



CIRCULAR FOAM

The state-of-the-art of stakeholders in waste and recycling in regions

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II Executive Summary

The Stakeholder Report identifies and analyses key stakeholders that shape the debate on circular solutions, provide knowledge and networks as well as directly engage in managing the material flows of interest – namely refrigerators and insulation boards /sandwich panels.

The report sets a focus on the three pilot regions of *Rheinisches Revier* in Germany, *Upper Silesia/GZM* in Poland, and *Amsterdam Metropolitan Area* in the Netherlands. In a first step, key stakeholders are identified on two different levels: (a) actors that set the stage for the introduction of *hubs for circularity* by shaping debates and knowledge and by setting regulatory standards and (b) stakeholders that are active in current waste management and have the potential to be active in creating future closed material loops. In a second step, key stakeholders are analysed by pointing out their relevance and positioning in the field of establishing *hubs for circularity* for PU hard foam. This is shown by an interest-influence matrix and a core-periphery map. Additionally, the report provides a description of stakeholders arranged along the material loops.

The analysis shows that each of the pilot regions has a broad and diverse stakeholder landscape which generally supports the introduction of circular economic solutions. Opposition towards establishing a circular economy is rare. Pushed by standards that are set by the European Union, key stakeholders know that a change towards a circular economy is coming - and is already happening on the ground. However, when it comes to setting the frame with national policies and regulations, with public debates and knowledge transfer, there are stark differences in the three regions.

Looking at waste management in all three regions there are reliable networks of companies and collection points in place to gather e-waste, white goods and construction waste containing polyurethane hard foam. While the logistics for refrigerators is very structured and formal, however, the material flow of construction waste is not fully documented and regulated in all three regions. Moreover, the findings suggest that key stakeholder groups are currently not focusing their circular activities on PU hard foam as well as durable plastics and that chemical recycling technologies are partly met with scepticism.

III Disclaimer

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V Table of Contents

I Technical References	2
II Executive Summary.....	3
III Disclaimer.....	4
IV Table of Contents.....	5
V Table of Figures.....	7
VI List of Tables	8
1 Joint Introduction.....	9
2 Pilot Region A: Rheinisches Revier	10
2.1 Stakeholder Identification.....	10
2.1.1 Setting the Frame: Key Stakeholders	10
2.1.2 Material Loops: Key Stakeholders	24
2.1.2.1 Refrigerators	24
2.1.2.2 Insulation Boards / Sandwich Panels	29
2.2 Stakeholder Analysis	31
2.2.1 Interest-Influence-Matrix	32
2.2.2 Core-Periphery Map (direct / indirect – primary/ secondary)	33
2.3 Conclusion.....	35
3. Pilot Region B: Upper Silesia / GZM	37
3.1 Stakeholder Identification.....	37
3.1.1 Setting the Frame: Key Stakeholders	37
3.1.3 Material Loops: Key Stakeholders	47
3.1.3.1 Refrigerators	48
3.1.3.2 Insulation Boards/Sandwich Panels.....	53
3.2 Stakeholder Analysis	57
3.2.1 Interest-Influence-Matrix	57
3.2.2 Core-Periphery Map	58
3.3 Conclusion.....	59
4. Pilot Region C: Amsterdam Metropolitan Area (AMA).....	60
4.1 Stakeholder Identification.....	60
4.1.1 Setting the Frame: Key Stakeholders	60
4.1.2 Material Loops: Key Stakeholders	68
4.2. Stakeholder Analysis.....	80



4.2.1 Interest-Influence-Matrix.....	81
4.2.2 Core-Periphery Map (Direct / Indirect – Internal / External).....	81
5. Joint Conclusion	82
6. Reference List.....	85
Pilot Region A: Rheinisches Revier	85
Pilot Region B: Upper Silesia / GZM	89
Pilot Region C: Amsterdam Metropolitan Area	89



VI Table of Figures

Figure 1: Collection Points in North-Rhine Westphalia for eWaste.....	25
Figure 2: Sorting of eWaste - Entsorgungszentrum Warden in Eschweiler operated	25
Figure 3: Loop Map - Refrigerators, Rheinisches Revier / North Rhine Westphalia.....	29
Figure 4: Loop Map - Insulation Boards / Sandwich Panels, Rheinisches Revier / North Rhine Westphalia	31
Figure 5: Interest-Influence-Matrix, Hubs for Circularity, Rheinisches Revier / North Rhine Westphalia	32
Figure 6: Interest-Influence-Matrix, chemical recycling, Rheinisches Revier / North Rhine Westphalia	33
Figure 7: Core-Periphery-Map, Rheinisches Revier / North Rhine Westphalia	34
Figure 8: Selected documents at European level related to circular economy issues	38
Figure 9: Collecting in GZM area.....	48
Figure 10: Thermal Treatment (Incineration), Biosystem S.A.....	50
Figure 11: Loop Map – refrigerators	53
Figure 12: Loop Map – insulation boards and sandwich panels.....	55
Figure 13: Reverse Logistics for PU waste from electronic devices.....	56
Figure 14: Reverse Logistics for PU waste from construction, Upper Silesia / GZM	57
Figure 15: Stakeholders core – periphery map, Upper Silesia / GZM.....	58
Figure 16: Loop Map, Refrigerators, Amsterdam Metropolitan Area	76
Figure 17: Loop Map, Insulation Boards / Sandwich Panels, Amsterdam Metropolitan Area	80
Figure 18: Interest-Influence Map, Hubs for Circularity, Amsterdam Metropolitan Area	81
Figure 19: Core-Periphery Map, Amsterdam Metropolitan Area.....	81

VII List of Tables

Table 1: Refrigerator manufacturers in Lower Silesian Voivodeship..... 52



1 Joint Introduction

A key task in work package 1 is to assess regional conditions for developing systemic solutions for cooperation that is needed to establish *hubs for circularity* for polyurethane (PU) hard foam on the ground. This shall lead to a blueprint model of cooperation that can be used to formulate a roadmap for the creation of such hubs in the pilot regions. A **first step to generate this blueprint model** is to **identify and analyse key stakeholders** that shape the debate on circular solutions, provide knowledge and networks as well as directly engage in managing the material flows of interest – namely refrigerators and insulation boards /sandwich panels.

The present stakeholder report sets a focus on the three pilot regions Rhenisches Revier, Upper Silesia/ GZM and Greater Amsterdam but each has to look at a broader stakeholder landscape including actors on the European, national and state level that are of relevance for decisions being made locally. The regional stakeholder reports in each region split in two parts that mirror the main steps for doing a thorough stakeholder analysis:

- It firstly **identifies key stakeholders** on two different levels: (a) looking at actors that set the stage for the introduction of *hubs for circularity* by shaping debates and knowledge and by setting regulatory standards and (b) to search out stakeholders that are active in current waste management and have the potential to be active in creating future closed material loops.
- It secondly **analyses key stakeholders** by pointing out their relevance and positioning in the field of establishing *hubs for circularity* for PU hard foam. The report will focus on using two key mapping techniques for this analysis: an interest-influence matrix and a core-periphery map. Additionally, the report will provide a description of stakeholders arranged along the material loops and sorted geographically.

The report concludes with key joint findings across all three pilot regions that are supposed to give interested parties a clear indication of how the stakeholder landscape is shaping up in different regions of the European Union (EU) and gives recommendations on how to further proceed with these actors that are important to later realise the creation of *hubs for circularity*.

It is important to note that the following report is designed as a **living document** which can and must be constantly further developed, fed with new information and revised in the course of the project.

