contractors to adapt incrementally.
Action 4.2	**awareness and educational campaigns**	Launch targeted awareness campaigns about quality recycled materials' availability, performance, and environmental benefits in the construction and demolition sectors. Education and case studies can help address misconceptions, increasing acceptance and willingness to pay for these materials.

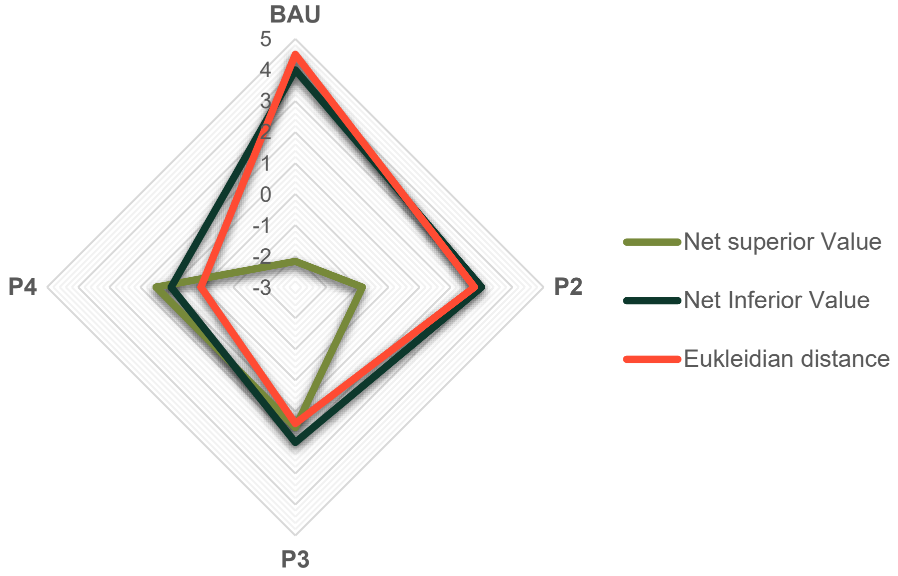
Furthermore, Estonia can strengthen linkages between demolition practices, recycling targets, and circular economy objectives. This could happen with a steady alignment with EU standards, best practices, and emerging circular economy frameworks. For example, review national regulations to align with the EU level. Also, a monitoring and reporting mechanism can be established so the government can track improvement in demolition rates, contamination levels, and the quality of recycled materials.

3.1.2 SPAIN

In the case of Spain, the results present a discordance between NSV(P3) and NIV (P4). To identify the best scenario, we estimate the Euclidean distance for the ideal point (P3, P4). We use this distance to see which scenario is closest to the ideal point. A smaller distance indicates the scenario is closer to a theoretical ideal situation, combining the best-observed performance on NSV and NIV dimensions.

Under this effect, the strongest scenario by Euclidean distance, coming very close to the ideal solution, is P4. This suggests a targeted approach focusing on key sectors (like construction or packaging) can yield significant improvements and move Spain closer to its circular economy goals. However, P3 is also a strong but not the most effective scenario. Indeed, Spain may benefit from policies that strengthen sector-specific regulations and implement ERP schemes to ensure the quality of reuse and recycling.

Figure 4 ELECTRE results, Spain



Below are policy recommendations for Spain that build on the identified gaps and opportunities and align with the best-performing scenario (P4, Sector-Specific Reforms) as indicated by the ELECTRE results. The focus is on targeted, sector-specific measures that strengthen circular economy practices while ensuring these reforms are practical, visible, and supported by the public.

Table 11 Policy recommendations, Spain

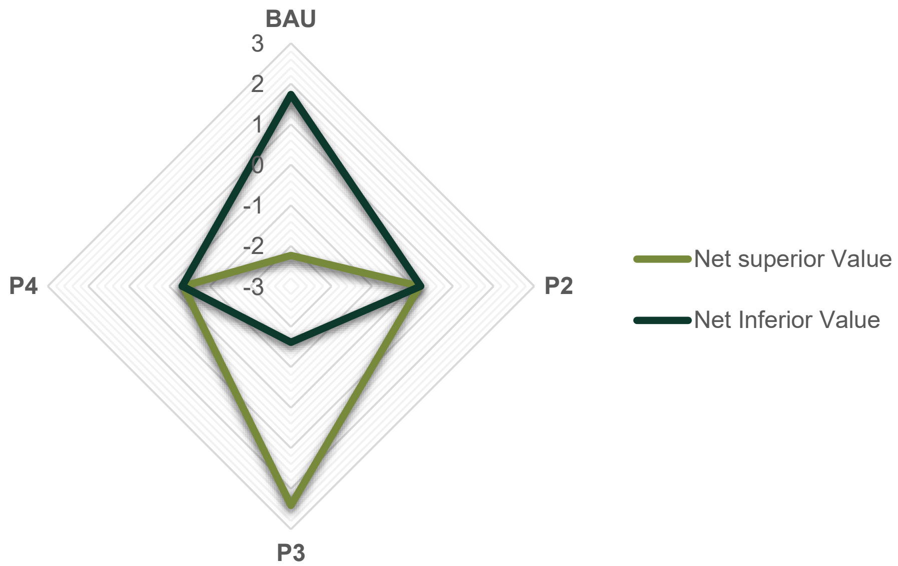
Expand and Standardize DRS Across Key Sectors		
Action 1.1	**Implement a Nationwide DRS for High-Impact Materials**	Focus initially on beverage containers, packaging, and construction materials significantly contributing to waste. By targeting these sectors, Spain can increase the recovery and recycling of valuable resources.
Action 1.2	**Incentivize Private Sector Participation**	To integrate DRS technology and logistics, provide financial or certification incentives for manufacturers, retailers, and importers in these targeted sectors. This ensures a consistent consumer experience and fosters industry collaboration.
Expand PAYT Schemes in Priority Regions and Sectors		
Action 2.1	**Tailor PAYT to sector-specific needs**	Differentiate PAYT schemes for commercial activities (restaurants, hotels, retail outlets) versus households. Align the fee structure to the waste type and volume commonly produced in these sectors, making it fair and motivating proper sorting.
Action 2.2	**Technology advancemsnt**	Incentives to municipalities to implement smart bin technology
Strengthen public awareness and engagement in targeted sectors		
Action 3.1	**Sector-focused communication campaigns**	Develop tailored information campaigns for construction firms, hospitality businesses, and packaging manufacturers that explain the benefits, regulatory requirements, and best practices for circular economy participation.
Action 3.2	**Integrate CE education into professional training**	Incorporate circular economy modules into vocational and professional courses relevant to the target sectors—such as hotel management, construction engineering, and retail operations—so that the workforce understands the rationale and methods for proper waste management.
Quality standards and compliance mechanisms		

Action 4.1	**Sector-specific quality protocols**	Develop technical guidelines and standards for construction material reuse, and packaging design.

