



CIRCULAR  
FOAM

# Report on business opportuni- ties in the regional systems for PUR hard foam recycling Deliverable D7.7

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## Technical References

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## History of changes

Version	Date	Short description of changes
V0.1	23.07.2025	First draft by IZNAB
V0.2	25.07.2025	Updated risk analysis
V1.0	07.08.2025	Final document, after review by consortium partners

## Executive Summary

This document presents the results of Task 7.8 within the CIRCULAR FOAM project, focusing on the identification and evaluation of new business opportunities arising from the implementation of rigid polyurethane (PUR) hard foam recycling. The objective is to support the development of a competitive, circular, and resource-efficient industry that contributes to Europe's climate neutrality, circular economy, and sustainable industrial transformation objectives.

Seven business opportunities were identified and analysed across technical, economic, and regional dimensions within the three participating regions: Rheinisches Revier (Germany), Amsterdam Metropolitan Area (Netherlands), and Metropolis GZM (Poland). These opportunities represent a potential blueprint for reshaping the PUR waste value chain in alignment with the EU Green Deal, upcoming digital product passport requirements, and increasing the rate of recycling materials.

The methodology combined regional analysis, business model development, SWOT and risk assessments, and critically a dedicated investor-oriented risk analysis. This additional layer provides insights into the financial and regulatory risk landscape from a private capital perspective and supports alignment with blended finance models, ESG goals, and long-term impact metrics.

Following the multi-criteria evaluation, a prioritisation of the seven opportunities was carried out. The conclusion of the report highlights which opportunities offer the highest potential for near-term implementation and strategic alignment with the CIRCULAR FOAM consortium's capabilities. These prioritised opportunities provide actionable pathways to pilot circular business models, attract investment, and scale impact across Europe's industrial and construction sectors.

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## 1 Introduction

This document has been written to present the results performed within Task 7.8 of the CIRCULAR FOAM project. The project aims to enable a sustainable transformation of the polyurethane (PUR) rigid foam value chain by establishing a circular economy model for its recycling. As PUR hard foams are extensively used in insulation materials, especially within the construction sector, their end-of-life disposal presents a growing environmental and economic challenge. CIRCULAR FOAM addresses this by promoting large-scale recycling solutions that reduce dependency on fossil-based raw materials, lower CO<sub>2</sub> emissions, and minimize landfill waste.

This report focuses on exploring the potential new business opportunities that can emerge from implementing PUR hard foam recycling within the regions represented in the project. The goal is to support the creation of a competitive, circular, and resource-efficient industry that contributes to Europe's climate and sustainability objectives. By identifying key opportunity areas, this work aims to foster regional innovation, stimulate investment in circular technologies, and build a foundation for new markets and business models centred on recycled PUR materials.

In the long term, this investigation is expected to deliver substantial benefits. It can drive the creation of new circular business models, stimulate regional economic growth, and generate high-quality employment opportunities. Enhanced resource efficiency and reduced greenhouse gas emissions will contribute directly to environmental targets, while positioning participating regions as innovation leaders in the circular economy. Furthermore, the insights gained can inform infrastructure development, support regulatory preparedness, and strengthen the resilience and competitiveness of local industries within a rapidly evolving sustainability landscape.

## 2 PUR market analysis

Polyurethane (PU) materials are integral to modern life, with applications ranging from insulation in buildings to refrigeration and automotive industries. Rigid polyurethane (PUR) foams are particularly valued for their excellent thermal insulation properties, making them a key material in energy-efficient construction and refrigeration.

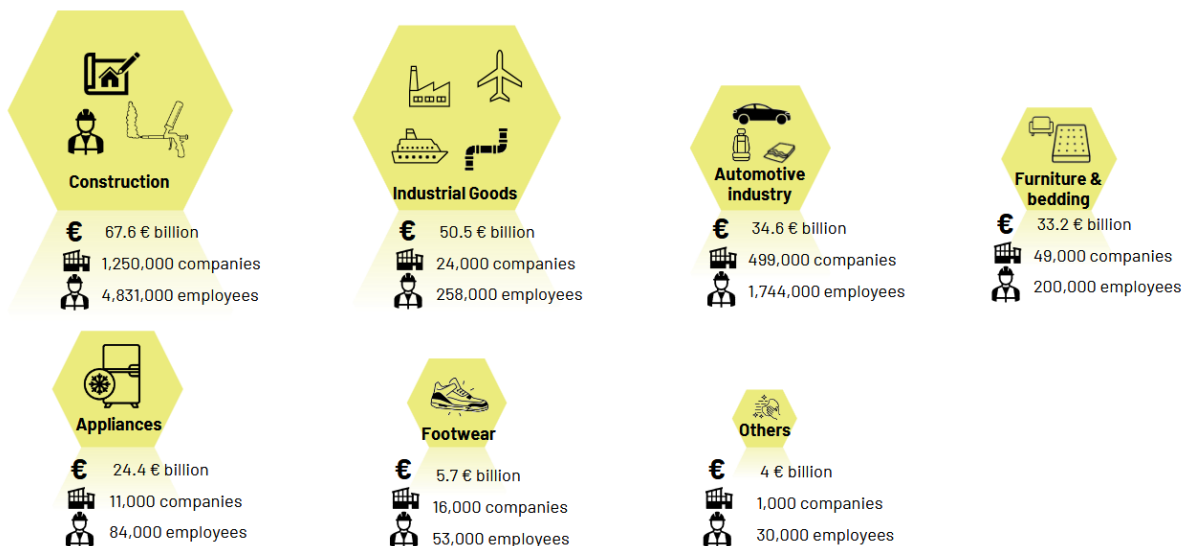


FIGURE 1. PU MARKET OVERVIEW BY INDUSTRY (2023).<sup>1</sup>

The European polyurethane market can be described in terms of three categories: product type, application, and region. In terms of the type of PU produced a distinction can be made between rigid or flexible foams, adhesives and sealants, coatings, membrane materials, composites, etc. In terms of possible applications, PU is used industry sectors like construction, footwear, furniture, automotive and appliances. And then considering regional level it can be divided for each European country, where the biggest production is performed in Germany, France, Spain, Poland, and Russia. Some of the largest European manufacturers of polyurethane products include Covestro, Huntsman Corporation, The Dow Chemical Company, Shell Chemicals, British Vita Limited, DuPont, Borsodchem and BASF. Due to the wide range of manufacturers, Europe is a highly competitive market when it comes to Polyurethane.<sup>2</sup>

Every year the European polyurethane market produces €233 billion worth of this material in various forms, and this production is carried out by around 1,850,000 companies in Europe. As a result, the polyurethane industry employs around 7.2 million people. It includes also non-PU industries. The European polyurethane industry involves close to 80,000 companies across the EU27, Switzerland, Norway, the UK, and Turkey, generating approximately €149 billion annually. The sector employs about 700,000 individuals who directly contribute to the production of polyurethane and polyurethane products. Additionally, over 1.7 million companies in Europe work with polyurethane products, generating another €84 billion and employing over 6.5 million people (see Figure 2).<sup>3</sup> The market is expected to grow at a compound annual growth rate (CAGR) of 4.0% from 2024 to 2030.<sup>4</sup> The demand for energy-efficient materials, coupled with stringent EU regulations on building energy performance, is a major growth driver.

<sup>1</sup> [ISOPA | European Polyurethane Industry Facts 2023](#)

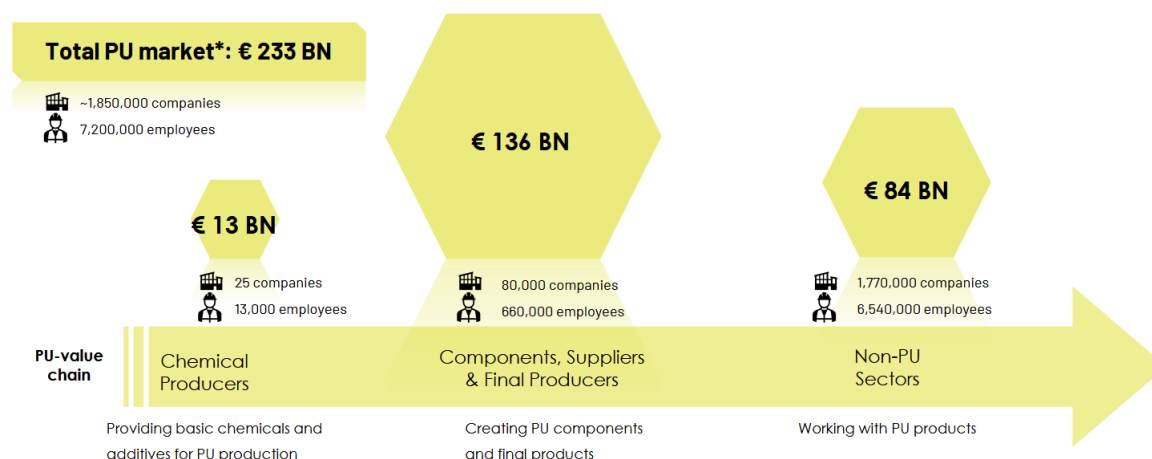
<sup>2</sup> [Europe Polyurethane \(PU\) Market Size Report, 2024](#)

<sup>3</sup> [ISOPA | European Polyurethane Industry Facts 2023](#)

<sup>4</sup> [Europe Polyurethane \(PU\) Market Size Report, 2024](#)

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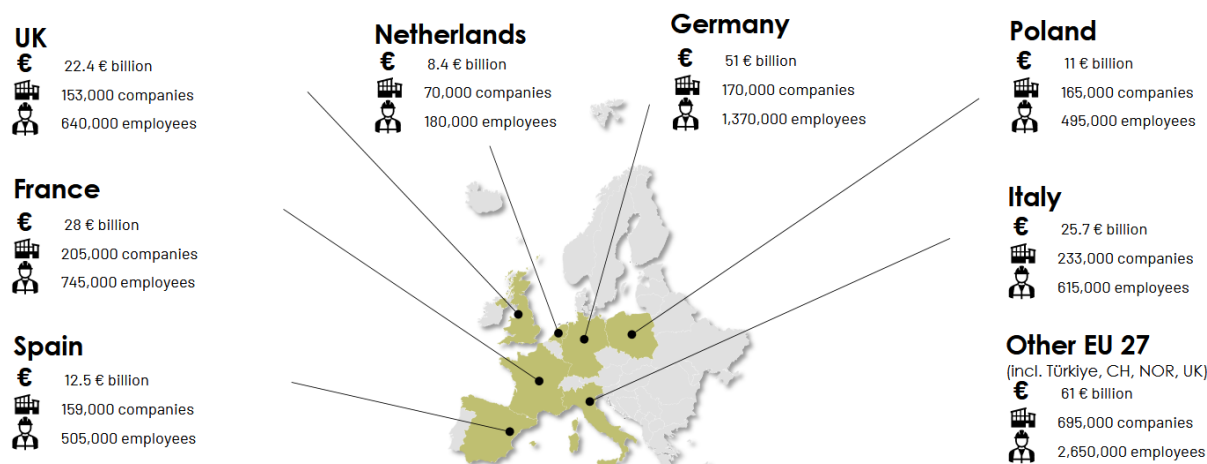
In terms of rigid PU foams, they contribute to 32% of the total volume of economic value added across all major PU materials. This part gives also employment to about 125,000 people in over 22,000 companies.