2 Pilot Region A: Rheinisches Revier

The regional stakeholder assessment at hand intends to reveal material stakeholder groups that have the potential to shape and influence the introduction of polyurethane (PU) hard foam *hubs for circularity* in *Rheinisches Revier* (Germany) – being one of the three pilot regions chosen for analysis in the Circular Foam research project. *Rheinisches Revier* constitutes a lignite mining area with currently 2.5 million inhabitants. It is in the middle of a major transformation process precipitated by the decision to end the extraction of coal in 2030. The urban-land transitional space is changing from a conventional energy powerhouse to a sustainable economic region with key activities in the fields of regenerative energy production, sustainable resource usage and future mobility.

The stakeholder report of the *Rheinisches Revier* region is split up in two parts. First, it starts with identifying key stakeholders that (a) set the frame for establishing *hubs for circularity* in the region by setting regulations, shaping debates and sharing knowledge and (b) work on the ground coordinating and steering the two material flows of interest – refrigerators and insulation boards/sandwich panels. Second, we analyse key stakeholder groups by using two different mapping techniques: the interest-influence-matrix and the core-periphery map. Both mapping tools help us to make assertions on stakeholders' positions, motivations and centrality in the context of establishing PU hard foam *hubs for circularity*.

2.1 Stakeholder Identification

The first task of this analysis is to identify key stakeholders that can have a significant influence on shaping and establishing PU hard foam *hubs for circularity* in the wider *Rheinisches Revier* region. We divide the stakeholder identification in two separate parts. First, we look at stakeholders that are important actors in setting the frame for the concrete design and organisation of *hubs for circularity* – nationally and regionally. Second, we take local stakeholders into focus that have an important role in the material flow of PU hard foam – in the current waste management value chain as well as prospectively by closing the material loop in the future.

2.1.1 Setting the Frame: Key Stakeholders

European Union

European Commission

The European Commission is a key driver in the transition towards establishing a circular economy. It adopted the first circular economy action plan in December 2015. It included 54 actions at the time which have since been delivered or are being implemented. In 2018, the EU followed up with a **European Strategy for plastics in a circular economy** laying the foundations to a new plastics economy, where the design and production of plastics and plastic products fully respect reuse, repair and recycling needs and more sustainable materials are developed and promoted.

In March 2020, the EU Commission adopted the new **Circular Economy Action Plan** (CEAP) as one of the main building blocks of the European Green Deal. The new action plan continuously announces initiatives along the entire life cycle of products. As part of the EU Industrial Strategy, the *Circular*



Economy Action Plan focuses on sectors that use the most resources and where the potential for circularity is high: a *Circular Electronics Initiative*, new mandatory **requirements for recycled plastic content**, and a **Strategy for a Sustainably Built Environment**.

The EU has legislated **Waste Electrical and Electronic Equipment (WEEE)** management since 2002. The WEEE Directive (Waste from Electrical and Electronic Equipment), passed in 2012, established the obligation to collect WEEE separately for sorting and recycling. It sets a detailed framework for Extended Producer Responsibility and aims to provide incentives to improve the design of electrical and electronic equipment to facilitate recycling. One of the obstacles in reaching collection targets is that considerable amounts of WEEE are diverted to other undocumented WEEE flows. Unwanted WEEE flows need to be reduced and steered into the formal WEEE management regime. The exports for reuse and illegal exports are hardly monitored in most countries due to the lack of trade codes for used-EEE.

Additionally, the EU Commission has put forward a regulation on **Ecodesign for Sustainable Products**. It sets new requirements to make products more durable, reliable, reusable, upgradable, repairable, easier to maintain, refurbish and recycle, and energy and resource efficient. In addition, product-specific information requirements will ensure consumers know the environmental impacts of their purchases. It notably addresses consumer electronics (smartphones, tablets, solar panels) - the fastest growing waste stream.

To ensure that regions are not left behind, the EU Commission also launched the **Initiative for Coal Regions in Transition** to help mitigate the social consequences of the low-carbon transition in coal, peat and oil shale regions of the European Union. The Initiative works as an open forum, which has gathered all relevant parties, local, regional and national governments, businesses and trade unions, NGOs and academia since 2017. *Rheinisches Revier* is part of the initiative.

National State: Germany

Federal Government (Bundesregierung)

The new German federal government was formed by the Social Democratic Party (SPD), Bündnis 90/die Grünen (Greens) and Freie Demokraten (FDP) in December 2021. In Germany, coalition agreements which are negotiated by party heads and experts play an important role in shaping the work of the administration in the coming legislative period. It is generally seen as a work programme for the new government.

In the current **coalition agreement** we find relevant announcements regarding the fostering of circular economy solutions in Germany. Circular economy is stated as being an important part of the federal government's strategy for climate protection and resource efficiency. The stated goal is to lower the use of primary raw materials and to close as many material loops as possible. Concrete measures to be implemented are:

- the creation of a **new national circular economy strategy** in which all existing raw material and recycling management initiatives are bundled and newly aligned;
- the introduction of
- digital product passes and
- a recycling label which sets quality standards for recyclates;
- the introduction of **chemical recycling** as a new recycling option;



- ending landfill of household waste;
- the strengthening of **financing innovations** in the sector of bio and circular economy.

Ministry of Ecology, Nature and Consumer Protection (BMUV)

The BMUV is entrusted with working out the above mentioned **national circular economy strategy**. A new department was formed inside the ministry (T 1-4) which is assigned to lead the transformation towards a circular economy for Germany's federal government. Its major task is to bundle, integrate and intermesh the existing recycling laws and resource efficiency activities (e.g. *Deutsches Ressourceneffizienzprogramm: ProGress III*). The formulation of a new circular economy strategy is currently in the making. In September 2022, a first round of consultations began with the *Länder* ministries and with key business and NGO stakeholders. In the first quarter of 2023, a first strategy paper (*Eckpunktekonzzept*) is expected to be formulated and further consulted. The BMUV will also shortly introduce a new programme which will **fund innovation on resource efficiency** in circular production processes. It also plans to set up a **Green-AI Hub** for SMEs which focuses on digital solutions for fostering circular economy solutions (BMUV, 2023).

Ministry of Economy and Climate Change (BMWK)

The BMWK is responsible for implementing and further developing the German **raw material strategy** which was introduced in January 2020. It mostly focuses on forming new international resource partnerships for Germany to secure the nation's raw material supply (BMWK, 2019). This task is seen as a vital part of the German industrial economic strategy. The BMWK is a member of the Raw Materials Supply Group on the EU level. The BMWK also regularly stresses the important role of chemical and plastic producing firms in Germany. Recently, Minister Robert Habeck said in a speech at an industry event: "*The importance of the chemical and plastic industry in Germany cannot be valued highly enough.*" (Kunststoffland, 2022).

Ministry of Education and Research (BMBF)

The BMBF has been funding sustainable technologies developed jointly by researchers from science and industry for many years as part of Germany's raw materials policy. The ministry supports the research for a more efficient utilisation of resources with numerous programs under the umbrella of **FONA (Research for Sustainability)**. With the FONA strategy published at the end of 2020, the BMBF has aligned its research funding for climate protection and greater sustainability with the United Nations' Sustainable Development Goals (SDGs). It formulates three strategic goals to which research can make a decisive contribution – among them the action **field of circular economy** with **action 19: closing the plastic cycle**. A resource-efficient circular economy has indeed been a focus of research policy since 2019 (BMBF, 2019). With a total of 150 million euros, the BMBF is funding new technologies and services, design concepts and business models for the resource-efficient circular economy – among them new recycling technologies for plastics (FONA, 2021).