3.1.3 Latvia

In Figure 5, a presentation of Latvia's results is depicted, incorporating the given scenarios and criteria. In the ranking of the scenarios in both **Net Superior Value (NSV) and Net Inferior Value (NIV) scenarios, P3 prevails. P3 (Aggressive Circular Economy Push)** emerges as the top performer on both NSV (2.4072) and NIV (-1.615) criteria. Its strong positive NSV and substantially negative NIV indicate that it consistently outranks the other scenarios and is rarely outranked. This suggests that policies such as increased landfill taxes, full DRS implementation, and expanded EPR systems provide Latvia with a robust path toward a circular economy. All other scenarios hold a lower portion in the ranking in both cases.

Figure 5 Latvia, Electre results



Based on the ELECTRE analysis, the Aggressive Circular Economy Push scenario (P3) performed the best overall, indicating that robust, comprehensive policy changes are more effective than incremental or narrowly focused reforms. The following policy recommendations for Latvia build on the identified key gaps and opportunities—particularly the need for legal frameworks on Construction and Demolition Waste (CDW), improved Quality Management Systems (QMS) for compost, and better integration of circular economy (CE) principles in construction—and align with the strong measures demonstrated in the top-performing scenario.

Table 12 Policy recommendations, Latvia

Enact Comprehensive Legal Regulations on CDW		
Action 1.1	**Develop and enforce a dedicated CDW legal framework**	Establish clear legal acts and standards regulating the sorting, storage, transport, and recovery of construction and demolition materials. (Require producers, construction firms, and developers to implement material recovery and recycling plans as part of building permit approvals. Introduce mandatory take-back schemes for reusable materials (e.g., wood, metal, glass) to be reintegrated into

		new construction projects. Implement traceability requirements for recovered materials to ensure compliance with circular economy goals. Define clear quality criteria for recycled C&D materials to facilitate their use in new construction projects
Action 1.2	**Incorporate Extended Producer Responsibility (EPR) provisions**	Make producers, construction firms, and developers accountable for the end-of-life phase of building materials. This aligns with the high-performing scenario's emphasis on EPR (E3), encouraging the use of recyclable and reusable materials.
Action 1.3	**Introduce stringent landfill taxes and DRS for building materials**	Similar to the successful elements of scenario P3 (aggressive reforms), increasing landfill and incineration taxes (E2) for construction waste will incentivize more sustainable material management.A DRS model for construction could work by ensuring that manufacturers, developers, or construction firms pay an upfront deposit on materials, which is refunded when they return them for reuse or recyclingScenario 1: Standardized Reusable Building Components (Modular DRS Materials such as windows, doors, bricks, steel beams, and insulation panels could be designed for disassembly and reuse..Scenario 2: Demolition-to-Construction Material ExchangesDigital material marketplaces can facilitate pre-demolition audits, mapping reusable materials for resale, reuse, or refurbishment before demolition occurs. Scenario 3: Thematic Material Exchange Points These could be sector-specific material recovery hubs, where producers take back used materials and reintroduce them into their production process. Examples include:Window exchange points at window factories (as you suggested) Brick reclamation hubs at brick manufacturers Best practise can be Netherlands: "Madaster" → A digital materials passport system for buildings, ensuring materials are reused rather than landfilled. France: Extended Producer Responsibility (EPR) for construction materials → Requires manufacturers to create take-back schemes. A DRS for building materials is more complex but possible if combined with: Material passports & tracking systems. Incentivized return schemes. Industry-led take-back initiatives
Strengthen compost Quality Management Systems		
Action 2.1	**Establish a QMS framework aligned with CE targets**	Define quality standards and regular testing protocols for compost derived from organic waste streams (EV3). Ensuring compost quality boosts market confidence, fosters the use of compost in agriculture and landscaping, and closes the nutrient loop.
Action 2.2	**Link QMS compliance to financial or certification incentives**	Offer reduced fees, tax benefits, or recognised "CE-compliant" labels for waste management companies and municipalities meeting QMS standards, encouraging higher adherence.
Integrate circular economy principles in the construction sector.		
Action 3.1	**Embed CE considerations in building codes and procurement rules**	Require that new construction and renovation projects incorporate a certain percentage of recycled materials or design components that facilitate easy disassembly and reuse. This leverages the circular economy push in scenario P3, enhancing material reuse (EV2) and infrastructure improvements (EV1).

Action 3.2	**Promote training and capacity-building & foster public support**	Provide technical guidance, workshops, and accreditation programs for architects, engineers, and construction firms on CE best practices. This supports smoother technology adoption (T1, T2) and develops local expertise to handle advanced recycling technologies.Conduct awareness campaigns to increase stakeholder buy-in (S1), ensuring that construction sector reforms are well-received by both industry and the general public.
Accelerate technological innovation and adoption		
Action 4.1	**Facilitate technology pilots and demonstration projects**	Financial and technical support should be structured in two distinct ways to advance innovation in waste management and circular economy practices. Direct financial support can be provided to waste management companies and research institutions to develop and test **innovative material sorting systems, advanced composting technologies, and digital platforms for material traceability**. Grants should be contingent on precise impact assessments, ensuring alignment with forward-thinking T1 and T2 criteria. The government or relevant authorities can **partner with research institutions and industry stakeholders** to co-develop and implement large-scale demonstration projects. These pilots should facilitate real-world testing, allowing companies to validate new technologies before full-scale adoption.
Action 4.2	**Encourage cross-sector collaboration**	Link construction firms, waste processors, and technology providers to accelerate the diffusion of best practices and new solutions