**FIGURE 2. TOTAL PU EUROPEAN MARKET OVERVIEW (2023).<sup>5</sup>**

The construction industry is a significant consumer of rigid polyurethane foams, driven by the material's excellent thermal insulation properties, which contribute to energy-efficient building solutions.<sup>6</sup>

Additionally, the refrigeration sector continues to expand, increasing demand for PUR foams in industrial and household appliances.



**FIGURE 3. POLYURETHANE INDUSTRY CREATED VALUE SPLIT BY COUNTRIES.**

In terms of regions the PU market can be divided as follows:

- Western Europe remains the dominant producer, with countries like Germany, France, and Spain leading the market.
- Eastern Europe is experiencing moderate growth, with Poland and Hungary attracting investments in PU foam manufacturing.
- The Netherlands is experiencing growth driven by sustainability initiatives and investments in high-performance insulation materials.

The European polyurethane industry faces increasing pressure to enhance sustainability. Key developments include:

<sup>5</sup> [ISOPA | European Polyurethane Industry Facts 2023](#)

<sup>6</sup> [Rigid Polyurethane Foam Market Trends](#)

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- Expansion of mechanical recycling efforts, with Germany, The Netherlands, and France leading in PUR foam waste repurposing.
- Growth of chemical recycling, including projects like Repsol's polyurethane foam recycling plant in Spain, targeting recycled polyols annually.
- EU regulations promoting circular economy strategies, encouraging manufacturers to integrate recycled polyols into new PUR foam products.

Today, polyurethane producers are obliged to meet certain environmental requirements. The main objective at the production stage is to keep production waste to a minimum. When recycling PUR from construction waste, the most common method is to use it to produce prefabricated building components. Unfortunately, buildings are still mostly constructed with new materials and prefabricated elements from waste can be used in some elements. PU foams can be recycled in two ways – manually or chemically. In the manual method PU waste is in its polymeric form and is shredded to be reused e.g., in applications such as insulation and acoustic mats, insulation panels, prefabricated construction elements, mattresses and carpets, etc. In the chemical method, the PU waste is decomposed into chemical components that can be used to create polyurethane for the original application.<sup>7</sup> The recycling of PU waste has gained importance globally in recent years. This is due to the depletion of fossil fuel resources and the limited space available for landfilling.

At present, mechanical recycling of PU consists mainly in breaking down waste fragments into granules or powder for subsequent use as fillers or additives in other products. Unfortunately, the resulting materials are of low value. Therefore, mechanical recycling of PU is still estimated to be low, at only about 10%. The rest ends up in landfills.<sup>8</sup> It is still the most common way to treat the polyurethane waste, and it is related to almost 50% of PU waste.<sup>9</sup> In case of chemical recycling of PU foams, it is still developing in Europe. In 2021 Repsol announced their project of construction of big polyurethane foam recycling plant in Spain joining forces with Rampf Eco Solutions<sup>10</sup>, that is planned to be ready by the end of 2022. It is planned to process 2,000 tonnes of external waste annually and obtaining 5,000 tonnes of polyols per year.<sup>11</sup> <sup>12</sup> In case of recycling of PU from mattresses, in 2021 The Netherlands was the leader in its mechanical and chemical recycling. It is performed by companies like RetourMatras and Recticel (mechanical recycling), but also Dowhas (chemical recycling).<sup>13</sup>

In conclusion, the European rigid polyurethane foam market is poised for steady growth, bolstered by rising demand in construction and refrigeration sectors. Sustainability efforts and regulatory frameworks will shape the future landscape, driving innovation in recycling and material efficiency.

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<sup>7</sup> [Plastics Europe](#)

<sup>8</sup> [Recycling Magazine "Chemical recycling of polyurethane waste"](#)

<sup>9</sup> [Polymers | Free Full-Text | Polyurethane Recycling and Disposal: Methods and Prospects | HTML \(mdpi.com\)](#)

<sup>10</sup> [Repsol, Rampf Eco Solutions Partner to Boost Polyurethane Recycling | plasticstoday.com](#)

<sup>11</sup> [Chemical recycling of polyurethane foam \(repsol.com\)](#)

<sup>12</sup> [Spain gets polyurethane foam recycling plant - RECYCLING magazine \(recycling-magazine.com\)](#)

<sup>13</sup> [The Netherlands: a world-leader in mattress recycling | Europur](#)

### 3 Methodology

This study implements a multi-step approach to identify, analyse, and evaluate potential business opportunities for advancing the circular economy of rigid polyurethane (PUR) hard foam recycling within the scope of the CIRCULAR FOAM project. The methodology combined regional analysis, stakeholder engagement insights, and business modelling frameworks to generate a comprehensive view of viable pathways across the value chain.

The analysis was guided by three primary dimensions: market readiness, regional suitability, and implementation feasibility. The opportunities were analysed through a comparison across the three regions participating in the project: Rheinisches Revier (Germany), Amsterdam Metropolitan Area (Netherlands), and Metropolis GZM (Poland).

The investigation followed these methodological steps:

#### 1. Identification of business opportunities

Potential opportunities were derived from a synthesis of project documents, public policy frameworks (EU Green Deal, EPR, DPP), circular economy literature, and consultation findings within the consortium. Emphasis was placed on system gaps, material flows, and intervention points along the PUR recycling value chain.

#### 2. Regional suitability assessment

Each opportunity was assessed against contextual criteria such as industrial capacity, stakeholder ecosystem maturity, infrastructure availability, policy alignment, and logistical feasibility in the three regions.

#### 3. Business model development

The Business Model Canvas was used to systematically describe each opportunity's value creation, delivery, and capture mechanisms. Key partners, activities, value propositions, customer segments, channels, and financial elements were developed based on realistic assumptions grounded in current market conditions.

#### 4. SWOT analysis

A structured SWOT (Strengths, Weaknesses, Opportunities, Threats) framework was applied to each opportunity to identify internal capabilities and external conditions that could influence success. This analysis helped clarify risks, barriers, and enablers for implementation.

#### 5. Risk assessment

Specific risks associated with each business model were studied, including technological uncertainty, regulatory complexity, economic viability, and market acceptance. In addition to general risk identification, each opportunity was assessed from an investor's perspective to evaluate the viability of private or blended capital involvement.

#### 6. Synthesis and prioritization

Finally, a comparative synthesis was conducted to evaluate which opportunities present the highest potential for success and alignment with the CIRCULAR FOAM consortium's capabilities. This informed the final recommendation on sequencing and prioritization for implementation.

This methodology ensured that each business opportunity was evaluated not only on its theoretical potential but also on its practical fit within the current and evolving landscape of PUR recycling in



Europe. The use of widely accepted analytical tools, region-specific data, and investment-oriented perspectives supports the relevance and applicability of the findings for strategic decision-making, financing, and future piloting.



## 4 New Business Opportunities

In the chapter the results of investigation of the new business opportunities in the regional systems for PUR hard foam recycling.

### 4.1 Opportunity 1: Regional Closed-Loop Recycling Hubs for PUR Waste

The first major opportunity identified within the CIRCULAR FOAM project is the development of regional closed-loop recycling hubs that manage the full lifecycle of polyurethane (PUR) hard foam, from collection and sorting to recycling and reintegration into manufacturing. Currently, while collection systems for refrigerators and construction waste exist in the project’s target regions – Amsterdam Metropolitan Area (Netherlands), Rheinisches Revier (Germany), and the Metropolis GZM (Poland) – most of the PUR hard foam is still being sent to incineration.<sup>14</sup> There is no dedicated, regionally integrated infrastructure that supports the circular processing of the waste PUR hard foam.

This opportunity addresses the pressing need to build a functioning value chain for PUR recycling, particularly through chemical recycling, which is becoming increasingly relevant as mechanical methods are unsuitable for many PUR applications.<sup>15</sup> By closing material loops locally, these hubs can reduce dependency on fossil-based raw materials, cut CO<sub>2</sub> emissions, and support EU circular economy objectives, including recycling rate and digital product passports.<sup>16 17</sup>

**TABLE 1. REGIONAL SUITABILITY ASSESSMENT – OPPORTUNITY 1.**

Region	Sustainability	Justification
Rheinisches Revier (Germany)	High	<ul style="list-style-type: none"> <li>- Presence of downstream chemical plants</li> <li>- Industrial land, skilled labour, and logistics support</li> <li>- High influence of regulation and subsidies (per FCM)</li> <li>- Opportunity to collocate with existing chemparks</li> </ul>
Amsterdam Metropolitan Area (Netherlands)	Moderate to High	<ul style="list-style-type: none"> <li>- Strong in logistics and dismantling, ideal to channel sorted materials to treatment hubs</li> <li>- Social and political will for waste reduction</li> <li>- Missing link between dismantling and chemical processing</li> </ul>
Metropolis GZM (Poland)	Moderate	<ul style="list-style-type: none"> <li>- Has collection and processing capacity but fragmented structure</li> <li>- Technical capability exists, but coordination and investment are barriers</li> <li>- Needs stronger industrial leadership to operate efficiently</li> </ul>

From a regional perspective, Rheinisches Revier in Germany offers the strongest foundation for implementing such a hub due to its proximity to major chemical facilities (e.g. Covestro), strong industrial infrastructure, and policy alignment under the Nationale Circular Economy Strategy (NKWS). Amsterdam presents an ideal setting for logistics coordination and stakeholder mobilization, with a dense

<sup>14</sup> [CIRCULAR FOAM, D1.1](#)

<sup>15</sup> [PlasticsEurope, 2021](#)

<sup>16</sup> [EU Circular Economy Action Plan, 2020](#)

<sup>17</sup> [European Green Deal, 2019](#)



ecosystem of dismantling companies and strong societal support for circular solutions.<sup>18</sup> Metropolis GZM has the technical potential, with all necessary actors located within 200 km of Katowice, but lacks integrated governance and clear leadership, making it more suitable for phased implementation or partnership with international operators.<sup>19</sup>



FIGURE 4. BUSINESS MODEL – OPPORTUNITY 1.