Governmental Agencies / Initiatives

Umweltbundesamt

Since its founding in 1974, the **German Environment Agency (Umweltbundesamt – UBA)** has been Germany's main environmental protection agency. UBA's work centres around gathering data concerning the state of the environment, investigating the relevant interrelationships and making projections – and then, based on these findings, providing federal bodies such as the Ministry of the Environment with policy advice. It also implements environmental law by making sure that it is applied



in areas such as CO₂ trading and approval processes for chemicals, pharmaceutical drugs and pesticides. Another key overarching mission is early detection of environmental risks and threats. In March 2020, UBA published its **guiding principles of a circular economy** (*Leitsätze einer Kreislaufwirtschaft*) which addresses the importance of closed material loops and the need for all stakeholders to cooperate along the value chain (Umweltbundesamt, 2020). UBA also organizes the well-known **European Resources Forum** which – in its next edition – will focus on transformative approaches for sustainable resource use and a circular economy. The Forum was founded in 2012 as a European and international platform for discussion on the issue of sustainable resource use and focuses on the political and scientific debate on this topic. It is accompanied by a newly convened **Resource Commission** which supports UBA with proposals for the sustainable management of natural resources and a circular economy. The Resource Commission consists of experts from science and research, administration, industry, and civil society (Umweltbundesamt, 2022).

Circular Economy Initiative Germany

With funding from the German Federal Ministry of Education and Research (BMBF), the *Circular Economy Initiative Deutschland* (CEID) was initiated in 2019. The initiative was carried out under the guidance of *acatech – National Academy of Science and Engineering* in cooperation with SYSTEMIQ. In three interdisciplinary and cross-sectoral working groups on the topics of Circular Business Models, Traction Batteries, and Packaging, some 130 experts from more than 50 institutions from science, industry, politics and civil society discussed how to enable and establish circular economic systems. They explored potential fields of application and discussed which framework conditions could lead to a successful implementation. Specific recommendations for action were derived from the results and summarised in the **Circular Economy Roadmap for Germany** (Circular Economy Initiative, 2023). The roadmap was published in May 2021 and officially handed over to the Federal Ministry of Education and Research (BMBF). The initiative has supported the establishment of relevant company networks and promoted new partnerships and cooperation opportunities that are central to the implementation of a Circular Economy. One of the key current projects is a **dialogue platform on recycling raw materials** (*Dialogplattform Recyclingrohstoffe*) which intends to create a dialogue between representatives from industry, associations, science and politics. The overarching goal of the dialogue platform is to increase the contribution of secondary raw materials to the raw materials supply of the German economy.

Political Parties on Federal Level: Positions

All major political parties in Germany – except for the AfD – support the fostering of circular economy solutions according to their platforms published in advance of the German federal elections (*Bundestagswahlen*) in 2021. The **SPD** explicitly stated the goal of a rebuilding of Germany's economy towards a circular economy. Its election platform says: “*The circular economy is the future.*” (SPD, 2021 p.52). The Christian Democrats (**CDU/CSU**) mentioned in their platform the innovation and growth potential that new solutions for closing material loops have on the German economy – among them new scanner technology and the innovative use of recyclates. CDU/CSU stated the goal of introducing a raw material strategy *Made in Germany* which should support the industry to use recycled raw materials in the national context (CDU/CSU, 2021). As an opposition party they introduced a motion in German parliament in April 2022 that promotes the idea of a circular economy as a way to foster Germany's raw material autonomy (CDU/CSU, 2022). The **FDP** put a focus in its platform on technological solutions for recycling – stressing that chemical recycling should be regarded as an equal



alternative to other recycling methods. Plastic is named as “*an engineering material of the future.*” (FDP, 2021). In its platform **Die Linke** stresses the fostering of establishing regional hubs for circularity and the introduction of regional fees for the use of plastic products. The party supports a runner-up model for the production of electronic devices in which the most sustainable products set the industry standard (DIE LINKE, 2021). The **Greens** have the most ambitious and developed agenda for establishing a circular economy. They want to pursue a systematic *Zero Waste strategy*. The platform stresses the commitment and responsibility of all stakeholders along the value chains to design, produce, use and dispose of products to close all material loops by 2040 (Die Gruenen, 2021).

Business / Industry

Bundesverband der Deutschen Industrie (BDI)

The BDI is the umbrella organisation of German industry and industry-related service providers. 40 industry associations, more than 100,000 companies with around eight million employees in Germany and 15 state representatives make BDI the voice of German industry. The BDI is supported in its work by the expertise of numerous committees, working groups and working parties that are supposed to provide “*a reliable sounding board*” which enables policy initiatives and decisions to be scrutinised at the earliest possible stage to check their viability in day-to-day business practice (BDI, 2016 & BDI, 2018). The BDI states that German industry supports the policy objective of promoting the sustainable use of natural resources while minimising harmful environmental and climate impacts. According to the BDI, 39 percent of companies along the value chain currently say they will include the Circular Economy in their innovation strategy in the next two years, 28 percent have already done so. However, BDI pushes for suitable indicators for measurements of sustainable resource use that do not restrict industrial growth (BDI, no date). In October 2021, the BDI published a policy paper titled **Six Steps toward a Circular Economy** in which it states the importance of new product designs as an important anchor for the circular economy, demands stable commodity markets for circular economies, proposes using public procurement as a lever for establishing hubs for circularity and stresses the importance of digitising the material loop (BDI, 2021).

Verband der Chemischen Industrie (VCI)

The VCI represents the interests of more than 1.900 companies in Germany’s chemical and pharmaceutical industry. In 2021, its member companies generated a value of 220 billion euros and had more than 530.000 employees. Organised in 22 professional associations it is currently one of the three biggest industry associations in Germany. The VCI has drawn up a **position paper on the EU Action Plan for the Circular Economy**. The position paper evaluates several fields of action of the plan in detail. It advocates a product design for sustainability instead of a design for recycling. It values waste, especially plastic waste, as an important resource and supports the introduction of chemical recycling options – in particular for waste that cannot be recycled as yet. It proposes strengthening the EU internal market for secondary raw materials through market-based rather than regulatory incentives (VCI, 2022a & VCI, 2022b). VCI is also a key member of **Plastics for Europe** (Plastics Europe, no date). Its 100 members produce over 90 percent of all polymers in Europe. The mission of Plastics Europe is to support the industry adapting and evolving into a low-carbon circular economy. It published a manifesto **Working Together Towards More Sustainable Plastics: A Joint Call for Action** in which it – amongst others – recommends to support and invest in the improvement of separate plastic collection and sorting and phase out landfilling of plastics. VCI and Plastics for Europa are

engaged in the **Circular Plastic Alliance** to accelerate the circular economy for plastics and reach 10 million tonnes of recycled plastics into new European products by 2025.

Chemie hoch3 (joint sustainability initiative by business and labour union IGBCE)

Under the umbrella organisation *Chemie hoch3* the VCI, the industry labour union IGBCE and the employers' association in the German chemical industry (BAVC) push for a change towards sustainability in the chemical industry by developing guiding manuals and webinars for companies, providing a sustainability check for firms and establishing dialogue platforms on topics such as progress factors of industry development (Fortschrittsindikatoren) (Chemiehoch3, 2023). The initiative recently published a **guiding manual on the introduction of circular economy solutions** in the chemical industry in Germany – with a special focus on SME's. The manual proposes best practice solutions in six fields of action – among them the sustainable procurement of products as well as circular design and recycling (Chemiehoch3, 2022).