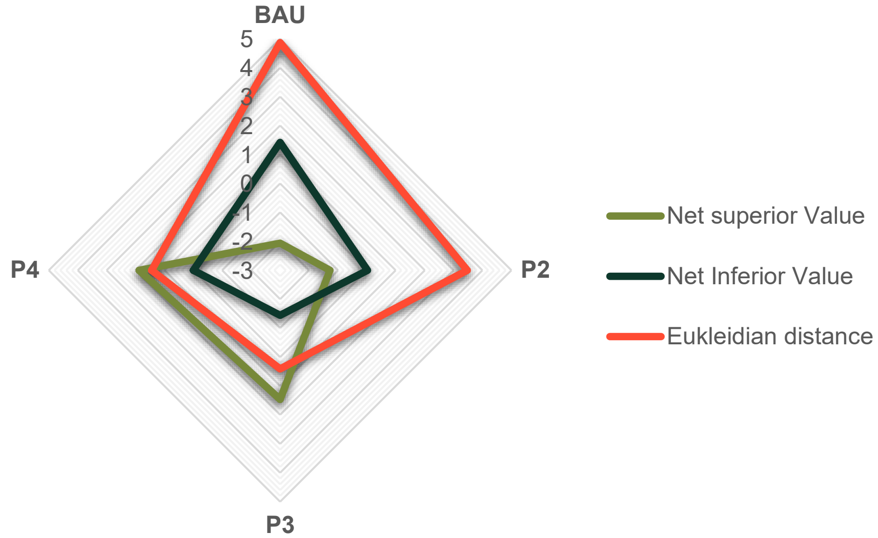
It is worth noting that the Aggressive CE Policy Shifts (P3) need to raise landfill taxes and restrict non-recyclable disposal channels to ensure that diverting CDW and organic waste to reuse, recycling, or composting streams is financially beneficial. In this overall attempt, there is also a need to create a robust system of monitoring and reporting the material flows in the construction sector.

3.1.4 Greece

Figure 6 presents the results for the **Greek case**. Again, in the case of Greece, there is no concordance between NSV and NIV; for this reason, we estimate the Euclidean distance. Each scenario is evaluated in terms of how well it performs compared to an ideal point, considering dominance (NSV/NIV) and closeness to a perfect solution derived from the best-observed criteria values. In NSV, the best scenario is P4 (1,874); under NIV, the best scenario is P3 (-1.442). For this, under the **Euclidean distance** (smaller distance to the ideal point) is the P3 scenario (distance to ideal 0.4095).

The **ELECTRE** results for Greece indicate a discordance between the Net Superior Value (NSV) and the Net Inferior Value (NIV) rankings for the evaluated scenarios. More specifically, the aggressive circular economy push (P3) stands out by being closest to the ideal scenario. Although P4 leads in NSV and P3 leads in NIV, the Euclidean distance metric, which considers both dominance and balance, shows P3 is the best compromise solution overall. This suggests that bold and comprehensive measures, such as strict regulations, full implementation of Extended Producer Responsibility (EPR) systems, and significantly increased landfill taxes, position Greece most effectively toward achieving its circular economy goals. The P3 scenario balances the need for substantial benefits with a minimized downside, making it the most favorable approach overall.

Figure 6 ELECTRE results | Greece



The policy recommendations for Greece, aligned with the aggressive circular economy push (P3) scenario, emphasize comprehensive reforms to achieve circular economy goals. These include implementing a nationwide Deposit Return System (DRS) for beverage containers and packaging to enhance high-quality material recovery and digital integration for seamless participation. Significantly increased landfill taxes are proposed to discourage disposal and redirect funds toward circular infrastructure development, such as advanced recycling facilities and material recovery plants.

Enhancing quality management standards for recycled materials is a priority, with the establishment of national benchmarks and certifications to boost market confidence and ensure consistent quality. Investments in technology and innovation are recommended, including support for advanced recycling technologies through grants, tax incentives, and R&D hubs, alongside capacity-building programs to create a skilled workforce. Public awareness and behavioral change campaigns are critical, promoting the environmental and economic benefits of a circular economy while engaging stakeholders in co-creating tailored solutions. This comprehensive approach aims to foster robust producer responsibility, elevate public engagement, and enhance the overall effectiveness of Greece's transition to a circular economy.

Table 13 Recommendations Greece

Implement a Comprehensive Deposit Return System		
Action 1.1	**Nationwide rollout of DRS for beverage containers and packaging**	Require deposits on beverage bottles, cans, and other common packaging to ensure high return rates and support high-quality material recovery.
Action 1.2	**Digital integration and consumer engagement**	Use smart collection points and mobile applications to make the return and refund process seamless, boosting participation and transparency
Significantly Increase Landfill Taxes		

Action 2.1	**High taxation on non-recyclable waste streams**	Raise landfill taxes to discourage disposal and push municipalities, businesses, and citizens towards prevention, reuse, and recycling.
Action 2.2	**Redirecting Funds to Circular Infrastructure**	Allocate the additional revenue from landfill taxes to building advanced recycling facilities, material recovery plants, and composting infrastructure
Enhance Quality Management and Standards for Recycled Materials		
Action 3.1	**Establish national quality standards for recyclates and compost**	Define quality benchmarks for recycled content and compost products to ensure market confidence and spur demand for secondary materials.
Action 3.2	**Regular Audits and certifications**	Implement independent verification systems and certifications for recycling facilities, guaranteeing that outputs meet established standards and encouraging continuous improvement
Technology, Innovation, and Skill Development		
Action 4.1	**Support R&D for advanced recycling technologies**	Provide grants, tax incentives, and innovation hubs to research institutions and startups working on next-generation sorting, mechanical and chemical recycling. Support mechanisms should be tailored to different stakeholders and technology readiness levels to drive innovation in waste management and circular economy practices. The following approaches are proposed: Target Beneficiaries: Research institutions, universities, and technology startups working on next-generation sorting, mechanical and chemical recycling. Encourage industry-driven R&D by reducing corporate tax liabilities for eligible innovation projects. Incentivize investment in waste valorization technologies (e.g., turning construction debris into high-value materials).
Action 4.2	**Capacity building and technical training**	Offer technical courses and workshops to develop a skilled workforce capable of operating new recycling technologies and adhering to best practices in waste management.
Public Awareness and Behavioral Change Campaigns		
Action 4.1	**Nationwide awareness initiatives**	Launch media campaigns, school programs, and community workshops to educate the public about the environmental and economic benefits of a circular economy.
Action 4.2	**Stakeholder Engagement and Co-Creation:**	Involve municipalities, NGOs, retailers, and consumer groups in policy formulation, ensuring that solutions are tailored to local needs and encouraging buy-in from all stakeholders.