The business model for these hubs revolves around integrating existing waste flows with regional treatment and recycling capacity, generating value through the sale of recycled PUR, waste processing services, and compliance with environmental standards. Potential customers include manufacturers of insulation and white goods, municipalities engaged in green procurement, and public authorities seeking to fulfil EU recycling mandates.<sup>20</sup>

<p><b>Strengths (S)</b></p> <ul style="list-style-type: none"> <li>• Strong policy support at EU and national level</li> <li>• Established waste logistics (e.g., in Amsterdam and Metropolis GZM)</li> <li>• Proximity to chemical industry (Rheinland)</li> <li>• Technological feasibility with chemical recycling</li> </ul>	<p><b>Weaknesses (W)</b></p> <ul style="list-style-type: none"> <li>• Low consumer awareness of PUR foam</li> <li>• High initial investment required</li> <li>• Lack of alliances and focus on PUR</li> <li>• Uncertain profitability without policy support</li> </ul>
<p><b>Opportunities (O)</b></p> <ul style="list-style-type: none"> <li>• Government subsidies and procurement mandates</li> </ul>	<p><b>Threats (T)</b></p> <ul style="list-style-type: none"> <li>• Regulatory delays or inconsistent implementation</li> </ul>

<sup>18</sup> [Amsterdam Circular Strategy, 2020](#)

<sup>19</sup> [CIRCULAR FOAM, D1.2](#)

<sup>20</sup> [Ellen MacArthur Foundation, 2017](#)

<ul style="list-style-type: none"> <li>• Expanding regulation (e.g., EPR, recycle quotas)</li> <li>• First-mover advantage in closed-loop PUR systems</li> <li>• Industry push for sustainability &amp; ESG (Environmental, Social &amp; Governance) goals</li> </ul>	<ul style="list-style-type: none"> <li>• Competition from cheaper virgin materials</li> <li>• Unclear market for recycled PUR</li> <li>• Public resistance to higher costs or disruptions</li> </ul>
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**FIGURE 5. SWOT ANALYSIS – OPPORTUNITY 1.**

A SWOT analysis reveals key strengths such as policy momentum, chemical recycling feasibility, and stakeholder interest. However, challenges include high upfront investment costs, low consumer awareness of PUR, and uncertainties in market demand for recycled materials. Despite these risks, the opportunity presents significant advantage, especially for first movers who can shape future market structures, secure regulatory support and lead the transition to circularity in the PUR sector.

**TABLE 2. RISK ANALYSIS – OPPORTUNITY 1.**

Risk type	Description	Likelihood	Impact	Mitigation strategy
Technical	Variability in feedstock quality affecting recycling output	Medium	Medium	Investing in robust preprocessing and sorting technology
Financial	High initial investment for hub infrastructure (€5-15M estimated)	High	High	Leverage EU grants (e.g. LIFE, Cohesion Fund), phased scaling
Market	Limited demand for recycled PUR due to buyer hesitance	Medium	Medium	Development of downstream offtake agreements, engage in early buyer education
Regulatory	Uncertainty around EoW criteria for PUR recycled material	Medium	High	Early consultation with environmental authorities and EU alignment
Operational	Coordination failure between municipalities and private sector	High	High	Establishment of governance model with clear roles and responsibilities

The key risks associated with this opportunity include systemic and coordination risks, as the value chain currently lacks dedicated structures and partnerships for PUR foam. Without effective regional collaboration, material flow gaps could emerge between collection, treatment, and recycling stages. Market risk is also significant – demand for recycled PUR is still developing, and end-users may be hesitant to switch without price incentives or regulatory pressure. Economic risk is present due to the initial investment required to integrate and manage regional actors, especially if economies of scale are not quickly achieved. Additionally, policy dependence is a major risk: the viability of these hubs is tied to the timely introduction of supportive EU and national regulations such as share of recycled materials or green procurement mandates. Lastly, logistical challenges, such as cross-border transport and quality consistency of input materials, may disrupt or raise the cost of operations.

For investors, regional recycling hubs present a medium- to high-risk opportunity with long-term strategic upside. The fragmented PUR value chain poses initial coordination and infrastructure challenges, but the model aligns well with public funding mechanisms and emerging policy trends. While returns may be delayed, hubs could serve as critical assets in a future circular economy market, especially if linked to municipal waste systems and EU climate targets. Investors should prioritize partnerships with

local authorities and anchor recyclers, and view returns in the context of impact metrics, regulatory alignment, and long-term market shaping rather than short-term financial gain.<sup>21 22</sup>

## 4.2 Opportunity 2: Establishment of Intermediate PUR Waste Treatment Facilities

A critical and currently overlooked opportunity in the PUR hard foam recycling chain lies in the development of intermediate treatment facilities. These facilities would serve as a missing bridge between existing waste collection and sorting systems and the chemical recycling plants that rely on clean, processed PUR input. While all three target regions have functioning networks of waste collection points, sorting centres, and final recycling destinations, they lack specialized treatment facilities to transform mixed and contaminated PUR foam into recyclable-grade material.<sup>23</sup>

At present, waste flows from appliances and the construction sector often reach sorting centres but are then diverted to incineration due to contamination, inconsistent quality, or logistical inefficiencies. This breaks the circularity loop and results in the loss of valuable materials and embedded carbon.<sup>24</sup> To address this bottleneck, intermediate treatment facilities would process collected PUR waste by removing non-foam components (e.g. plastic, metal, adhesives), performing controlled shredding and quality checks, and preparing standardized input for chemical recyclers. These facilities could operate as stationary industrial units or flexible mobile modules depending on local volumes and geographic context.

**TABLE 3. REGIONAL SUITABILITY ASSESSMENT – OPPORTUNITY 2.**

Region	Sustainability	Justification
Rheinisches Revier (Germany)	Very high	<ul style="list-style-type: none"> <li>- Proximity to Covestro and other chemical processors</li> <li>- Presence of multiple chemparks needing stable feedstock</li> <li>- Currently lacks intermediate purification capacity</li> <li>- Strong regional push for circular hubs (NKWS policy momentum)</li> </ul>
Amsterdam Metropolitan Area (Netherlands)	High	<ul style="list-style-type: none"> <li>- Advanced collection and sorting of appliances and construction waste</li> <li>- No dedicated PUR preprocessing facilities</li> <li>- Strong logistics and sustainability infrastructure</li> <li>- Government and society aligned with resource efficiency and waste reduction</li> </ul>
Metropolis GZM (Poland)	Moderate	<ul style="list-style-type: none"> <li>- Technically all value chain components exist but coordination is weak</li> <li>- Fragmented waste management landscape</li> <li>- Opportunity for investment-led model by international operators to fill the preprocessing gap</li> </ul>

Such an intervention would have a significant enabling effect: it would create stable, predictable feedstock streams, improve recycling efficiency, and support the growth of regional circular business models. Furthermore, it would generate green jobs in waste treatment and logistics and help meet rising

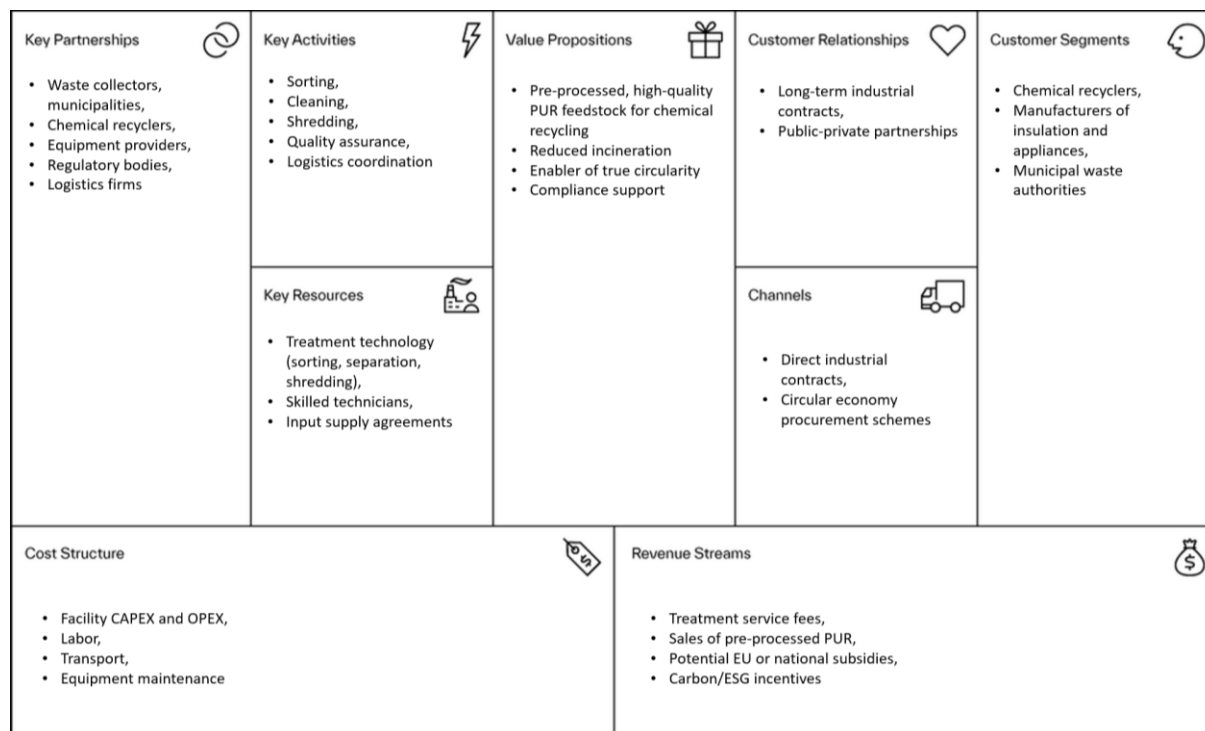
<sup>21</sup> [EU Circular Economy Action Plan, 2020](#)

<sup>22</sup> [European Circular Economy Stakeholder Platform](#)

<sup>23</sup> [EU Circular Economy Action Plan, 2020](#)

<sup>24</sup> [EEA, “Case for Increasing Recycling”, 2019](#)

regulatory demands related to material traceability, recycle quotas, and Extended Producer Responsibility (EPR).<sup>25</sup>



**FIGURE 6. BUSINESS MODEL – OPPORTUNITY 2.**

The proposed business model for intermediate treatment facilities is centred on providing value-added preprocessing services to waste collectors and chemical recyclers. These facilities would act as a processing-as-a-service platform: taking in collected PUR waste, upgrading its quality, and delivering a consistent output that meets the technical and safety requirements of downstream recyclers or manufacturers using secondary raw materials.

Key customers would include chemical recycling companies, insulation and appliance manufacturers, and municipalities needing to comply with circular procurement policies.<sup>26</sup> Revenue would be generated through a mix of processing fees, sales of pre-treated PUR material, and potentially public subsidies or carbon credit mechanisms for reducing incineration. Partnerships with local governments and waste companies would be crucial to securing consistent input supply.

The business model relies on several key resources: advanced sorting and shredding technology, trained operators, a regional logistics network, and long-term collaboration agreements. In early stages, EU funding, regional development grants, or private-public investment vehicles could support capital expenditures (CAPEX) and de-risk market entry.

<p><b>Strengths (S)</b></p> <ul style="list-style-type: none"> <li>Directly addresses a known gap in the PUR value chain</li> <li>Can standardize feedstock quality</li> <li>Supports regional circular hubs</li> </ul>	<p><b>Weaknesses (W)</b></p> <ul style="list-style-type: none"> <li>Capital intensive</li> <li>Lacks market visibility</li> <li>Dependence on sufficient, stable input volumes</li> </ul>
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<sup>25</sup> EEA, “A Framework for Enabling Circular Business Models”, 2021

<sup>26</sup> Europur, 2023

Opportunities (O)	Threats (T)
<ul style="list-style-type: none"> <li>• First-mover advantage in a niche market</li> <li>• Enables chemical recycling scalability</li> <li>• Creates skilled green jobs</li> <li>• Can attract policy support</li> </ul>	<ul style="list-style-type: none"> <li>• Uncertain demand from chemical recyclers in early phases</li> <li>• Risk of insufficient quality/quantity of incoming PUR waste</li> <li>• Long ROI periods</li> </ul>

FIGURE 7. SWOT ANALYSIS – OPPORTUNITY 2.