Industrieverband Hartschaum e. V. (IVH)

The IVH represents key companies which produce expanding polystyrol hard foam (EPS) in Germany. With its trademark **EPS Cycle** it is on its way to make EPS insulation boards fully recyclable. With partners such as Interzero IVH offers building companies and owners as well as craft businesses solutions to return construction waste from building sites. This solution is called **PS Loop B.V.** in which a PolyStyreneLoop facility in the Netherlands is included (Industrieverband Hartschaum, 2021a). The IVH recently published a guiding manual on how to reuse and recycle EPS insulation boards (Industrieverband Hartschaum, 2021b). IVH invited key experts to a talk in the Cradle-to-Cradle Lab in Berlin in September 2022 on circular solutions in the building sector in Germany. Keynote speaker was the parliamentary undersecretary of BMUV Chris Kühn (Industrieverband Hartschaum, 2022).

Environment / Nature

There are several key environmental groups in Germany which regard circular economy solutions as a key to mitigate emissions, save energy and resources. The four leading NGOs are NABU, Deutsche Umwelthilfe (DUH), WWF Deutschland, and BUND (Friends of the Earth Germany).

Naturschutzbund Deutschland (NABU)

NABU formulated **ten key demands for the fostering of circular economy solutions**. They include mandatory goals for waste avoidance, a proposal for making circular design a norm for new products, fostering circular economy by using the power of public procurement, stop plastic exports to foreign countries and introducing quotas for the use of recyclates (NABU, 2023a). Since 2009, NABU organizes the dialogue forum on circular economy (**Dialogforum Kreislaufwirtschaft**). It brings together key stakeholders in politics, business, NGOs and science to discuss new perspectives on circular solutions. In recent years the forum focused more and more on the topic of plastic avoidance and recycling (NABU, 2023b).

Deutsche Umwelthilfe (DUH)

DUH has evolved into a key environmental group in Germany in recent years. It plays a significant and publicly exposed role in proceeding against companies and public authorities in court – enforcing environmental standards, e.g. on the Diesel scandal in the automotive industry. With its **plastic strategy for Germany** it laid out a comprehensive plan for producing, using and handling plastics. Key demands of DUH are mandatory goals for waste avoidance, a fee on producing new plastics, quotas for the use of recyclates in products and a ban on microplastics (Deutsche Umwelthilfe, 2018). In a



policy paper DUH delved into the question of the opportunities and hazards of **chemical recycling**. DUH regards chemical recycling as an “*immature and highly risky technology*” whose effects on the environment are barely known. It sees three major critical points: the high energy input in the whole recycling process, possible detrimental byproducts, and high losses and quality problems of new upcycled products. DUH demands transparent and independent research studies on the environmental effects of chemical recycling techniques (Deutsche Umwelthilfe, 2023).

World Wildlife Fund - WWF Deutschland

WWF Deutschland is a partner together with Öko-Institut, the Freie Universität Berlin and Fraunhofer ISI in a research project titled **Model Germany Circular Economy**. Its goals are to do an inventory of the status quo of German circular economy activities and to lay the foundation for modelling various effects of future CE measures that are planned nationally. The project aims to identify in which sectors circular economy solutions have the biggest impact for climate protection, economy and society, and which measures should be prioritised by conducting an encompassing cost-benefit analysis (WWF, 2023).

BUND (Friends of Earth Germany)

Together with Friends of the Earth Europe BUND has proposed **key demands for introducing a circular economy** – among them the compulsory measurement of material footprints, the introduction of mandatory resource reduction goals, the proposal to raise recycling quotas for key plastics up to 70 percent and the fostering of new business CE models (BUND, 2014).

State: North Rhine-Westphalia

State Government

The new state government in North Rhine Westphalia (NRW) was formed by the Christian Democrats (CDU) and Bündnis 90/ Die Grünen (Greens) in June 2022. In the current **coalition agreement** we find relevant announcements regarding the fostering of circular economy solutions. Circular economy is stated as being an important part of the state government's strategy for climate protection and resource efficiency. Concrete measures to be implemented are:

- development and implementation of an “encompassing” **state circular economy strategy** for NRW. One of its goals is to foster the use of circularised products;
- introduction of a **Zero Waste 2050 Impuls Programm** which is supposed to set new state standards for avoiding waste in NRW;
- further development of the **guiding principles for industry policy** (*Industriepolitisches Leitbild*) in NRW together with key stakeholders in business and labour unions – key issues are innovation in industry, climate and nature protection as well as circular economy solutions;
- innovation in **controlling material flows and waste management** and to strengthen authorities to fight against illegal waste disposal;
- advancement of **recycling solutions of building materials** and removal of hampering factors for the **reuse of demolition materials** – e.g. by commissioning a study on an improved handling of recycled building materials.
- support for **state-supported initiatives** such as *Circular Valley Wuppertal and Greentech.Ruhr* (see below) (DIE GRUENEN-NRW, 2022).



Ministry of Ecology, Nature and Transport (MUNV)

MUNV put forward a major revision of the *Kreislaufwirtschaftsgesetz* in NRW which was adopted in February 2022 and substituted an older law on waste management in the state. This *Kreislaufwirtschaftsgesetz* is supposed to foster the change from linear waste management to a resource saving circular economy. It primarily focuses on the guiding role of public authorities in shaping the way towards a circular economy by

- observing sustainable criteria in public procurement;
- increasing the amount of applied recyclates in products used in the public sector;
- helping the building industry to become circular by binding public authorities on using more natural building material and on recycled demolition material (Ministerium für Umwelt, Naturschutz und Verkehr des Landes NRW, no date).

The federal government is in the process of putting forward a new overall national circular economy strategy. Once it is adopted, NRW will align its own plan by complementing the national framework with concrete guidelines for actions – also building on the current *Kreislaufwirtschaftsgesetz*. The Ministry of Environment and the Ministry of Economic Affairs will share the lead management for bringing a comprehensive **state circular economy strategy** forward. To that end, MUNV has created a new administrative unit VIII-1 which has the responsibility of coordinating activities of the Ministry towards establishing a circular economy in NRW. MUNV is also working on **key points** of the new **zero waste impulse program** mentioned in the coalition agreement and will start funding projects beginning in 2023 (Interview A, 2022).

Ministry of Economy, Industry, Climate Protection and Energy (MWIKE)

After the new minister Mona Neubaur (Greens) took over the reign at MWIKE the ministry is noticeably more active in promoting circular economy solutions in industry. Her declared goal is to develop NRW into a model region for the social-ecological transition (Ministerium für Wirtschaft, Industrie, Klimaschutz und Energie des Landes NRW, 2022b). Shortly after taking over the ministerial office, Mrs. Neubaur went on a **circular economy tour** in NRW visiting companies such as LANXESS in Krefeld, ZINQ in Gelsenkirchen and Covestro in Leverkusen that already have a strong focus on recycling and circular solutions. On this trip, the new minister was quoted by saying: “*Our understanding of waste has to substantially change. We must see it as a secondary raw material.*” (Interview A, 2022).