Consequently, for Greece, a transformative, all-encompassing approach—resembling P3's Aggressive Circular Economy Push—means reinforcing producer responsibility, scaling up deposit systems, substantially increasing landfill costs, and fostering innovation. These measures, supported by strong public engagement and quality standards, can establish a robust circular ecosystem where resources are valued, recycled, and reused, driving Greece closer to its sustainability and economic resilience objectives.

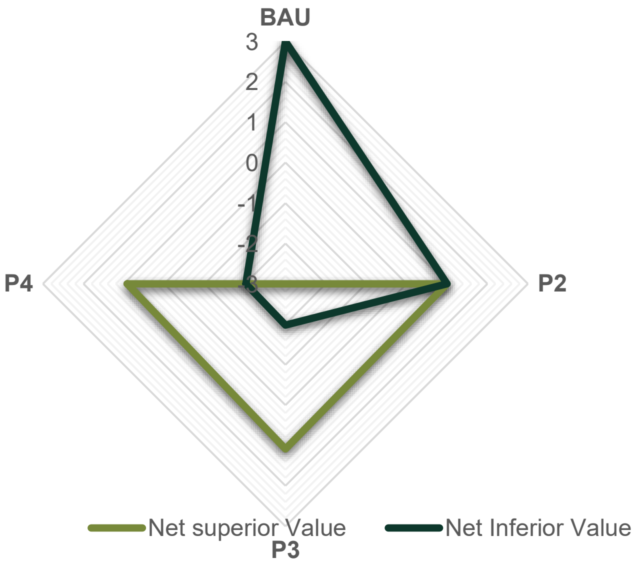
3.2 Results at the municipality level

3.2.1 Tartu

Figure 7 presents each scenario's results, including the Net Superior Value (NSV) and Net Inferior Value (NIV). It is observed that there is no consensus in the case of the city of Tartu. The NSV provides the best scenario for P3 (aggressive circular economy push), indicating that P3 provides the most positive benefits overall. On the other hand, the **Net Inferior Value (NIV)** indicated the best outcome P4 (sector-specific targeted policies), suggesting that this scenario minimises negative impacts more effectively than the other scenarios.

In this case, since no single scenario excels in both cases simultaneously, we determine that the best scenario is the one that maximises positive outcomes (Net Superior Value). Therefore, P3 is the best choice. However, in the recommendations, we consider, in some cases, the P4 (Sector-Specific Targeted Policies) to address and effectively minimise adverse outcomes.

Figure 7 Results for Tartu city



The policy recommendations are provided in Table 10 below based on the description of Scenario P3, which refers to an aggressive circular economy push.

Table 14 Policy Recommendations for Tartu – P3

Policy Recommendations for Tartu		
Action 1.1	**Implement high landfill taxes and incineration fees**	Introduce substantial increases in landfill and incineration fees for all waste streams, including construction and demolition waste (CDW).Since landfill taxes and incineration fees are determined at the national level, the role of Tartu should focus on ensuring effective local implementation and supporting complementary policies that align with the national tax increase. The following measures can be adopted: material exchange programs: develop reuse centers or digital trading platforms for construction materials to reduce landfill dependency. Discounted Fees for Circular Practices: Offer reduced disposal fees for pre-sorted CDW materials destined for reuse or high-quality recycling. Collaborate with regional authorities to negotiate waste treatment alternatives (e.g., partnerships with private-sector material recovery facilities). Encourage public-private investments in sorting and recycling infrastructure to prevent waste from being exported.
Action 1.2	**Comprehensive DRS, including CDW components**	Broaden the DRS coverage in relation to construction packaging waste to include conventional bulk waste management types such as metals, specific plastic materials, and wood if the case

		applies. Recycle waste by returning pre-processed construction materials to validated sites and get paid for that.
Action 1.3	**Robust EPR for construction materials and other high-impact products**	Mandate producers and suppliers of key construction materials (e.g., insulation, roofing materials, concrete aggregates) to manage end-of-life processing. Link compliance to stringent recovery and recycling targets.
Action 1.4	**Subsidies and grants for CE innovations**	Provide substantial financial support to startups, SMEs, and research institutes in Tartu to develop advanced sorting technologies, material recovery facilities, and upcycling hubs.
Action 1.5	**Mandatory training and capacity-building programs**	Introduce compulsory training courses for demolition contractors, architects, and construction managers on selective demolition, material identification, and recycling best practices.

The reasons behind A1.1 is that it encourages a shift away from disposal toward recycling and reuse, reducing greenhouse gas emissions and advancing circular economy goals. Over time, as recycling infrastructure matures, recovered materials can be sold, increasing profitability. Furthermore, A1.2 could improve recycling rates and reduce the burden of unsorted demolition debris, while the recovered materials lead to lower pollution and less resource extraction. In the case of A1.3, this will give incentives to producers to design for dismantling, material purity, and recyclability, preserving natural resources and ecosystems while at the same time fostering new jobs in sorting, refurbishing, and recycling industries. For A1.4, this will reduce the possible financial barriers to building high-quality recycling infrastructure and encourage local innovation. In this line, innovations can create profits and new solutions. A1.5 aims to ensure smooth adoption by equipping stakeholders with the know-how, increasing acceptance, reducing implementation difficulty, easing the transition to more complex CE requirements, and improving long-term feasibility.

Although the P4 scenario is not the best solution, some actions might help the P3 scenario and boost the overall results of the policy recommendation. Table 15 describes some actions as possible policy recommendations.