This opportunity benefits from clear strengths, including filling a critical infrastructure gap in the PUR recycling value chain and providing recyclers with clean, standardized input material. It supports circular economy goals and aligns with EU policy developments.<sup>27</sup> However, it faces weaknesses such as high initial investment requirements and a dependence on reliable waste supply and coordination with downstream recyclers. The opportunity is well-timed, offering first-mover advantage and access to public funding and ESG-driven demand. Yet, it also comes with threats including uncertain market maturity, potential competition from virgin materials, and inconsistent enforcement of recycling regulations.

TABLE 4. RISK ANALYSIS – OPPORTUNITY 2.

Risk type	Description	Likelihood	Impact	Mitigation strategy
Technical	Process optimization challenges for separating PUR from mixed waste streams	Medium	Medium	Adoption of proven mechanical separation systems and modular upgrades
Financial	Moderate CAPEX for intermediate sorting/shredding (€2-5M)	Medium	Medium	Co-financing via local waste authorities and recyclers
Regulatory	Permitting delays due to classification as waste treatment facility	High	Medium	Pre-consultation with regional environmental agencies
Market	Lack of reliable feedstock inflow due to informal disposal	Medium	Medium	Partnership with municipalities and construction firms for steady supply

Establishing intermediate treatment facilities for PUR hard foam carries several key risks that must be carefully managed. First, there is a financial risk due to the high capital expenditure needed for facility development, machinery, and skilled labour, which may be difficult to justify without guaranteed throughput or long-term contracts. Operational risks also arise from the dependence on consistent and sufficient input waste streams; if collection or sorting systems underperform or fluctuate, the facility may face underutilization. Additionally, there is a market risk: demand for recycled PUR is still uncertain, and the chemical recyclers that rely on these pre-treated inputs may not scale up fast enough to absorb supply. On a broader level, regulatory risk is present, as the success of such facilities heavily depends on clear and enforced policy frameworks around recycling mandates and incentives.<sup>28</sup> Finally, technology risk should be considered, particularly if evolving chemical processes outpace or render certain preprocessing approaches obsolete.

<sup>27</sup> [EU Circular Economy Action Plan, 2020](#)

<sup>28</sup> [EEA, “A Framework for Enabling Circular Business Models”, 2021](#)

From an investor perspective, financial and regulatory risks present the main investment barriers. Securing commitments from local government or waste authorities reduces CAPEX risk and ensures feedstock. Market risk can be addressed via offtake agreements. Regulatory uncertainty, particularly around recycled content mandates, is high impact but can be mitigated through early engagement with policymakers. Technology risk is moderate and manageable if treatment facilities are constructed modularly to adapt to future chemical recycling advancements.<sup>29</sup>

### 4.3 Opportunity 3: Pyrolysis-Based Recycling of PUR Hard Foam

Pyrolysis (thermo-chemical decomposition of polymers in absence of oxygen) has emerged as one of the few viable methods to process contaminated or mixed plastic streams that mechanical recycling cannot handle. For polyurethane hard foam (PUR), particularly from end-of-life appliances and construction, pyrolysis can yield pyrolysis oil or by-products that serve as feedstock for petrochemical or energy applications. Recent chemical recycling data show pyrolysis yields of around 70–80% for mixed plastics.<sup>30</sup> A preliminary LCA report from the CIRCULAR FOAM project shows that pyrolysis of PU rigid foam reduces environmental impacts across multiple categories, including significantly lowering climate change burden compared to incineration.

Despite industry enthusiasm – Europe has around 80 pyrolysis-based chemical recycling companies with a combined capacity of roughly 275 kt/year – leading actors like Shell have slowed commitments due to feedstock scarcity, high costs, and regulatory uncertainties. Critics warn that pyrolysis remains a long way from commercial maturity, with some projecting decades before economic viability.<sup>31</sup>

**TABLE 5. REGIONAL SUITABILITY ASSESSMENT – OPPORTUNITY 3.**

Region	Sustainability	Justification
Rheinisches Revier (Germany)	High	<ul style="list-style-type: none"> <li>- Strong industrial ecosystem and chemical clusters</li> <li>- Existing infrastructure and proximity to recyclers make it ideal for pyrolysis pilot or full-scale plants.</li> <li>- Aligned with NKWS policy</li> </ul>
Amsterdam Metropolitan Area (Netherlands)	Moderate to high	<ul style="list-style-type: none"> <li>- Logistical networks and innovation capacity exist,</li> <li>- Lack of local chemical infrastructure makes it more suited for pilot projects with feedstock aggregation and pyrolysis integration</li> </ul>
Metropolis GZM (Poland)	Moderate	<ul style="list-style-type: none"> <li>- REDCHEM in Poland is already piloting pyrolysis-based plastic recycling projects</li> <li>- Fragmented coordination and limited PUR-specific focus reduce readiness</li> </ul>

The regional suitability for implementing pyrolysis in PUR hard foam recycling varies across the three CIRCULAR FOAM project regions. Rheinisches Revier (Germany) stands out as the most suitable location due to its established chemical industry infrastructure, presence of Covestro and other key players, and strong regulatory and policy backing for circular technologies. Amsterdam Metropolitan Area (Netherlands) offers a robust collection and logistics system with strong political and societal support for circular solutions; however, its limited heavy industry footprint may restrict local pyrolysis deploy-

<sup>29</sup> [European Circular Economy Stakeholder Platform](#)

<sup>30</sup> [Chemical Recycling Europe FAQ](#)

<sup>31</sup> [Zero Waste Europe, 2023](#)

ment, making it better suited as a supply and coordination hub. Metropolis GZM (Poland) holds conditional potential with an integrated industrial landscape and proximity of key actors, but would require targeted investments, improved stakeholder coordination, and EU-backed initiatives to overcome current governance and market readiness challenges for pyrolysis implementation.

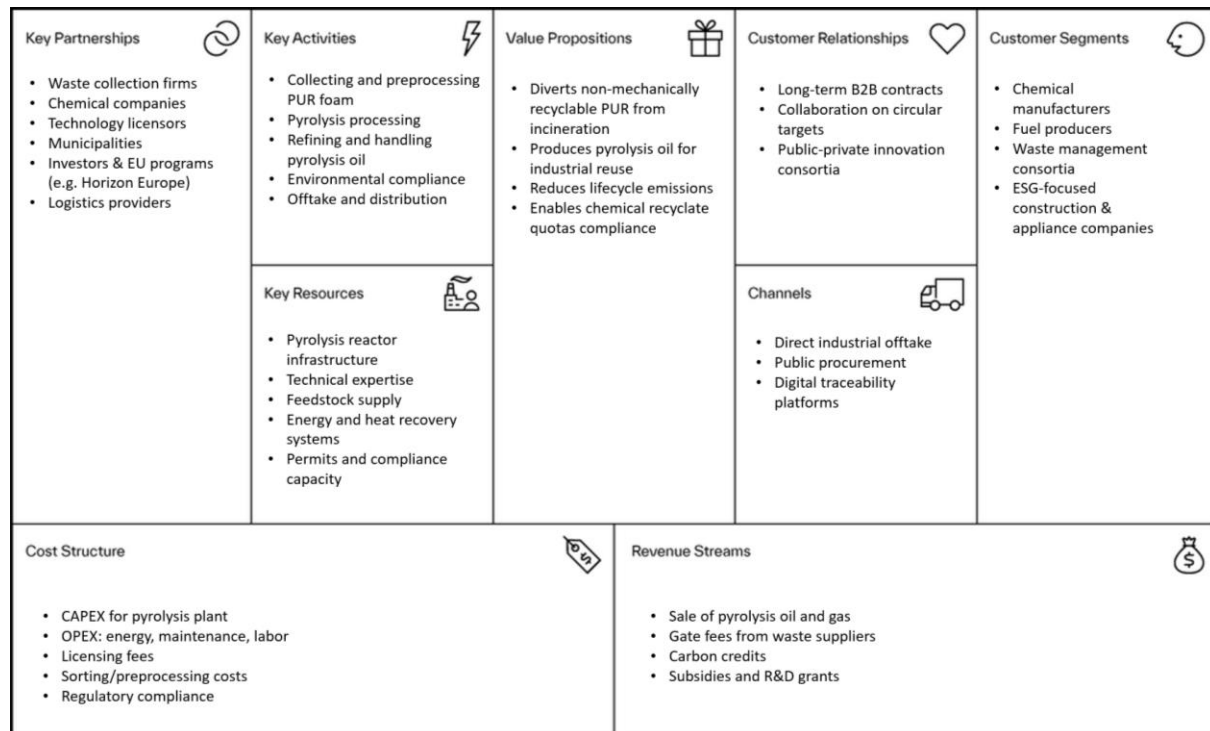


FIGURE 8. BUSINESS MODEL – OPPORTUNITY 3.

A pyrolysis business targeting PUR hard foam would establish a regional facility (or modular network) to process collected rigid foam waste via pyrolysis, converting it into pyrolysis oils and gases. The value proposition includes diverting difficult-to-recycle waste from incineration, creating secondary feedstocks to offset virgin fossil inputs, and lowering life-cycle GHG emissions. Key customers would be chemical companies, waste management firms, cogeneration power plants, and industrial buyers of pyrolysis oil or wax residues. Revenue streams would include feedstock processing fees, sales of oil/gas, and subsidies or carbon credit incentives aligned with EU circular economy policies. Key partners would be waste collectors, recyclers, local municipalities, chemical manufacturers, and tech licensors. Capital-intensive infrastructure, reliable feedstock, permits, and integration with downstream usage would be critical resources.

<p><b>Strengths (S)</b></p> <ul style="list-style-type: none"> <li>Converts contaminated or mixed PUR into valuable inputs</li> <li>Complements mechanical recycling and reduces incineration</li> <li>Demonstrated environmental benefit in preliminary LCA (lower emissions)</li> <li>Proximity to chemical parks enables integration and scale.</li> </ul>	<p><b>Weaknesses (W)</b></p> <ul style="list-style-type: none"> <li>High CAPEX and operational complexity</li> <li>Moderate yields (70–80%) mean inefficiency compared to solvolysis (~90%)</li> <li>Requires clean feedstock or preprocessing; residual chlorine from flame retardants complicates processing</li> </ul>
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Opportunities (O)	Threats (T)
<ul style="list-style-type: none"> <li>Increasing EU push for chemical recycling investment (€7 billion projected by 2030)</li> <li>Complementary to developments in solvolysis and supercritical-water methods (e.g. Mura/HydroPRS)</li> <li>First-mover advantage in regional PUR pyrolysis niche.</li> </ul>	<ul style="list-style-type: none"> <li>Regulatory ambiguity around mass-balance accounting and end-of-waste status for pyrolysis-derived oils</li> <li>Public scrutiny or backlash if technology fails to deliver environmental benefits (greenwashing risk)</li> <li>Volatile market: competition from cheap virgin feedstocks and energy-intensive processing.</li> </ul>

FIGURE 9. SWOT ANALYSIS – OPPORTUNITY 3.