Governmental Agencies and Initiatives

NRW.Energy4 Climate / IN4Climate.NRW

NRW.Energy4 Climate was founded as a new state agency for energy and climate protection in North Rhine-Westphalia in 2018. Its aim is to be a key driving force behind efforts to implement the energy transition and meet climate targets in NRW, while simultaneously strengthening the state as a location for industry and services. NRW.Energy4 Climate focuses its activities on four high emitting sectors – energy, industry, heat and buildings, and mobility – which together are responsible for more than 90 per cent of greenhouse gas emissions in NRW. One of its main goals is to create and present selected research and application projects from NRW that are helping the industrial sector make the transition towards climate neutrality (Energy4Climate, 2023a). One of the key projects NRW.Energy4 Climate is involved in is called **IN4climate.NRW**. As a think tank, IN4climate.NRW discusses practical measures needed to make industry climate neutral. Alongside experts from industry, science and policy-making,



it is developing specific measures to ensure climate-neutral production processes and supply chains. IN4climate.NRW's targets and responsibilities are – amongst others – to point out key areas where research is needed, to identify fields of innovation and research for climate-neutral industrial production as well as potential and consistent product-specific developmental steps (Energy4Climate, 2023b). A key cornerstone of IN4climate.NRW is a working group on circular economy. The group has already published a **discussion paper** called ***Chemical Recycling for Plastics*** which gives an overview of the technologies involved in chemical recycling and the state of the art (Interview B, 2022). Additionally, an academic offspring project **SCI4CLIMATE.NRW** works on an analysis on the development paths of recycling technologies in NRW focusing on **smart pyrolysis**. IN4climate.NRW just recently started a regional project called **IN4climate.RR** with a special focus on fostering the transition in Rheinisches Revier. Its work has not been started yet.

Effizienz Agency NRW

The Effizienz-Agentur NRW (EFA) is the **centre of competence for resource efficiency** of the North Rhine-Westphalian Ministry of the Environment with a staff of over 30 employees in Duisburg and eight regional offices. Its range of services encompasses consultation on resource efficiency, financing activities and putting on events and training courses for companies in NRW. EFA provides advice to resource efficient business practices in the areas of production, product design, maintenance, cost accounting, CO₂ balancing and new value chains. EFA's financial experts also help their clients in identifying and obtaining financial support via the use of the most appropriate funding programme and support companies through to the implementation. EFA is a founding member of the European network of Ecodesign Centres (ENEC) and member of the Focus Group on European resource efficiency self-assessment tool for SMEs. On average, the Effizienz-Agentur NRW carries out **250 resource efficiency and finance consulting projects**, some 200 events, training courses and workshops every year. It illustrates best-practice examples which one can find in the EFA online database at www.ressourceneffizienz.de. The Effizienz-Agentur NRW also takes up the CIRCO method to support companies in North Rhine-Westphalia, Germany, in developing new, sustainable business models and product adaptations in the sense of the circular economy (CIRCO, 2022).

Political Parties in NRW: Positions

The major political parties in the federal state of NRW support the fostering of circular economy solutions according to their platforms published in advance of the state elections (*Landtagswahlen*) in 2022. The **CDU** mentioned its support for the introduction of an encompassing circular economy in NRW with a special focus on innovation in re- and upcycling projects. The **SPD** is more ambitious stating in its platform to remodel the NRW economy to a circular creation of value. It proposed the creation of a new competence centre on circular economy (*Kompetenzzentrum Zirkuläre Wertschöpfung*) as well as regional plans and concepts that help introduce circular economy solutions in regions and municipalities in NRW. The **FDP** set a focus in its platform on establishing a circular economy in the building sector but also proposes the advancement of new up- and recycling technologies in NRW for plastics. The **Greens** in NRW echo the political goals set by the national party. They call out for NRW to become a model region in Europe for the introduction of an encompassing zero waste strategy – with a special focus in NRW on the introduction of bio economy solutions.

Business / Industry

Kunststoffland NRW



Kunststoffland is a major business initiative that brings key actors in plastic production and recycling together in NRW. It was founded in 2006. With more than 134.000 employees and 34 billion euro revenue in NRW the business sector is one of the key branches of the state's economy. *Kunststoffland NRW* works as a **competence centre** for the state of North-Rhine Westphalia in the context of the state's **leading markets strategy**. One of these leading markets in NRW is plastics as a new engineering material. The main goal of the competence centre is to foster the cooperation of all stakeholders along the value chain and to function as a sounding board for the state ministries in advancing new legislation and regulation (*Kunststoffland NRW, 2023*). *Kunststoffland NRW* formulated **economic policy demands** (*Wirtschaftspolitische Forderungen*) containing claims such as

- the advancement of chemical recycling technologies,
- the primacy of market based solutions over state regulation,
- the leading role of public authorities in procurement of recycling or circularised material,
- the systemic support of innovation and industry upscaling (*Kunststoffland NRW, 2022*).

VCI NRW

The NRW state chapter of the *Verband der Chemischen Industrie (VCI)* is active in signalling that the business branch is part of the transition towards more resource efficiency. In the context of the start of the new state government in June 2022, it published a **policy paper** containing key fields of action. One of them is labelled **Getting a Circular Economy off the Ground**. The VCI NRW proposes to develop a carbon management strategy for NRW as well as the advancement of chemical recycling methods. The VCI NRW regularly honors innovation in the field of circular economy solutions by awarding a prize for good practise (*Verband der chemischen Industrie, 2017*).

Chambers of Commerce NRW

The various Chambers of Commerce (*Industrie- und Handelskammern, IHK*) in NRW represent more than 1,1 million companies and business institutions in NRW. IHK are organised regionally. In *Rheinisches Revier*, there are three different IHK active to foster business opportunities, cooperation and innovation: IHK Aachen, IHK Düsseldorf, IHK Köln. The umbrella organisation, IHK NRW, is actively pushing companies to gain broad knowledge on how to step into a circular economy. Among other things, it organised a **special conference** dedicated solely to sound out the chances and challenges regarding the establishment of *hubs for circularity* („**Zirkuläres Wirtschaften in NRW - Wirtschaftsmodell der Zukunft?**“) in 2020. The former minister for Environment, Ursula Heinen-Esser, was attending it as well as Tara Nitz, Global Positioning & Advocacy Circular Economy, Covestro Deutschland AG. It additionally published a **special newsletter** to its member organisations focusing on presenting information and good practice in the field of circular economy (*IHK, 2021*).

VKU NRW

The NRW state chapter of the *Verband Kommunaler Unternehmen (VKU)* represents the interests of local public utility sector companies, which includes both supply and disposal services. The almost 500 member companies organised within VKU NRW are primarily active in the fields of energy supply, water supply and sewage, waste management, municipal cleaning and telecommunication. There is a special **working group** (*Landesfachgruppe*) inside VKU NRW which focuses on the discussion of new ways in **local waste management**. In August 2022 it organised a conference on **Circular Economy Solutions as a Way of Fostering Communes** which took place in Münster (*VKU, 2021*).



Science / Competence Centres

Wuppertal Institute

The Wuppertal Institute (WI), located in close proximity to Rheinisches Revier, is one of the leading research institutions in Germany on climate protection and resource efficiency. It created a separate **division on circular economy** headed by **Henning Wilts** who is seen as one of the most competent European experts on questions on the introduction and implementation of circular economy solutions (Wuppertal Institut, 2023). The Wuppertal Institute heads a key research project in NRW on circular designs for products which includes various projects on cooling appliances with the *Folkwang University* as a key partner. WI recently published a new **study** it has been working on for MWIKE: **NRW 2030: From a Fossil Past to a Circular Future**. In this study a vision of a circularised NRW is formulated and translated into a broad roadmap to achieve a circular economy in the state by 2030.