Table 15 Policy recommendations- Tartu city | Scenario P4

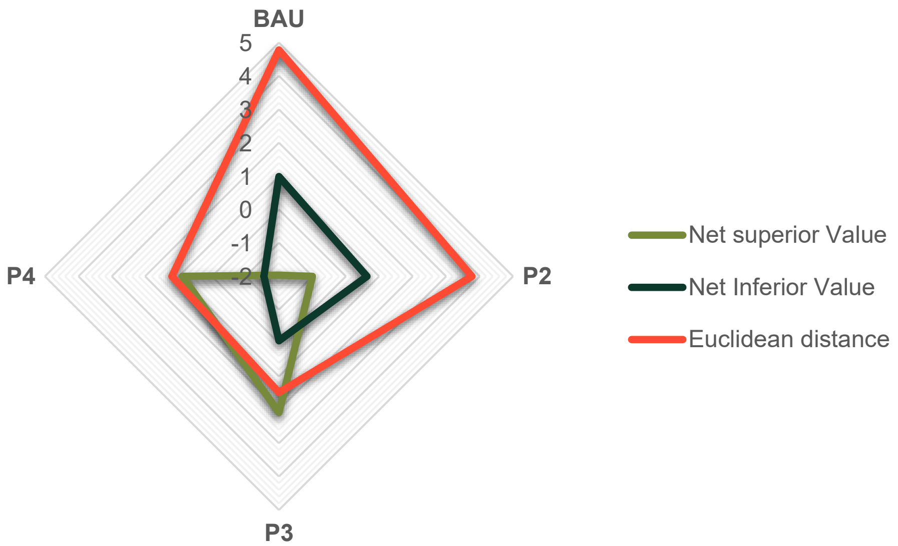
Policy Recommendations for Tartu | Sector-Specific Targeted Policies		
Action 2.1	**Enforce selective demolition guidelines for key construction projects**	Mandate that all municipal and large private construction projects in Tartu follow selective demolition protocols, separating materials at source.
Action 2.2	**Public Procurement Requirements for recycled materials**	City building and infrastructure projects require a certain percentage of reclaimed or recycled materials.
Action 2.3	**Targeted DRS for packaging and construction sectors**	Introduce or enhance a sector-focused DRS system for problematic streams (e.g., wooden pallets and certain types of metal or plastic packaging used in construction).
Action 2.4	**Urban Resource Centers (URCs) and Niche Innovation Hubs**	Establish small-scale URCs dedicated to construction material reuse and refurbishment. Encourage partnerships with local universities, incubators, and the building sector.
Action 2.5	**Sector-specific training and certification programs**	Offer specialised certification courses for construction and demolition stakeholders, focusing on best practices in material sorting, recycled material usage, and compliance with EPR obligations.

A2.1 will improve the quality of recycled aggregates and other secondary materials, reduce contamination, and protect local ecosystems. A2.3 may stimulate market demand for secondary materials, improve recycling operations' profitability, encourage local recycling firms to scale up, create jobs, and strengthen Tartu's CE ecosystem. Focusing on DRS (A2.3) will raise recycling rates for the most impactful materials. Furthermore, it will make gaining public and industry buy-in easier when targeting well-defined sectors with clear benefits. The operation of URCs strengthens local circular infrastructure, enabling high-quality sorting, minor repairs, and innovation (A2.4).

3.2.2 Barcelona

Barcelona's results are displayed at Figure 8. While P3 has the highest NSV and P4 has the best NIV, P4 emerges as the closest scenario to the ideal point when considering both dimensions together. This suggests that targeted, sector-specific reforms can bring Barcelona's circular economy performance nearer to the optimal balance of outranking power and minimal dominance by others. P3 remains a strong option, indicating ambitious, comprehensive reforms also deliver substantial benefits. For Barcelona, a strategy that prioritizes sector-specific reforms (P4) aligns most closely with the ideal outcome in terms of both dominance (NSV) and resilience against being outranked (NIV). Such an approach implies focusing on key sectors to drive efficient, targeted policy interventions that accelerate the transition towards a more circular, sustainable economy.

Figure 8 Results for Barcelona – P3



Below are the recommended policy measures that align with the evaluation criteria (E1–E3, S1–S2, EV1–EV3, T1–T3) and build upon the more transformative scenarios (P3 and P4) identified through the ELECTRE analysis. These policies aim to address identified gaps—such as insufficient DRS for construction waste, low landfill taxes, weak EPR systems, minimal incentives, and underdeveloped innovation infrastructures—while striving for robust improvements in circular economy outcomes.

Table 16 Policy recommendations- Barcelona city | Scenario P3

Policy Recommendations for Barcelona		
Action 1.1	**Scaled Landfill and Incineration Taxes**	Introduce high landfill and incineration taxes to incentivize recycling and discourage disposal. Reinvest a portion of these revenues into infrastructure upgrades and circular economy innovation hubs.
Action 1.2	**Performance-Based Subsidies for CE Innovations**	Offer subsidies or tax breaks to companies that achieve specific recycling or reuse targets, as well as funding for research and development in innovative sorting, treatment, and upcycling technologies.

Action 1.3	**Mandatory DRS across Multiple Material Streams**	Expand Deposit Return Systems (DRS) beyond packaging to include construction and electronics waste. This increases return rates, improves quality of recyclates, and fosters higher recycling and reuse rates.
Action 1.4	**Public Awareness Campaigns and Educational Programs**	Launch nationwide campaigns demonstrating the environmental and economic benefits of circular economy initiatives. Highlight successful city-level pilots (e.g., Barcelona's innovation hubs) to inspire confidence and acceptance.
Action 1.5	**Support for Social Enterprises and Cooperatives**	Offer grants to community-based recycling and refurbishment initiatives, fostering local employment and inclusive growth.
Action 1.6	**Incentivizing Community Participation**	Provide discounts on waste fees for households and businesses that regularly return materials to DRS stations or participate in pilot programs. This encourages a positive feedback loop of public support and better source separation.

The policy recommendations for Barcelona (P3 Scenario) emphasise creating a robust circular economy by addressing waste management challenges through innovative and inclusive actions. Introducing high landfill and incineration taxes aims to deter waste disposal and encourage recycling while reinvesting tax revenues in circular economy infrastructure and innovation hubs. Performance-based subsidies are suggested to reward companies meeting recycling and reuse targets and support for research in advanced sorting and upcycling technologies. Expanding Deposit Return Systems (DRS) to include materials such as construction and electronics waste is proposed to improve recycling quality and return rates. Public awareness campaigns are recommended to showcase the benefits of circular economy initiatives, using successful local examples to build trust and participation. Grants for social enterprises and cooperatives would support community-based recycling projects, creating local jobs and fostering inclusive growth. Additionally, incentivising community participation through waste fee discounts for households and businesses actively engaging in recycling programs aims to enhance public commitment and improve waste separation at the source.

Although the P4 scenario is not the best solution, some actions might help the P3 scenario and boost the overall results of the policy recommendation. Table 17 describes some actions as possible policy recommendations.