The pyrolysis opportunity presents a strong technical advantage by enabling the processing of contaminated or mixed PUR foams that are otherwise incinerated, making it a strategic complement to mechanical and chemical recycling. It aligns with circular economy goals and provides a unique value proposition in producing secondary raw materials like pyrolysis oil. The approach fits well within industrial regions such as Rheinisches Revier, where chemical infrastructure exists. However, it is also technically complex and capital-intensive, with moderate yield efficiency and a need for clean feedstock to avoid toxic emissions. Regulatory uncertainty about product classification and recycled material recognition remains a major risk, along with volatile markets and public scepticism of chemical recycling. Overall, while high-risk, the opportunity offers long-term strategic value and first-mover advantage in a niche recycling space if executed with careful risk mitigation and strong stakeholder alignment.

TABLE 6. RISK ANALYSIS – OPPORTUNITY 3.

Risk type	Description	Likelihood	Impact	Mitigation strategy
Technical	Toxic byproducts due to flame retardants in PU foams	High	High	Pre-cleaning feedstock; advanced gas scrubbing systems
Financial	High CAPEX (€10-20M per unit), long Return of Investment horizons	High	High	Secure Innovation Fund, de-risk with PPAs or long-term offtake deals
Regulatory	Lack of clarity on classification of pyrolysis oil as recyclate	High	High	Engagement with EU taxonomy and mass-balance negotiations
Market	Volatile demand for pyrolysis oil and by-products	Medium	Medium	Diversification of product output; linking with hydrogen/renewable energy applications

The main risks stem from technical, financial, and regulatory uncertainties. Technically, pyrolysis yields vary depending on contamination and presence of flame-retardants in rigid PU foam, which may generate toxic byproducts and require complex gas cleanup systems (e.g. chlorine compounds). Financially, substantial upfront investment is required for reactors, permits, and energy integration, and profitability depends on stable offtake agreements and access to subsidies. There is also operational risk related to feedstock variability and plant uptime. Regulatory risk is present: EU rules on recognition of chemical recycling, mass-balance claims, and acceptance of pyrolysis products in recycled materials

remain unresolved. Finally, environmental risk arises if the process proves more polluting than anticipated, undermining stakeholder confidence and provoking public opposition.<sup>32</sup>

From an investor’s perspective, these risks translate into significant capital exposure and uncertain return timelines, particularly given the early-stage maturity of pyrolysis for rigid PU foam. The absence of clear regulatory guidance on mass-balance crediting and recycling materials classification may delay market access or devalue outputs. Market uptake of recycled outputs depends heavily on downstream demand, policy incentives, and price competitiveness versus virgin alternatives. Therefore, investors will expect strong technology validation, secured feedstock contracts, long-term offtake agreements, and ideally co-financing through EU innovation programmes or green bonds. Projects that demonstrate environmental compliance, community acceptance, and scalability within evolving regulatory frameworks are more likely to be seen as investable and resilient over time.<sup>33 34</sup>

#### 4.4 Opportunity 4: Digital Platforms for PUR Waste Tracking and Reverse Logistics

One of the major barriers to effective PUR recycling is the lack of transparency and coordination across the value chain. Developing a digital platform to monitor, document, and optimize the flow of PUR-containing materials – from collection and dismantling to preprocessing, recycling, and reintegration – can address this fragmentation. Such a platform could serve as a central tool to align stakeholders, reduce material loss, and improve the economic and environmental efficiency of reverse logistics. Features could include real-time tracking, digital product passports, blockchain-based chain-of-custody certification, and data dashboards for stakeholders. The approach directly aligns with EU circular economy mandates, including digitization goals under the Circular Economy Action Plan and upcoming requirements from the Eco-design for Sustainable Products Regulation (ESPR) that mandate product-level traceability via digital product passports.<sup>35</sup>

**TABLE 7. REGIONAL SUITABILITY ASSESSMENT – OPPORTUNITY 4.**

Region	Sustainability	Justification
Amsterdam Metropolitan Area (Netherlands)	High	- Strong digital infrastructure and high digitalization readiness. - Government and private actors are experienced in circular economy initiatives and logistics.
Rheinisches Revier (Germany)	Moderate to high	- Industrially advanced with digital pilot projects in logistics and manufacturing. - EU policy alignment is strong, but platform uptake may require coordination.
Metropolis GZM (Poland)	Moderate	- Waste collection and processing systems are present but fragmented. - Digital infrastructure exists, yet stakeholder integration and adoption could be slower.

In terms of regional suitability, the Amsterdam Metropolitan Area is best positioned to pilot and develop such a platform due to its high digitalization level, progressive circular economy policies, and

<sup>32</sup> [Recycling Magazine, 2023](#)

<sup>33</sup> [Packaging Reporter](#)

<sup>34</sup> [Plastics Today](#)

<sup>35</sup> [European Circular Economy Stakeholder Platform](#)

experience in sustainability-related projects. Rheinisches Revier follows with strong industrial potential and a maturing digital ecosystem that could support broader implementation. Metropolis GZM in Poland, while possessing adequate digital infrastructure, may need to strengthen institutional coordination and stakeholder engagement before achieving full readiness for such a platform.

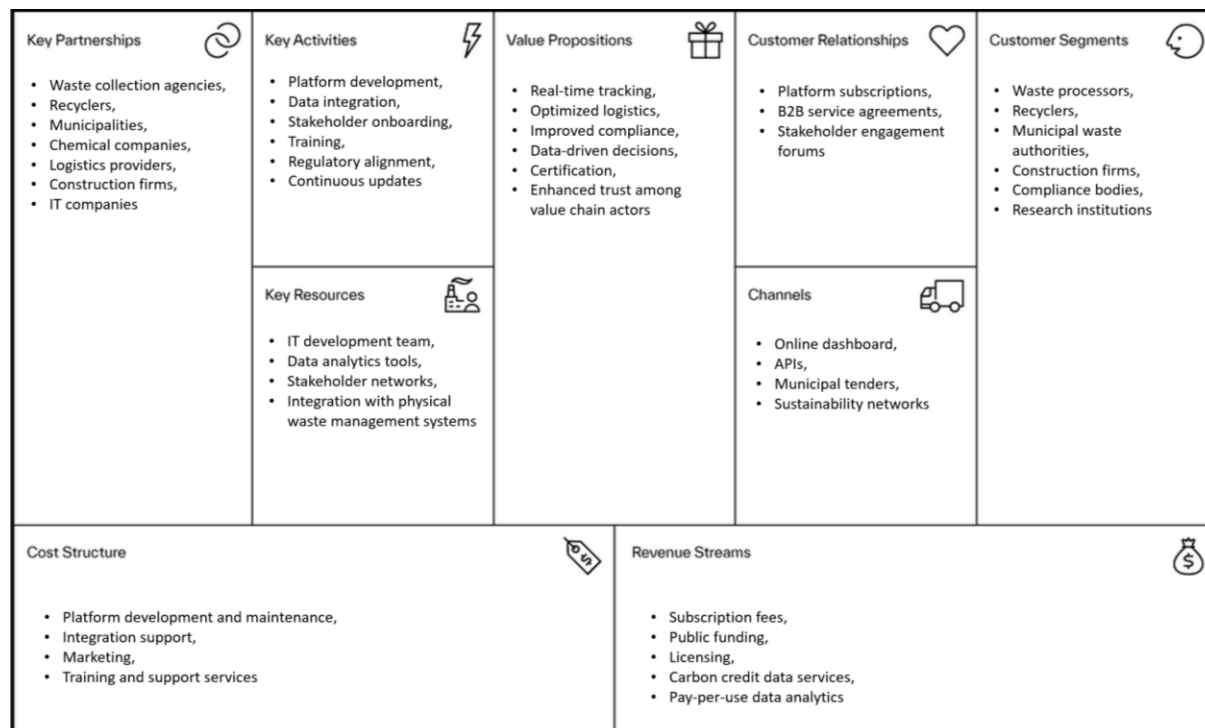


FIGURE 10. BUSINESS MODEL – OPPORTUNITY 4.

The core business model would be subscription-based, offering services such as digital traceability, compliance support, logistics optimization, and data analytics. Key customers would include municipal waste authorities, recyclers, construction firms, and chemical producers. Value is created through enhanced material traceability, data-driven decision-making, and improved regulatory compliance, with revenue generated via licenses, subscriptions, and public-private funding streams. Partnerships with logistics providers, chemical industries, municipalities, and IT firms are crucial for effective platform design and uptake.

<p><b>Strengths (S)</b></p> <ul style="list-style-type: none"> <li>Enables transparency and traceability across the value chain.</li> <li>Reduces logistical inefficiencies and material loss.</li> <li>Supports regulatory compliance (e.g. digital product passports).</li> <li>Scalable and adaptable to different regions and waste streams.</li> </ul>	<p><b>Weaknesses (W)</b></p> <ul style="list-style-type: none"> <li>High upfront development and integration costs.</li> <li>Requires active participation and data-sharing from diverse stakeholders.</li> <li>Difficult to standardize across regions with varying waste systems.</li> </ul>
<p><b>Opportunities (O)</b></p> <ul style="list-style-type: none"> <li>Growing EU focus on digital tools for circular economy (e.g., EPR, DPP).</li> </ul>	<p><b>Threats (T)</b></p> <ul style="list-style-type: none"> <li>Cybersecurity risks and data privacy concerns.</li> </ul>

<ul style="list-style-type: none"> <li>• Potential to expand platform to other plastics or waste types.</li> <li>• Strong alignment with smart city and green digital transformation agendas.</li> <li>• Creates data monetization and benchmarking opportunities.</li> </ul>	<ul style="list-style-type: none"> <li>• Resistance to change from traditional operators or fragmented systems.</li> <li>• Risk of underutilization if adoption is not widespread.</li> <li>• Dependence on public sector or regulatory enforcement to incentivize use.</li> </ul>
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**FIGURE 11. SWOT ANALYSIS – OPPORTUNITY 4.**

The opportunity’s strengths include enhanced transparency, regulatory alignment, scalability across materials and regions, and potential for data monetization. Weaknesses lie in the initial development costs, dependency on stakeholder cooperation, and fragmentation of existing waste systems. On the opportunity side, the platform fits EU digital and circular economy agendas, including mandates for interoperable Digital Product Passports. Threats include cybersecurity vulnerabilities, stakeholder resistance, and limited adoption without incentives or regulation. <sup>36</sup>

**TABLE 8. RISK ANALYSIS – OPPORTUNITY 4.**

Risk type	Description	Likelihood	Impact	Mitigation strategy
Operational	Stakeholder reluctance to share data	High	Medium	Implementation of access controls, incentivisation with analytics services
Technical	Interoperability issues with legacy systems	Medium	Medium	Using API-based modular design and EU-compliant standards
Financial	High initial development cost (€1-2M)	Medium	Medium	Blending of EU digitalization funds and subscription-based revenue model
Cybersecurity	Data breaches or integrity issues	Medium	High	End-to-end encryption, third-party audits, GDPR compliance

Developing and implementing a digital tracking platform for PUR waste comes with several risks. Operational risk is significant: the success of the platform hinges on the full cooperation of various stakeholders (waste managers, recyclers, municipalities, and manufacturers) who may resist adopting new systems or sharing proprietary data. Technical risk includes ensuring interoperability across existing infrastructure and databases, especially given the fragmented systems in regions like Metropolis GZM. Financial risk lies in the high development and scaling costs, which require external funding or long-term commercialisation to remain viable. Moreover, policy risk exists if digital product passport or EPR regulations are delayed or inconsistently enforced. Cybersecurity and privacy concerns could also limit trust in the platform, especially if not properly addressed from the outset. Lastly, if platform uptake remains low due to lack of awareness or incentives, the system may not deliver the intended environmental or economic benefits.