Circular Valley Wuppertal

Also located in Wuppertal, the Circular Valley is the **first specific Circular Economy accelerator in the world** run by the Circular Valley Foundation. Circular Valley's main assignment is supporting the creation of new business models for circular economy solutions and foster the process of scaling innovation up. It connects leading companies in the business with young entrepreneurs from all over the world. Partner institutions in NRW are Covestro, BASF, TOMRA, Remondis, or AWG (innovative disposal technologies) (Circular Valley e.V., 2022).

Round Table: Circular Economy

The Round Table Circular Economy was initiated by MUNV and MWIKE in 2018. It works as a **competence centre** on the introduction of circular economy solutions in NRW. Its goal is to bring state of the art business stakeholders along the material loops together to foster the discussion on a circular economy strategy for NRW, to discuss best practices as well as to interlink stakeholders by finding synergies in working more closely together in common projects. Partners are – among others – Metropolis Ruhr, EFA, NRW.Energy4Climate, Fraunhofer Umsicht, and Zukunftsagentur Rheinisches Revier (ZRR). Key element of Round Table Circular Economy are working groups (*Thementische*) on different subjects such as product design, collecting and sorting, production and recycling options (Runder Tisch ZW, 2023). The Round Table Circular Economy published a **charter of circular economy for NRW** (*Charta der zirkulären Wertschöpfung NRW*) stating the important impact a circular economy can perform for a climate fair industry, raw material autonomy, and innovation and jobs (Runder Tisch ZW, 2021).

NRW.Zirkulär

NRW.Energy4Climate started a new research network in January 2022 called *NRW.Zirkulär*. It focuses its activities explicitly on new ways of circular plastic production and recycling with a special focus on the assessment and analysis of **(smart) pyrolysis techniques**. A first **implementation study** (*Umsetzungsstudie*) is intended to be published in 2023 including scenarios for the future implementation of pyrolysis methods in NRW. The study is conducted by Fraunhofer UMSICHT, Wuppertal Institute and CarbonMinds. A sounding board was set up which includes significant companies in the value chain – among them Covestro, Lanxess, BASF and Rain Carbon as well as Remondis (Energy4Climate, 2022).

Greentech.ruhr



Greentech.Ruhr is a network of innovative companies, research and educational institutions as well as various public institutions in the environmental industry. It runs programmes for the ecological restructuring of neighbourhoods and waters, develops concepts for renewable energies, modern mobility concepts and sketches **ways for more climate-friendly business models in the sense of circular value creation**. The Greentech.Ruhr engages in networking of local companies, educational and research institutions in order to further promote the innovation potential in the field of environmental economics within the Ruhr area. One central issue for Greentech.Ruhr – called Lead Market – is the careful and efficient use of raw materials and other resources (Metropole Ruhr, 2023).

Region: Rheinisches Revier

Zukunftsagentur Rheinisches Revier (ZRR)

ZRR is a key intermediary institution in Rheinisches Revier which supports the transition of the region by creating guidelines and paths for regional transformation, drafting innovation strategies, and developing concepts of action. It works closely with partners in science, business, politics, and civil society in the region. Guided by a **framework for regional development** (*Wirtschafts- und Strukturprogramm 1.1*) (ZRR, 2021) ZRR funds specific transition projects in key action fields (*Zukunftsfelder*). One of these action fields is focused on a regional transition towards resource efficiency and agribusiness. ZRR's main goal in this action field is to develop *Rheinisches Revier* into a **model region for the resource transition**. The two key approaches are the establishment of a functioning bio economy and the development of broader circular economy solutions. ZRR is in close contact with regional and local managers who are responsible for transition projects on the ground in the region's county and municipal administrations. It runs a *Revier Academy* which regularly trains local responsible parties on funding and organising structural change on the ground.

Counties & Municipalities

Rheinisches Revier is not an entity with fixed political and geographical borders (see: Regional Readiness Report). It largely consists of seven districts and 65 municipalities. Of interest for the present stakeholder report are two main management **functions** which these municipalities in Rheinisches Revier fulfil:

- *Transition Management*

The counties and municipalities in *Rheinisches Revier* which are influenced by the structural change triggered by the decision to end coal extraction by 2030 have set up internal structures and management responsibilities to master the transition in the next decade. Key stakeholders are the **county commissioners** and **mayors** in the region. They are the central local multipliers setting the frame for change – in public as well as internally in their respective administration. In all major counties and municipalities in *Rheinisches Revier* county commissioners and mayors can draw on publicly financed **transition managers** (*Strukturwandelmanager*) who they regularly employ as a specialist close to the administrative head office.

- *Waste Management*



Counties and municipalities play a key role as entities responsible by law for the local **organisation of the waste disposal and management** (*Entsorgungsträger*). Generally, municipalities are responsible for the collection of household waste, the counties then organise its further treatment. County-independent towns such as Mönchengladbach combine these two tasks in one entity. But: Not all communes fulfil these tasks by using their own public waste management companies, some municipalities commission private firms with waste management tasks dependent on the specific material flow. Another important function counties and municipalities perform is an **administrative supervisory role**. They are responsible by law to notify and monitor waste streams and have to approve of special waste treatment and demolition activities on the ground.

In *Rheinisches Revier* some communes organise waste management on their own such as Mönchengladbach with **mags Mönchengladbacher Abfall-, Grün- und Straßenbetriebe AÖR** (mags, 2023), which is responsible for waste management in the whole city area. One major exception is the **Zweckverband Entsorgungsregion West (ZEW)** (ZEW, 2023) which is jointly responsible for waste management in Städteregion Aachen, the City of Aachen, Kreis Düren and Kreis Euskirchen. It encompasses more than 40 cities and small municipalities and has a gathering ground of 1.647 square metres (one third of *Rheinisches Revier* area). ZEW transfers its duties to the publicly owned *AWA Entsorgung GmbH* (AWA) which again is allowed to commission private firms for certain disposal and treatment tasks – such as NOEX AG in Grevenbroich for the treatment of cooling appliances.

Science / Competence Centers

Rheinisches Revier is a region with a high density of research institutes and innovation spaces which engage in the transfer of knowledge for establishing circular solutions in the field of plastic production and construction.

RWTH Aachen

RWTH Aachen is one of the leading technical universities in Germany. It is not only engaged in foundational research but sets a focus on **knowledge transfer**. According to IHK Aachen, more than 850 new companies were founded as start-ups in the context of RWTH Aachen during the last 30 years and still exist today (Interview C, 2022).

- *Institut für Kunststoffverarbeitung (IKV)*

IKV at RWTH Aachen is a **leading European research and training institute** in the field of plastics engineering. Key task at IKV is to combine scientific with practical knowledge. IKV's work is based on foundational research at RWTH Aachen but transfers this knowledge to make it of use in industrial practice. IKV's network encompasses all branches in the regional plastic industry – consisting of more than 290 members. It engages in publicly financed research as well as in bilateral projects with industry partners. IKV's research focuses on four **guiding topics**: additive production, **circular economy**, digitalisation of industry, and lightweight construction – with a special emphasis on the automotive sector (IKV Aachen, no date). IKV recently worked on **recommendations for a national circular economy strategy** – integrated into a dialogue process organised by PlasticsEurope (IKV Aachen, 2022).



- *DWI – Leibniz-Institut für Interaktive Materialien e.V.*

At the DWI a research group lead by Dr. Jens Möller engages in innovative research on **bio-based isocyanat-free polyurethane** for using in textile production (DWI Leibniz Institut, no date).