Table 17 Policy recommendations- Barcelona city | Scenario 4

Policy Recommendations for Barcelona | Sector-Specific Targeted Policies		
Action 2.1	**Enhanced EPR Schemes for High-Waste Sectors**	Enforce EPR obligations for construction, electronics, and packaging producers. Require them to finance collection, sorting, and recycling infrastructure and meet defined recovery targets.
Action 2.2	**Eco-Design and Material Standards**	Introduce eco-design criteria and material bans for products that are hard to recycle. Reward producers that design easily recyclable goods, reducing waste at source
Action 2.3	**Investment in URCs and Innovation Hubs**	Establish Urban Resource Centers (URCs) and prototyping hubs in cities like Barcelona to pilot new technologies for sorting, material recovery, and upcycling.
Action 2.4	**Digital Tools and Traceability Systems**	Promote the use of digital platforms, IoT-based smart bins, and blockchain traceability to streamline logistics, reduce contamination, and track material flows. This improves implementation efficiency and transparency.
Action 2.5	**Upskilling and Training Programs**	Develop vocational training and certification programs to build a skilled workforce for emerging CE sectors—e.g.,

		urban resource centers (URCs), electronics repair facilities, and advanced composting plants.
Action 2.6	**Selective Demolition Guidelines in Construction**	Mandate source separation at demolition sites and require minimum percentages of recycled materials in public construction projects, especially in cities like Barcelona and Tartu.

These policy recommendations translate the ambitions of the Aggressive Circular Economy Push (P3) and Sector-Specific Targeted Policies (P4) scenarios into actionable regulatory frameworks. They are designed to improve recycling (E1), manage financial and infrastructural costs (E2, E3), ensure public buy-in and job creation (S1, S2), enhance environmental outcomes (EV1–EV3), and address technological feasibility and innovation needs (T1–T3). These measures can drive a transformative shift toward a more circular and sustainable economy through stringent regulations, market-based incentives, community engagement, and technological support.

3.2.3 Riga

Riga's results show each scenario's performance in terms of Net Superior Value (NSV) and Net Inferior Value (NIV), along with their respective ranks. Higher NSV ranks indicate a scenario frequently outranks others, while lower (more negative) NIV values indicate the scenario is less often outranked. P3 (Aggressive Circular Economy Push) emerges as the top performer. It achieves the highest NSV (1) and the most favorable NIV (1), meaning it consistently outperforms other scenarios and is rarely outdone by them. This suggests that ambitious reforms—such as comprehensive policy changes, robust Extended Producer Responsibility (EPR) systems, stronger landfill taxes, and a fully implemented Deposit Return System (DRS)—provide the most substantial benefits for Latvia. A Deposit Return System (DRS) is a policy mechanism that places a refundable deposit on certain materials at the point of sale, which is refunded when the item is returned for recycling or reuse. In the context of circular economy reforms, a DRS for packaging materials (e.g., plastic bottles, aluminum cans) is common, but the concept can also be extended to construction materials, electronics, and other high-value waste streams. Implementing a well-regulated DRS can significantly improve material recovery rates, reduce landfill dependency, and incentivize sustainable production and consumption practices.

For Riga, the analysis suggests that adopting a more ambitious, wide-ranging approach toward circular economy practices—such as the Aggressive Circular Economy Push (P3)—delivers the strongest performance. Meanwhile, sector-specific reforms (P4) also show promise as a second-best strategy. Incremental improvements (P2) and a business-as-usual approach (P1) are comparatively less effective, underscoring the need for more assertive policies to achieve significant progress in circular economy goals.

Figure 9 Results for Riga Municipality – P3

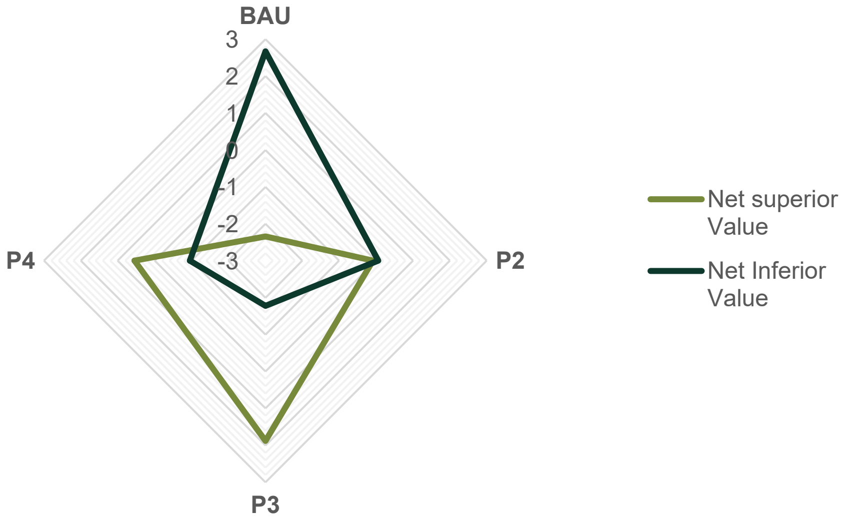


Table 18 presents the policy recommendations tailored to Riga's identified gaps, aligned with the higher-performing scenarios (P3: Aggressive Circular Economy Push and P4: Sector-Specific Targeted Policies).

A Deposit Return System (DRS) is a policy mechanism that places a refundable deposit on materials at the point of purchase. This deposit is refunded when the materials are returned in an acceptable condition for reuse or recycling. While traditionally applied to beverage containers, expanding it to construction and demolition waste (CDW) can improve material recovery, promote source separation, and reduce landfill disposal. In order to be work in practice, the following steps are needed:

1. Deposit at Purchase – When purchasing construction materials such as wood, metals, and aggregates, a deposit fee is added to the price.
2. Collection & Sorting – Contractors and demolition firms separate and return materials to authorized collection centers, material banks, or directly to suppliers.
3. Deposit Refund & Material Reuse – If the returned materials meet quality standards, the deposit is refunded, and the materials enter reuse or high-value recycling streams.
4. Reinvestment of Unclaimed Deposits – If materials are not returned, unclaimed deposits fund waste prevention initiatives and recycling infrastructure.

A digital DRS enhances efficiency, tracking, and accessibility through smart technology solutions that streamline material returns, reduce fraud, and improve data quality.

1. Smart Material Tagging – QR codes or RFID tags are attached to construction materials upon sale to track their movement.
2. Smart Return Stations – Construction firms return materials to digital drop-off points equipped with scanners that verify returns.
3. Automated Refund Processing – Once the system confirms a successful return, the deposit refund is processed digitally (via bank transfer, mobile payment, or tax deductions).
4. Data Collection for Policy Monitoring – The system records real-time data on returns, material recovery rates, and reuse performance, helping authorities refine policies over time.