From an investor perspective, the main concern is whether the platform can achieve wide adoption and regulatory alignment in a fragmented market. The high upfront costs and dependency on stake-

<sup>36</sup> [Packaging Europe: Traceability guidelines, 2023](#)



holder engagement require clear monetisation strategies, early client commitments, and policy support. Demonstrated scalability, cybersecurity safeguards, and public co-funding will be critical to de-risking the investment.<sup>37 38</sup>

#### 4.5 Opportunity 5: Consumer Incentive Programs for Recycled PUR-Based Products

The development of consumer incentive programs targeting recycled PUR-based products represents a strategic opportunity to boost end-market demand and close the loop on circular value chains. Given that PUR hard foam recycling is still underdeveloped, increasing consumer interest and willingness to pay for products with recycled content, particularly in insulation and appliances, can stimulate investment and production. These programs could take the form of financial rebates, eco-vouchers, extended warranties, labelling schemes, or point-based rewards, aiming to make sustainable choices more accessible and attractive to the end-user.<sup>39</sup>

In terms of regional suitability, the Amsterdam Metropolitan Area offers the most promising environment for piloting such programs due to its environmentally conscious population, experience with sustainable consumption campaigns, and digitally advanced public services. Rheinisches Revier in Germany also shows potential, supported by regulatory momentum and eco-aware consumers, although stronger messaging may be needed to clarify the environmental benefits of recycled PUR foam. The Metropolis GZM region in Poland presents more significant challenges, where consumer awareness of PUR and circular economy issues is relatively low and price remains the dominant purchase driver. There, incentive schemes would need to be heavily supported by public institutions and accompanied by robust educational campaigns.<sup>40</sup>

**TABLE 9. REGIONAL SUITABILITY ASSESSMENT – OPPORTUNITY 5.**

Region	Sustainability	Justification
Amsterdam Metropolitan Area (Netherlands)	High	<ul style="list-style-type: none"> <li>- Environmentally aware consumers.</li> <li>- Strong digital infrastructure.</li> <li>- Policy leadership in sustainability, and existing frameworks for green consumer programs.</li> </ul>
Rheinisches Revier (Germany)	Moderate	<ul style="list-style-type: none"> <li>- Strong regulatory environment and industrial innovation potential.</li> <li>- Consumer engagement on recycled PUR is still developing and may require targeted awareness campaigns.</li> </ul>
Metropolis GZM (Poland)	Moderate	<ul style="list-style-type: none"> <li>- Consumers are highly price-sensitive, and awareness of PUR or circular plastics is low.</li> <li>- Implementation would need to be led by public sector with strong education and incentive backing to be effective.</li> </ul>

The business model would be focused on public-private collaboration, with manufacturers, retailers, and local governments co-financing reward systems or discount schemes for products containing recycled PUR. Key resources would include marketing platforms, consumer outreach networks, and data

<sup>37</sup> [Deloitte](#)

<sup>38</sup> [EU Circular Economy Action Plan, 2020](#)

<sup>39</sup> [Europur, “Resource Efficiency & Recycling”](#)

<sup>40</sup> [CIRCULAR FOAM, D1.2](#)

analytics to track adoption.<sup>41</sup> Revenue could come from increased sales volume, green public procurement contracts, or environmental performance-based subsidies. Value propositions would include environmental impact reduction, cost savings for consumers, and enhanced brand image for participating businesses.<sup>42</sup>

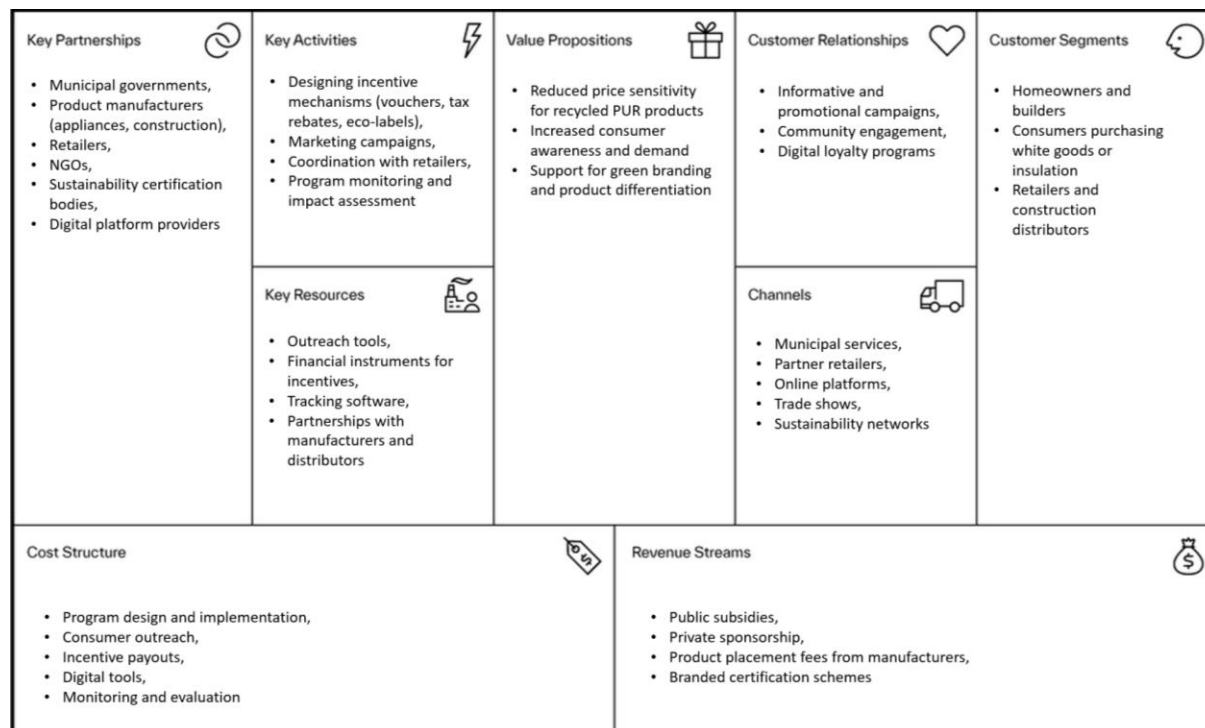


FIGURE 12. BUSINESS MODEL – OPPORTUNITY 5.

Considering the SWOT analysis, the opportunity’s strengths include high alignment with EU circular economy goals, potential for strong public visibility, and the ability to accelerate consumer-driven market transformation. Its weaknesses involve low baseline awareness of PUR foam and its recycling among consumers, as well as the relatively low perceived value of recycled content unless well-communicated. Opportunities lie in leveraging digital product passports, ESG reporting trends, and evolving consumer preferences.<sup>43</sup> However, threats include budget limitations for incentive schemes, greenwashing concerns if standards aren’t clear, and the possibility of low uptake in price-sensitive markets without robust promotion.

<b>Strengths (S)</b> <ul style="list-style-type: none"> <li>Encourages circular demand pull rather than relying only on supply-side solutions</li> <li>Enhances public awareness of circular economy and PUR-based materials</li> <li>Can be adapted across product categories (construction, refrigeration, etc.)</li> <li>Aligns with green public procurement and EU circular targets</li> </ul>	<b>Weaknesses (W)</b> <ul style="list-style-type: none"> <li>Needs significant upfront funding or political will</li> <li>Hard to measure direct impact on recycling rates</li> <li>Relies heavily on consumer trust and product availability</li> <li>May be ineffective without simultaneous regulation or pricing mechanisms</li> </ul>
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<sup>41</sup> [European Circular Economy Stakeholder Platform](#)

<sup>42</sup> [EU Circular Economy Action Plan, 2020](#)

<sup>43</sup> [Packaging Europe: Traceability guidelines, 2023](#)

Opportunities (O)	Threats (T)
<ul style="list-style-type: none"> <li>• Ties in with digital product passports and eco-labelling initiatives</li> <li>• Supported by EU consumer engagement policies and environmental incentives</li> <li>• Can attract ESG-driven manufacturers and investors</li> <li>• Facilitates brand differentiation for early movers</li> </ul>	<ul style="list-style-type: none"> <li>• Public resistance to perception of green-washing if products aren't truly sustainable</li> <li>• Market fatigue or lack of participation if incentives are too low or complex</li> <li>• Risk of rebound effects (e.g., more consumption under "green" justification)</li> <li>• Potential pushback from manufacturers if costs increase</li> </ul>

FIGURE 13. SWOT ANALYSIS – OPPORTUNITY 5.

Risks involve the reliance on consumer behaviour, which is inherently variable and often cost-driven, especially in the construction and appliance sectors. A lack of understanding of PUR materials or visible benefits from recycled content could result in limited engagement unless clear, targeted messaging is applied. There's also the operational risk that incentive schemes may be underfunded, inconsistently implemented, or fail to coordinate well across regions. Furthermore, if labelling or verification mechanisms are weak, trust in recycled PUR-based products may be compromised, undermining long-term impact.

TABLE 10. RISK ANALYSIS – OPPORTUNITY 5.

Risk type	Description	Likelihood	Impact	Mitigation strategy
Market	Low consumer awareness or interest in recycled PUR products	High	Medium	Targeted campaigns, labelling schemes, retailer partnerships
Financial	Funding burden for rebates/incentives	High	Medium	Combination with ESG branding budgets and government subsidies
Operational	Inconsistent implementation across regions	Medium	Medium	Centralized coordination and KPI-based monitoring
Strategic	Perceived greenwashing without credible standards	Medium	High	Third-party certification, transparency in lifecycle claims

This opportunity presents a low-barrier entry point for impact-driven investors, particularly those aligned with ESG goals or consumer brand enhancement. While financial returns are indirect, consumer incentive schemes, such as rebate programs, eco-label campaigns, and take-back bonuses build early market traction for recycled PUR and support regulatory alignment. The key risk lies in behavioural unpredictability and fragmented uptake, which can limit scalability. To mitigate this, investors should prioritize pilots tied to trusted brands, measurable impact KPIs, and co-funding from public or corporate ESG budgets.<sup>44 45</sup>

<sup>44</sup> [Ellen MacArthur Foundation](#)

<sup>45</sup> [McKinsey & Company, 2023](#)

## 4.6 Opportunity 6: High-Performance Building Insulation Using Recycled PUR

There is currently little focus on circular economy applications for materials like PUR in the building sector. Most insulation materials (including PUR foam) are discarded through incineration after use, especially from construction waste. The market is dominated by conventional insulation products such as mineral wool and polystyrene, with limited availability of circular, recycled alternatives. Chemical recycling of PUR is still emerging, and there is a clear gap in converting recovered PUR into new high-performance products.<sup>46</sup>

The EU’s evolving regulatory landscape, including recycling rate, the Circular Economy Action Plan, and the Renovation Wave, will drive demand for sustainable construction materials.<sup>47</sup> Green building certifications (e.g. BREEAM, LEED), public procurement standards, and carbon footprint reduction targets are likely to increase pressure on the building materials industry to adopt low-emission, circular products. Recycled PUR insulation, if it meets performance criteria, could be positioned as a premium sustainable solution.