- *Professorial Chair: Recyclable Construction*

The **Junior Professorship Cycled-Oriented Construction** has been established at the Faculty of Architecture in October 2014 at RWTH Aachen – with a focus on the production and deconstruction phase of a building’s life cycle. The junior professor Linda Hildebrand and her team do research on integrating secondary materials in construction design (RWTH Aachen, 2023).

Region of Excellence: Sustainability in Construction

Rheinisches Revier has gradually developed into a **region for excellency in sustainability in construction** (*Exzellenzregion Nachhaltiges Bauen*). In the region, a network of partners and initiatives exists that interlinks universities, research institutions, planning agencies, construction companies, and producers to plan and construct model buildings guided by regional principals of sustainable construction. Part of this alliance are the **Healthy Building Network (HBN)** (HBN, 2023), **Aachen Building Experts (ABE)** (ABE, 2023) and **ReBAU – Regionale Ressourcenwende in der Bauwirtschaft** (Rebau 2023a). It is especially ReBAU which stands for a consistent change in construction to a wider circular economy approach reducing resource usage to a minimum in the region. In the context of ReBAU a competence center for the regional resource transition in construction (*Kompetenzzentrum für eine Regionale Ressourcenwende im Bauwesen*) was established which is run by ZRR and the regional Faktor X agency of indeland GmbH. It systematically scans new approaches to planning and construction in the region, supports architects and building owners, and is in the early stage of planning a model city quarter which will be planned and built in a circular way in Rheinisches Revier (Rebau, 2023b).

Media Institutions

Regional journalism has an attending role in reporting on regional transition projects by explaining complex processes – such as the establishment of hubs for circularity – and by filtering how this transition is relevant to the people in the region. Three main media outlets seem to play an important role in *Rheinisches Revier*:

- **Rheinische Post (RP)** is the dominant newspaper in the region with a circulation of 237.100 copies per day in the region. It has local newsrooms in Düsseldorf, Mönchengladbach, Neuss, Krefeld, Jüchen, and Erkelenz.
- **Aachener Zeitung** covers the western parts of the *Rheinisches Revier* with a circulation of 81.550 copies sold in the areas of Aachen, Heinsberg, and Düren.
- **WDR** is media outlet for radio and television governed by public law (*öffentlich-rechtlich*) in NRW. It has local outlets (*Landesstudios*) in Aachen, Cologne, and Düsseldorf.

2.1.2 Material Loops: Key Stakeholders

Having identified a dense network of stakeholders that shape the debate, engage in knowledge transfer and define regulations for introducing *hubs for circularity* on the national and regional level (*setting the frame*), we now need to delve deeper into the specific material loops that are of importance for establishing PU hard foam *hubs for circularity* in the region. Key stakeholders will be identified along the two different material loops of interest - refrigerators and insulation boards / sandwich panels – by looking at the current waste management value chain as well at the prospective material loop.

2.1.2.1 Refrigerators

The waste management process for end-of-life refrigerators is highly regulated in Germany (see: WP 3). An important overall monitoring and managing role for refrigerator waste is played by

stiftung elektro-altgeräte register (stiftung ear)

stiftung ear is a foundation under German civil law and was originally founded in 2004 by producers and associations of the electrical and electronic sector as a joint body. It has been granted sovereign rights resulting from the ElektroG by the German Environment Agency. *stiftung ear* fulfils the main following tasks and authorities:

- **registration of producers** that place electrical and electronic equipment on the market in Germany, or, in cases of authorisation according to § 8 ElektroG, their authorised representatives;
- guarantee examination;
- determination of collective producer guarantee systems;
- **data collection** of the amounts of electrical and electronic equipment placed on the market;
- **coordination of the provision of containers for handover facility and the pick-up of waste equipment at the public waste disposal authorities;**
- charge fees for the public services rendered.

stiftung ear does not discharge operational activities such as take-back and disposal of waste equipment, or logistics, sorting, dismantling and recycling. The producers and authorised representatives are responsible to do so. They bear the economic and factual responsibility for the recovery and disposal of waste equipment. The municipalities still collect waste equipment and provide the citizens with collection/recycling depots.

stiftung ear is currently represented by the managing director Alexander Goldberg. Further organs are the supervisory board, comprised of six representatives who are executives from registered producers, and the advisory board with representatives of the producers and the distributors, the Federal Government and the federal states (*Länder*), the waste disposal industry and environmental and consumer protection associations (EAR, 2023).

Waste Management (status quo)

Collecting



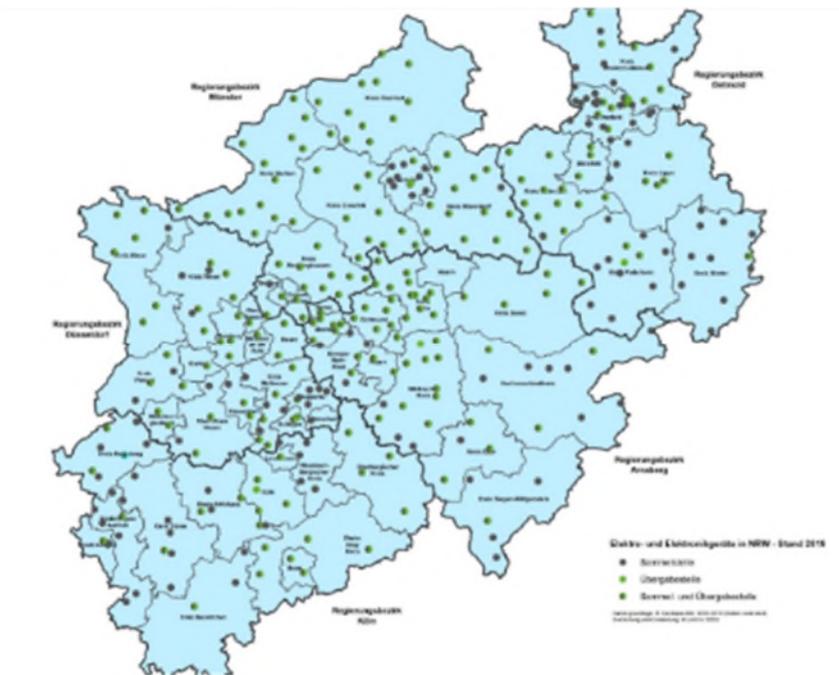


Figure 1: Collection Points in North-Rhine Westphalia for eWaste, Source: LANUV, NRW

In the *Rheinisches Revier* region there are just above 40 **collecting points** for electronic devices – including cooling appliances – which are run by public and private waste management companies (see figure 1).

In the *Rheinisches Revier* region *Zweckverband Entsorgungsregion West* (ZEW) operates the closest knit network of local civic waste collection points in the western parts of the region covering more than one third of the area and population. At several **disposal centres** (*Entsorgungszentren*) it collects and pre-sorts cooling appliances. Major disposal centres of ZEW's **AWA Entsorgungs GmbH** are *Entsorgungszentrum Warden* (see picture) in Eschweiler, *Horn* in Hürtgenwald, *Süd* in Monschau, and *Rurbenden* in Niederzier as well as *Recyclinghof Brand* in Aachen. The other counties in the region such as Rhein-Kreis-Neuss, Kreis Heinsberg, and Rhein-Erft-Kreis have also established disposal centres. They are only in part run by the communes themselves but also commissioned to be managed by private companies.