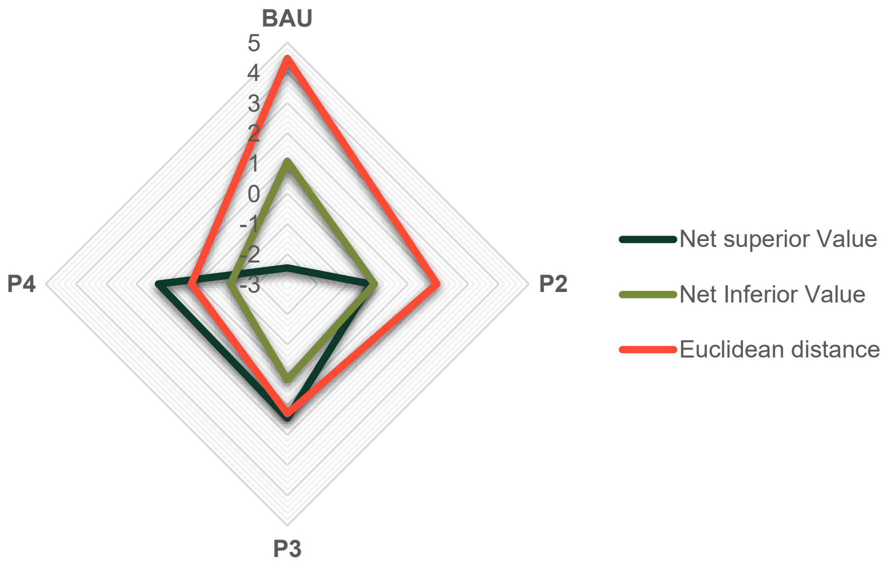
Table 18 Riga Municipality policy recommendations

Strengthen DRS Implementation		
Action 1.1	**Expand DRS to Construction and High-Waste Sectors**	Move beyond limited implementation for Construction & Demolition Waste (CDW) by introducing a deposit-return system for key construction materials (wood, metals, and certain aggregates). This aligns with P3's nationwide DRS coverage and P4's sector focus, improving recycling rates (E1), promoting source separation, and reducing landfill disposal.
Action 1.2	**Digitalized DRS Platforms**	Implement digital systems (smart bins, QR codes) to track returns. This enhances user convenience (S1), encourages participation, and improves data quality, aiding monitoring and continuous improvement (T3).
Action 2.1	**Increase Landfill and Incineration Taxes**	Following P3's approach, high taxes incentivize recycling and discourage landfilling, pushing waste streams towards more sustainable management. The revenue generated can fund circular infrastructure (T3), making CE investments more profitable (E3) and reducing greenhouse gas emissions from landfills (EV1).
Action 2.2	**Use fund for innovation and infrastructure.**	Dedicate a portion of the tax revenues to build Urban Resource Centers (URCs), improving technical feasibility (T1) and fostering local innovation in recycling and upcycling (E3, S2).
Enhance circular material use rates (E1, EV1–EV3)		
Action 4.1	**Set Material Reuse and Recycled Content**	Require a minimum percentage of recycled content in construction materials, packaging, and in public procurement. This creates a stable demand for recycled materials (E1, EV3), reduces reliance on virgin resources (EV2), and cuts greenhouse gas emissions by lowering energy consumption in material production (EV1).
Increase CDW Management Efficiency (T3, E1, EV3)		
Action 5.1	**Implement Advanced Tracking and Certification Systems**	Introduce **a national digital tracking platform for Construction and Demolition Waste (CDW)** to ensure **consistent data collection, transparency, and accountability.** This platform would function as a **digital building material passport**, recording **material composition, origin, reuse potential, and disposal history**. By standardizing data collection, it supports better pollution control (EV3), aids in meeting Circular Economy (CE) targets (E1), and facilitates the implementation of circular solutions (T3)

3.2.4 Kavala

For Kavala (Figure 10), the results are arguing that the best scenario is P4- **Sector-Specific Targeted Policies.** P3 excels in NSV, and P4 excels in NIV; the Euclidean distance metric, which considers both dimensions, clearly shows P4 as closest to the ideal. This suggests that targeted, sector-based interventions would yield the most balanced and effective outcome for Kavala's circular economy transition.

Figure 10 ELECTRE results, Kavala



Below are policy recommendations for Kavala that address the identified gaps while aligning with the best-performing scenario (P4: Sector-Specific Targeted Policies) and the evaluation criteria. P4's strength lies in customizing interventions to each city's most critical waste streams, ensuring that policies are both locally relevant and impactful. By integrating the targeted approach of P4 with ambitious measures inspired by P3, Kavala can overcome current limitations in DRS, EPR, and separate collection systems, improve circular material use, and foster innovation in Construction & Demolition Waste (CDW) management.

Table 19 Policy reccomedantiosn, Kavala

Strengthen DRS implementation for construction and packaging waste (E1, T2, T3)		
Action 1.1	**Introduce a Construction & Demolition Waste**	Incentivize the return of clean, sorted demolition materials (e.g., metals, certain aggregates) to designated collection points, offering a deposit refund. This will directly increase material reuse and recycling rates (E1), enhance DRS effectiveness (T2), and build infrastructure for material processing hubs (T3).
Monitor mass balances in CDW management plants and set thresholds to drive sustainable practices (E2, E3, EV1)		
Action 2.1	**Mass balance monitoring :**	Monito mass balances in CDW plants and set thresholds at levels that make recycling and reuse financially more attractive (combined with Action 4.1). Reducing greenhouse gas emissions (EV1) and creating profitable circular business models (E3).
Enforce and enhance separate collection systems (E1, EV2, EV3)		
Action 3.1	**Public Education Campaigns**	Run communication initiatives and training sessions for local contractors and citizens. Well-informed stakeholders are more likely to comply, improving acceptance and stable policy support (S1).
Boost circular material use and CDW management efficiency (E1, T3)		
Action 4.1	**Selective demolition and material quality standards**	As suggested in P4, mandate selective demolition practices that ensure the recovery of valuable materials. Introduce standards and certifications to guarantee the quality of reclaimed materials, encouraging reuse in public construction projects. This raises circular material use rates (E1) and enhances the feasibility of such solutions (T3).