**TABLE 11. REGIONAL SUITABILITY ASSESSMENT – OPPORTUNITY 6.**

Region	Sustainability	Justification
Rheinisches Revier (Germany)	High	<ul style="list-style-type: none"> <li>- Industrial base and chemical industry presence support manufacturing</li> <li>- Regional policy (NKWS) aligns with circular and sustainable construction</li> <li>- Active in chemical recycling R&amp;D</li> <li>- Strong potential for innovation partnerships</li> </ul>
Amsterdam Metropolitan Area (Netherlands)	Moderate to high	<ul style="list-style-type: none"> <li>- Strong policy environment and green building push</li> <li>- High construction activity and circular economy awareness</li> <li>- Service-oriented economy limits manufacturing base, but strong R&amp;D and public sector engagement</li> </ul>
Metropolis GZM (Poland)	Moderate	<ul style="list-style-type: none"> <li>- Technical capability exists, and construction sector is large</li> <li>- Fragmented local governance and slower circular economy adoption</li> <li>- Chemical recycling mentioned in national plans, but limited implementation to date</li> </ul>

In terms of regional suitability, Rheinisches Revier offers the most comprehensive ecosystem for development and scaling, Amsterdam is well suited for market development and piloting, and Metropolis GZM could be a strategic future manufacturing location if stakeholder engagement improves.<sup>48</sup>

The proposed business model focuses on transforming recycled PUR into certified, high-performance insulation products for the construction sector. By partnering with recyclers and manufacturers, the model delivers eco-friendly alternatives to conventional insulation, with value stemming from regulatory compliance, carbon footprint reduction, and green procurement appeal. It targets both public and

<sup>46</sup> [Plastics Europe, 2019](#)

<sup>47</sup> [EU Circular Economy Action Plan, 2020](#)

<sup>48</sup> [CIRCULAR FOAM, D1.3](#)

private developers through direct and indirect sales channels and aims to monetize sustainable performance through premium pricing and possible subsidies.<sup>49</sup>

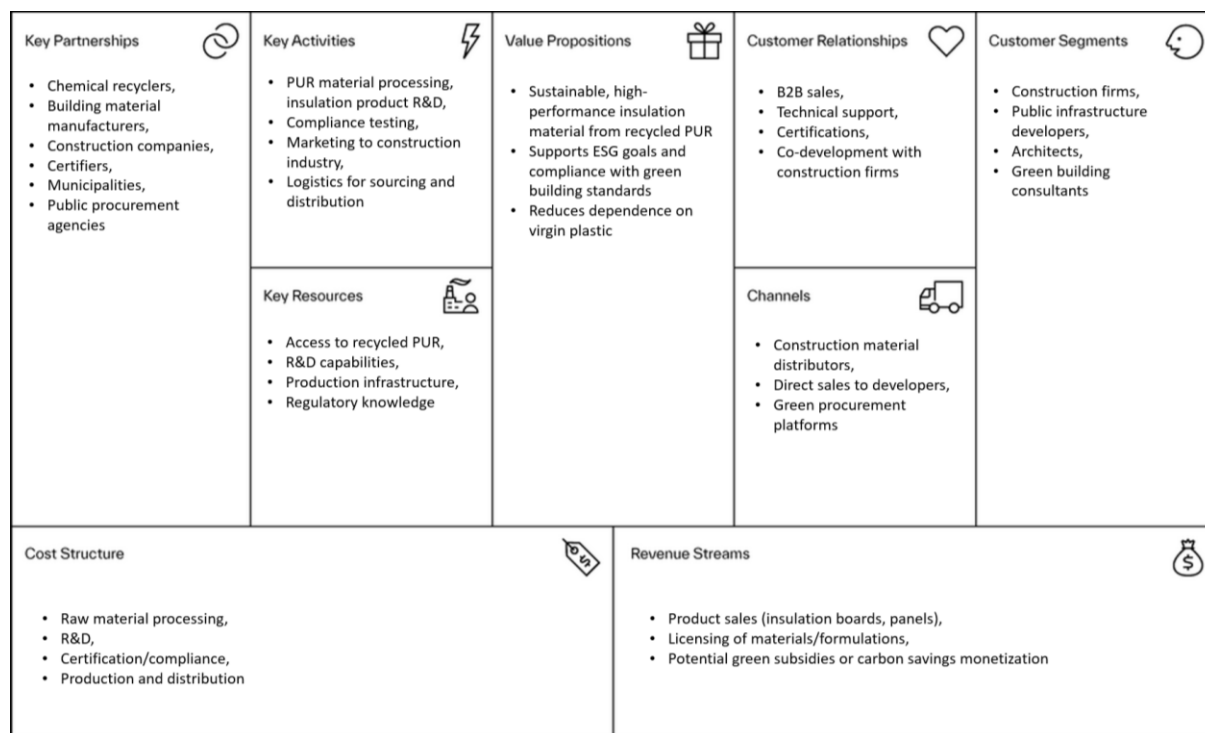


FIGURE 14. BUSINESS MODEL – OPPORTUNITY 6.

The opportunity is strong in terms of policy alignment, innovation potential, and value creation from waste. The product fits rising demand for sustainable building materials and supports the EU’s circular and climate goals. However, weaknesses include limited market awareness, technical challenges in matching the performance of traditional insulation, and dependency on a stable supply of recycled PUR. Opportunities exist in public procurement, green certification markets, and innovation funding. Yet threats include strict construction regulations, competition from entrenched alternatives, and a lack of recycled materials supply chain maturity.<sup>50</sup>

<b>Strengths (S)</b> <ul style="list-style-type: none"> <li>Aligns with EU sustainability goals and recycle content requirements.</li> <li>Reduces reliance on virgin materials and cuts carbon emissions.</li> <li>Offers high thermal performance potential of PUR foam.</li> <li>Addresses a current circularity gap for plastics like PUR foam.</li> </ul>	<b>Weaknesses (W)</b> <ul style="list-style-type: none"> <li>Requires extensive testing and certification to meet construction standards.</li> <li>Limited current awareness and trust in recycled PUR products.</li> <li>High production costs may challenge competitiveness with traditional insulation.</li> <li>Inconsistent availability of high-quality recycled PUR input material.</li> </ul>
<b>Opportunities (O)</b>	<b>Threats (T)</b>

<sup>49</sup> [EU Climate Pact](#)

<sup>50</sup> [Smart Cities Information Systems](#)



<ul style="list-style-type: none"> <li>• Growing demand for sustainable building materials in green construction.</li> <li>• Public procurement policies and ESG reporting can drive early adoption.</li> <li>• Innovation funding and subsidies available at EU and national levels.</li> <li>• Potential for product differentiation through eco-labels or digital product passports.</li> </ul>	<ul style="list-style-type: none"> <li>• Strict building codes may limit market entry or require long approval cycles.</li> <li>• Competition from established insulation materials (e.g., mineral wool, cellulose).</li> <li>• Policy delays in mandating recycled content or circular procurement.</li> <li>• Consumer price sensitivity may limit willingness to pay a premium.</li> </ul>
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FIGURE 15. SWOT ANALYSIS – OPPORTUNITY 6.

The most pressing risks include technical and regulatory compliance risks, as building insulation materials must meet strict standards (e.g. fire safety, thermal efficiency). Failure to certify products can delay or prevent market entry. There’s also a market acceptance risk, with possible resistance from contractors or developers who favour established materials. The economic risk is linked to the cost of converting recycled PUR into high-performance products and achieving price competitiveness. Moreover, supply chain dependency on consistent, high-quality recycled PUR remains a challenge. Finally, policy timing risks may slow uptake if “green procurement” and recycle mandates are delayed or inconsistently applied.

TABLE 12. RISK ANALYSIS – OPPORTUNITY 6.

Risk type	Description	Likelihood	Impact	Mitigation strategy
Technical	Difficulty achieving thermal/fire standards with recycled content	Medium	High	R&D investments, partner with certified labs
Regulatory	Long certification process for building materials	Medium	High	Early testing under national construction norms
Market	Construction sector conservatism toward new materials	High	Medium	Work with green building certifiers and lead developers
Financial	High cost of PUR purification and reprocessing	Medium	Medium	Blending with subsidies, focus on premium markets (LEED, BREEAM buildings)

From an investor perspective, this opportunity lies at the intersection of green innovation and construction, making it attractive for ESG-aligned capital. However, risks are concentrated in the certification phase and the scaling of cost-efficient manufacturing. These may delay time-to-market and revenue recognition. Mitigating these risks requires strong technical partnerships, early engagement with building regulators, and targeting premium or public sector building projects with sustainability mandates. Returns may be slower but potentially stable once technical credibility is established, and regulatory alignment is achieved.<sup>51 52</sup>

<sup>51</sup> [European Commission - Construction](#)

<sup>52</sup> [MAPFRE Global Risks](#)

## 4.7 Opportunity 7: Securing Public Funding for PUR Waste Recycling

Public funding is increasingly pivotal to enable large-scale chemical recycling investments. The EU and member states are supporting circular economy infrastructure via instruments such as the LIFE programme, Horizon Europe, EU Innovation Fund, and national state-aid schemes for chemical recycling projects. France, for example, has secured EC approval for a €500 million state aid scheme that covers up to 40% of eligible costs for chemical recycling plants.<sup>53</sup> Plastics Europe estimates planned chemical recycling investment in Europe will grow from €2.6 billion in 2025 to €8 billion by 2030.<sup>54</sup> These trends indicate growing financial support and regulatory momentum that could be leveraged for region-specific PUR recycling initiatives.

Germany’s Rheinisches Revier is particularly well-positioned to access public funding given its existing industrial and policy support infrastructure. The Amsterdam Region also offers strong potential, with innovation-oriented governance and municipal capabilities to channel EU and national funds into circular plastics projects. Metropolis GZM (Poland) holds moderate suitability: large volumes of PUR waste exist, and national recovery plans allocate resources for circular infrastructure, but fragmented governance may require tailored approaches for funding uptake.

**TABLE 13. REGIONAL SUITABILITY ASSESSMENT – OPPORTUNITY 7.**

Region	Sustainability	Justification
Rheinisches Revier (Germany)	High	<ul style="list-style-type: none"> <li>- Strong alignment with national circular economy policy (NKWS)</li> <li>- Existing industrial ecosystem</li> <li>- Track record in EU financing for chemical recycling projects</li> </ul>
Amsterdam Metropolitan Area (Netherlands)	High	<ul style="list-style-type: none"> <li>- Progressive circular economy agenda,</li> <li>- Established public innovation funding mechanisms, and infrastructure investment readiness.</li> </ul>
Metropolis GZM (Poland)	Moderate	<ul style="list-style-type: none"> <li>- Poland’s recovery plans under NextGenerationEU include climate and circular economy investments</li> <li>- Region would benefit from targeted cohesion funding</li> </ul>

The business model proposed in this case focuses on assembling public-private consortia capable of securing and implementing EU and national circular economy funding for PUR hard foam recycling infrastructure. Stakeholders, such as municipalities, chemical recyclers, and industry groups, collaborate to produce competitive project proposals under programs like LIFE, Horizon Europe, and cohesion funds. Funding offsets CAPEX and operational risk, enabling regional recycling hubs, preprocessing plants, or consumer schemes aligned with regulatory mandates. Participating partners benefit from

<sup>53</sup> [Packaging Europe, 2025](#)

<sup>54</sup> [Plastics Europe](#)

reduced financial burden, enhanced regional circular economy credentials, and early compliance with upcoming recycling materials and traceability regulations.