For Kavala, a targeted approach (P4) that addresses the city's specific gaps—such as introducing a DRS for CDW, strengthening EPR in key sectors, enforcing separate collection, incentivising innovation in CDW management, and removing implementation barriers—offers the most balanced and effective path toward a thriving circular economy. These recommendations align with the ELECTRE criteria and help Kavala improve recycling rates (E1), ensure profitable CE initiatives (E3), secure public support (S1), create jobs (S2), enhance environmental quality (EV1–EV3), and facilitate smooth implementation (T1–T3).

4 Roadmap for policy recommendations

4.1 Strategic Vision & Policy Priorities

The findings from the ELECTRE analysis indicate that ambitious, sector-specific, and integrated circular economy policies are necessary to improve Construction and Demolition Waste (CDW) management across Estonia, Spain, Latvia, and Greece. The roadmap outlines key regulatory, economic, technological, and social interventions tailored to each country and municipality.

The **key policy priorities** identified include:

1. **Strengthening Regulatory Frameworks:** Implement Extended Producer Responsibility (EPR) for construction materials, enforce mandatory recycling targets, and establish CDW-specific legal frameworks.
2. **Economic & Financial Incentives:** Introduce landfill and incineration taxes, implement deposit-return systems (DRS) for construction materials, and provide targeted subsidies for circular economy innovation.
3. **Infrastructure & Digitalization:** Develop national digital platforms for CDW tracking, material passports, and smart waste collection systems.
4. **Capacity Building & Stakeholder Engagement:** Promote industry training, public-private collaboration, and behavioral incentives to enhance participation in circular economy initiatives.

4.2 Key Policy Recommendations by Thematic Area

1. Regulatory & Governance Measures

- **Adopt Extended Producer Responsibility (EPR) for Construction Materials:**
    - Require producers to ensure recyclability, traceability, and take-back schemes for key construction materials.
    - Incentivize reusable and recyclable material design in building projects.

- **Strengthen CDW Legislation & Enforcement:**
  - Develop national legal frameworks ensuring **standardized sorting, collection, transport, and recovery** of CDW.
  - Introduce selective demolition mandates to facilitate high-value material recovery.

2. Economic & Financial Instruments

- **Increase Landfill Taxes & Incineration Fees:**
  - Raise taxes on non-recyclable CDW to discourage landfilling and redirect funds into circular economy infrastructure.
  - Establish differential fees for sorted vs. unsorted waste to promote source separation.
- **Expand Deposit-Return Systems (DRS) for Construction Materials:**
  - Implement refundable **deposit schemes** for materials such as wood, metals, glass, and aggregates.
  - Establish **sector-specific exchange points** (e.g., **window factories for glass, brick reclamation hubs**).
- **3. Infrastructure & Digitalization**
- **Develop a National Digital Building Material Passport:**
  - Track material composition, reuse potential, and disposal history for construction materials.
  - Ensure transparency in material flows to facilitate high-quality recycling and secondary market development.
- **Invest in Smart Waste Collection & Sorting Technologies:**
  - Implement **QR-coded material tracking** for automated deposit-refund processing.
  - Upgrade recycling plants with **AI-driven sorting technologies** to improve efficiency.

4. Capacity Building & Public Engagement

- **Provide Technical Training for the Construction Sector:**
  - Develop certification programs for architects, engineers, and demolition contractors on material recovery best practices.
  - Strengthen compliance with circular economy principles in procurement and project planning.
- **Launch Public Awareness & Incentive Programs:**
  - Promote urban resource centers (URCs) for material reuse and citizen engagement.

- Offer **discounted waste fees** for companies & individuals actively participating in DRS programs.

Table 20 Implementation Timeline & Phasing Plan

Timeframe	Key Actions
Short-Term (1-2 years)	- Introduce new CDW legal frameworks. - Implement landfill tax increases. - Establish voluntary EPR guidelines. - Pilot DRS programs in targeted cities.
Medium-Term (3-5 years)	- Scale up deposit-refund systems for key construction materials. - Develop and deploy a national digital tracking system for CDW. - Establish financial incentives for material reuse in public projects.
Long-Term (5+ years)	- Fully integrate material passports across national infrastructure projects. - Expand circular economy innovation hubs. - Ensure self-sustaining CDW management through digital monitoring and adaptive policies.

4.3 Monitoring, Evaluation & Adaptation

A comprehensive monitoring and evaluation framework must be integrated into national and municipal governance structures to ensure the long-term effectiveness of circular economy policies. This will allow policymakers to track progress, assess impact, and adapt regulations to evolving economic, environmental, and technological conditions. A well-structured monitoring system will help ensure that circular economy initiatives remain dynamic, evidence-based, and aligned with international best practices.

Developing and monitoring quantifiable KPIs is essential to assess the success of circular economy policies. These indicators should be tracked annually at national and local levels to provide insights into policy effectiveness and areas requiring adjustment.

The core KPIs include:

Increase in Circular Material Use Rates:

- Measures the percentage of secondary (recycled) materials used in construction and other relevant industries.
- Tracks progress toward EU Circular Economy Action Plan (CEAP) targets and national sustainability goals.

Reduction in Landfill-Bound Construction & Demolition Waste (CDW):

- Evaluates the percentage decrease in CDW sent to landfills or incineration.

- Assesses the impact of landfill taxes, selective demolition mandates, and material recovery initiatives.

Growth in Recovered Material Market Share:

- Tracks the proportion of CDW materials successfully reintroduced into the economy through reuse, recycling, and resale.
- Evaluates the effectiveness of digital material tracking systems and deposit-return schemes (DRS).

Additional indicators may include:

- Compliance rates with Extended Producer Responsibility (EPR) regulations.
- Volume of materials processed through urban resource centers (URCs).
- Public participation rates in material recovery programs.

Given the evolving nature of circular economy practices, adaptive policymaking is critical for long-term success. Policymakers should conduxt periodic policy reviews by establishing biannual or annual assessments to measure the effectiveness of circular economy policies. Also, they can use KPI data to adjust financial incentives, regulatory frameworks, and investment priorities. Establish open-access digital dashboards where policymakers, businesses, and the public can track progress on circular economy targets. By implementing a robust monitoring and adaptive policy framework, national and municipal governments can ensure that circular economy initiatives remain effective, scalable, and responsive to emerging challenges and opportunities.

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