FIGURE 16. BUSINESS MODEL – OPPORTUNITY 7.

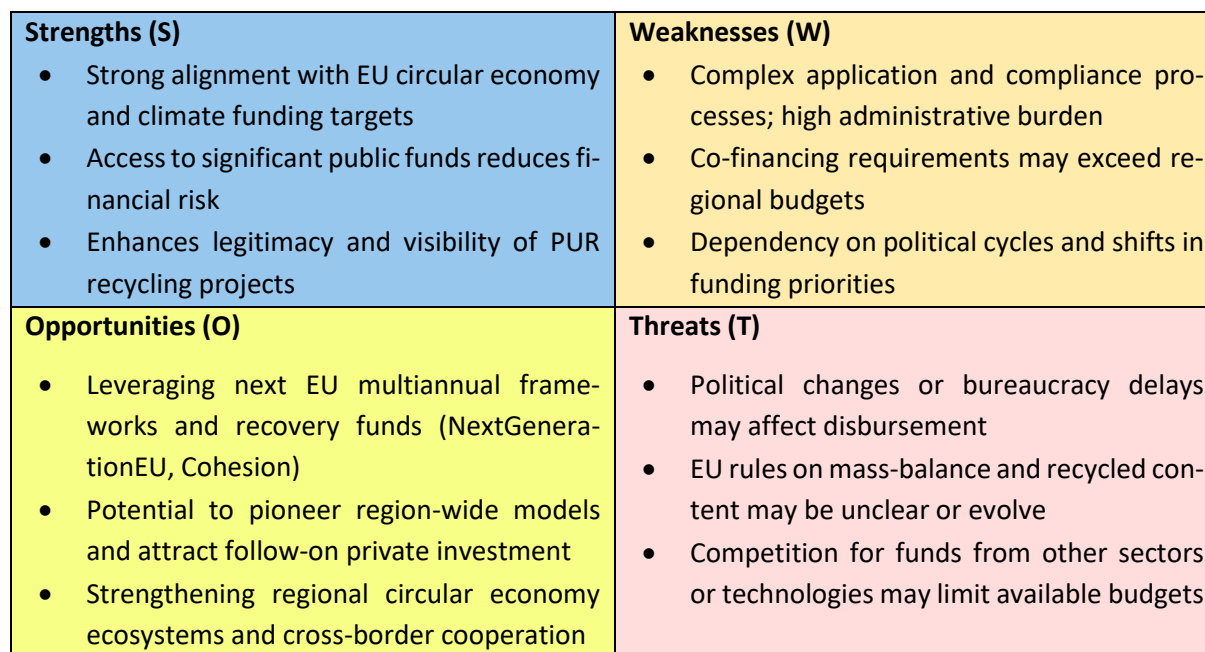


FIGURE 17. SWOT ANALYSIS – OPPORTUNITY 7.

Public funding opportunities offer robust strengths in reducing financial risk, aligning with EU policy mandates, and enabling pioneering projects in PUR recycling. They also carry weaknesses such as bureaucratic complexity and co-financing needs. The opportunity exists to leverage major funding pro-

grammes (from LIFE to NextGenerationEU) and to catalyse regional collaboration and industrial innovation. However, uncertainty in regulatory frameworks, changing political priorities, and competition over limited funds pose significant threats to successful execution.

**TABLE 14. RISK ANALYSIS – OPPORTUNITY 7.**

Risk type	Description	Likelihood	Impact	Mitigation strategy
Financial	Dependency on uncertain grant cycles	High	High	Portfolio approach across LIFE, Horizon, ERDF, national schemes
Administrative	Complex application and reporting processes	Medium	Medium	Professional grant consultants, cross-border consortia
Strategic	Misalignment between funding timelines and project readiness	Medium	High	Maintaining project pipeline, flexible execution windows
Reputation	Failure to meet KPIs may affect future funding access	Medium	High	KPI monitoring systems, conservative impact projections

Key risks include grant dependency. Projects may stall or become unviable if funding is delayed, reduced, or withdrawn. Administrative risk arises from stringent compliance and monitoring requirements, which may strain regional capacity. There's also strategic risk: if funding cycles misalign with project timelines, investor interest, or regulatory implementation, the business case weakens. Additionally, reputational risk is present if publicly funded projects fail to meet environmental or circularity targets, potentially undermining trust and future eligibility. Finally, co-financing risk may emerge where required contributions surpass local budget capabilities, limiting participation.

Considering investor’s point of view, public funding can de-risk early-stage technologies and infrastructure, but reliance on grants introduces vulnerability to political cycles and bureaucratic inefficiencies. Investors should view this opportunity not as a standalone investment vehicle, but as a strategic enabler to unlock blended finance models. The most viable approach involves aligning public grants with private capital through co-financed consortia, with well-defined KPIs and flexible execution timelines. Professional grant management and a robust pipeline of ready-to-launch projects can reduce exposure to delays and strengthen confidence in long-term returns.<sup>55 56</sup>

<sup>55</sup> [European Circular Economy Stakeholder Platform](#)

<sup>56</sup> [Reuters, 2024](#)



## 5 Conclusion

The CIRCULAR FOAM project has explored a diverse and complementary set of business opportunities that aim to establish a circular economy for rigid polyurethane (PUR) hard foam waste. These opportunities were identified and analysed across technical, economic, and regional dimensions in three European regions: Rheinisches Revier (Germany), Amsterdam Metropolitan Area (Netherlands), and Metropolis GZM (Poland). Together, the seven opportunities form a potential blueprint for reshaping the value chain of PUR waste management in line with EU Green Deal ambitions, digital product passports, and evolving recycle quotas.

The first opportunity – developing regional closed-loop recycling hubs – offers the most strategic and structural leverage. By creating coordinated regional systems for collecting, treating, and reintegrating PUR waste into new production cycles, this approach directly addresses the core fragmentation in the existing value chain. Particularly in Rheinisches Revier, where chemical industry clusters and policy support are strong, the infrastructure and stakeholder networks are already partially in place. Amsterdam offers highly developed logistics and circular economy expertise that can complement the technical operations. Metropolis GZM, while more fragmented, holds geographic potential and can be scaled into the loop with targeted governance improvements. This opportunity is therefore foundational and serves as a practical entry point for CIRCULAR FOAM to achieve early results while preparing ground for more advanced solutions.

Closely linked to this is the opportunity to develop intermediate treatment facilities, which would solve a critical missing link between sorting centres and final recycling plants. These facilities would allow for preprocessing, such as cleaning, separation, and size reduction of PUR waste to produce material suitable for chemical recycling. The lack of such nodes in the current infrastructure significantly limits the scalability of recycling solutions. Intermediate treatment centres could be relatively quick to implement within existing industrial zones and would enhance both throughput and material quality across the entire value chain.

The third opportunity, pyrolysis-based recycling of PUR foam, presents a more experimental but potentially high-impact approach. Pyrolysis offers a pathway to process complex and contaminated PUR waste streams that are not amenable to mechanical or direct chemical recycling. Although still emerging in its application to PUR, the technology could unlock additional waste volumes and reduce dependency on clean, homogeneous feedstock. Given its innovation ecosystem and industrial assets, Rheinisches Revier is particularly well-positioned to host pilot installations. However, due to current technological maturity and CAPEX intensity, this opportunity is more long-term in nature and best approached through consortia, research funding, and gradual scale-up.

The fourth opportunity involves creating digital platforms for PUR waste tracking and reverse logistics. As EU regulations move toward digital product passports and traceability across material lifecycles, this type of digital infrastructure will be essential for compliance, transparency, and coordination. While implementation would require stakeholder alignment and digital integration, it is technically feasible and highly scalable. Amsterdam's strengths in innovation, ICT infrastructure, and smart governance make it an ideal region to test and deploy such a platform, which would also enhance reverse logistics performance across all regions.

Consumer incentive programs, such as deposit-return systems, green labelling, or trade-in offers represent another angle to stimulate demand for recycled PUR-based products and increase return rates. This opportunity depends heavily on market behaviour, public awareness, and retailer involvement. It

is most likely to succeed in regions like Amsterdam, where consumer consciousness around sustainability is high, and where existing platforms for circular procurement can be extended to include PUR products. However, implementation in Metropolis GZM or Rheinisches Revier may require stronger public engagement and regulatory nudging to drive behavioural change.

Another longer-term opportunity lies in the use of recycled PUR in high-performance building insulation. This option addresses both sustainability and energy efficiency goals by producing advanced, durable insulation from recycled content. It builds on technical innovation and growing demand in the green construction sector. While attractive, its success depends on the ability to guarantee input quality and meet regulatory performance standards. Scaling this opportunity would likely follow the establishment of earlier stages in the value chain, such as treatment and purification of waste.

Finally, securing public funding for PUR recycling across the project regions is not only a complementary opportunity but a critical enabler for nearly all others. With the increasing availability of EU and national funds targeting circular economy, decarbonization, and industrial innovation, the CIRCULAR FOAM consortium is well positioned to leverage these mechanisms. Public funding can de-risk early investment, support cross-sector pilots, and provide legitimacy for consortium-led infrastructure projects. Germany and the Netherlands already have strong funding frameworks aligned with EU goals, and Poland is progressively expanding its access to cohesion and transition funds. By targeting funding strategically, the consortium can accelerate infrastructure development and innovation, while maintaining alignment with EU regulatory roadmaps.

In conclusion, the most feasible and high-impact opportunities for the CIRCULAR FOAM consortium to prioritize are the development of regional closed-loop recycling hubs and intermediate treatment facilities, supported by targeted efforts to secure public funding. These approaches address immediate gaps in the value chain, build on regional strengths, and create enabling conditions for more advanced or demand-driven innovations like pyrolysis, digital platforms, and recycled insulation products. By sequencing implementation pragmatically, starting with infrastructure and policy alignment, the consortium can establish early wins, build long-term momentum, and help position Europe as a leader in circular solutions for durable plastic waste.

From an investor's perspective, the CIRCULAR FOAM opportunities present a well-balanced portfolio across infrastructure, innovation, and market development. Regional recycling hubs and intermediate treatment facilities offer near-term, lower-risk investment opportunities with strong public co-financing potential and alignment with EU circular economy mandates. Higher-risk options like pyrolysis or digital platforms cater to innovation-focused investors but require regulatory clarity and phased deployment. Market stimulation efforts, such as consumer incentives and recycled insulation, provide indirect returns through brand value and ESG alignment. Overall, the phased implementation strategy de-risks capital deployment, enabling investors to align financial returns with measurable environmental and policy-driven impact.