Figure 2: Sorting of eWaste - Entsorgungszentrum Warden in Eschweiler operated

The three major privately-run disposal centres are operated by:

REMONDIS GmbH & Co. KG – Region Rheinland

REMONDIS GmbH & Co. KG runs a disposal centre at *Haus Forst* in Kerpen. Remondis is one of the world's leading recycling, services and water companies with operating firms in all German major regions. Its clients are private customers, businesses and local authorities. Remondis collects, treats and markets around 30 million tonnes of recyclables per year handling a wide range of material types – from electronic devices, paper and wood, to construction waste and steel. With regard to cooling appliances, Remondis offers sorting, bulking up, classifying, conditioning and recycling services (see below) (Remondis, 2023).

Schönackers Umweltdienste GmbH

Schönackers Umweltdienste GmbH is one of the biggest waste management companies in *Rheinisches Revier* with its headquarters in Kempen (close to Mönchengladbach). Schönackers employs 1.600 people at more than 20 facilities in the region. Its clients are private customers, businesses and local authorities. Schönackers treats most waste types – ranging from household to industrial waste. *Schönackers Umweltdienste GmbH* operates major regional disposal centres in *Rheinisches Revier* – in Aldenhoven, Geilenkirchen, Niederkrüchten, and Kerpen (Schoenmakers, 2023).

Drekopf Recyclingzentrum GmbH

A. & P. Drekopf GmbH & Co. KG is one of the biggest owner-managed waste management company in Germany with its headquarters in Mönchengladbach. Drekopf develops sustainable disposal and recycling concepts for its clients according to its own concept of “*green waste disposal*” (*Grüne Entsorgung*) which gives recycling of materials a priority over thermal processing (incineration). Since 2018 the company operates its biggest, climate neutral and most modern sorting facility in Dortmund in which it has invested more than 3 million euros. In the northern area of *Rheinisches Revier* Drekopf runs several disposal centres – the biggest is located in Erkelenz in Kreis Heinsberg.

A grey area in the collection process are unregistered private **scrap dealers** who collect refrigerators on the roadside from house owners that have ordered bulky household waste to be disposed of (Drekopf, 2023).

Sorting and Dismantling

In the wider *Rheinisches Revier* region there are three major 1st and 2nd line treatment facilities for cooling appliances – including refrigerators:

- **NOEX AG**

NOEX AG operates a facility for certified 1st line treatment and recycling of electronic devices – including cooling appliances – in Grevenbroich which is located in the geographical heart of *Rheinisches Revier*. NOEX is a subsidiary company of *Entsorgungsgesellschaft Niederrhein* (EGN) which also operates the *MVA Weisweiler* together with *AWA Entsorgungs GmbH* (see below). NOEX's motto is: „*We transform old electronic devices into raw material for the*

future.” With its 90 employees NOEX treats 80.000 tons of electronic waste each year – 38.000 tons of it at the main facility in Grevenbroich (NOEX, 2023). Refrigerators are treated by hand and with the support of machines. NOEX conditions and sells 20.000 tons of recycled metal per year.

- **Enviprotect Kühl- und Elektrogeräterecycling GmbH**

Enviprotect Kühl- und Elektrogeräterecycling GmbH is a subsidiary firm of Lohmann Unternehmensgruppe located in Emsdetten, NRW, approximately 200 km outside of the *Rheinisches Revier* region. Enviprotect concentrates on the 1st and 2nd line treatment of electronic waste – with a special focus on cooling appliances. It is able to all-automatically recapture CFC and penthane and separate fractions of metal, plastic and especially **PUR-insulation material** (Enviprotect, 2023).

- **Remondis Electrorecycling GmbH**

Remondis Electrorecycling GmbH operates one of Germany's most modern demolition centres in Lünen close to Dortmund (*Rückbauzentrum Lünen*). It treats approximately 100.000 tons of electronic waste at this facility. At the site *Remondis Electrorecycling GmbH* runs a separate dismantling line for cooling appliances including refrigerators recapturing CFC and penthane and separating metals (Fe, NE, Hg etc), oil, freezing agents, and **PUR hard foam** (Remondis, 2022).

Thermal Treatment (Incineration)

Müllverbrennungsanlage (MVA) Weisweiler

MVA Weisweiler is a modern and high-efficient waste incinerating plant located in Weisweiler in close proximity to Aachen. 360.000 tons of waste can be incinerated at this facility. EGN Entsorgungsgesellschaft Niederrhein mbH (EGN) and AWA each hold 50 percent share of the company since 2005. As a waste-to-energy facility MVA Weisweiler produces heat and power for more than 70.000 households in the region. It additionally operates a metal recycling line which is able to separate 90 percent of the remaining metal fractions before they go into incineration (MVA Weisweiler, 2023).

Forward (future loop)

Chemical Recycling

Chemical recycling technologies have still to be developed further. In the wider *Rheinisches Revier* region two major companies could be identified as having the potential and know-how to engage in complex chemical recycling techniques.

- **Covestro**

Covestro is among the leading suppliers of premium polymers. It produces precursors for polyurethane foams and the high-performance plastic polycarbonate as well as precursors for coatings, adhesives, sealants, and specialty products, including films. Covestro’s focus with its 17,900 employees who work at 50 production sites across the globe is on sustainability and



innovation. Guided by its new sustainable future strategy the company aims to become fully circular. With its production facility for PUR at Chempark Dormagen and its research labs at Chempark Leverkusen Covestro is well suited to establish chemical recycling processes for PU hard foam (Covestro, 2023).

- **Lyondell Basell**

At its Wesseling/Knapsack Complex *Lyondell Basell* operates two manufacturing sites as an integrated facility, its largest in Europe. The Wesseling/Knapsack Complex has a production capacity of more than 2.2 million tons of polyolefins a year. Two crackers, four high density polyethylene plants, two low density polyethylene plants, three polypropylene plants and one advanced polyolefins plant are in operation among the two sites. Additionally, Wesseling has its own power plant with a capacity of 470 MW, a wastewater treatment plant and a sewage incineration plant. Products from the facilities are used for films, cable and pipe coatings, fuel tanks, injection mouldings and household articles. Approximately 1,400 employees and 170 trainees work at Wesseling, along with 1,000 contractors. Knapsack has about 150 employees (LyondellBasell, 2023).

Production

In the *Rheinisches Revier* region there are no active production facilities for cooling appliances. Key players in the German market are Bosch, Siemens, Liebherr, Bauknecht, Samsung. The production of main parts of refrigerators is located outside of Germany. **BSH Haushaltsgeräte** is the only manufacturer with production facilities in Germany, located in Giengen und Ochsenhausen in Baden-Württemberg. BSH works for Bosch und Siemens assembling refrigerators parts. **Miele** is, however, the only electrical household equipment company in the region operating a Technology Center (TCD) in Euskirchen. TCD was established as a competence centre and production facility for the development and manufacturing of drives and pumps for Miele products such as vacuum cleaners, washing and dish washing machines (Miele, 2023). In NRW there can also be found **Igloo Deutschland**, a major polish-based manufacturer of refrigeration equipment, inverter and cogeneration units for the food industry / supermarkets and confectionery, baking and catering industries. Its German headquarters and production facility is located in Kierspe in the Sauerland area in NRW.

Retail

There are several speciality markets for electronic devices in the *Rheinisches Revier* area. The biggest players in the business to consumer (B2C) segment are

- **MediaMarkt** with markets in Eschweiler, Cologne, and Neuss;
- **Saturn** with markets in Düren, Kerpen, Cologne, and Mönchengladbach;
- **expert** with markets in Düren, Heinsberg, Simmerath, Neuss, Dormagen, and Euskirchen.
- **Metro** with markets Aachen, Düren, Cologne, and Neuss

Loop Map



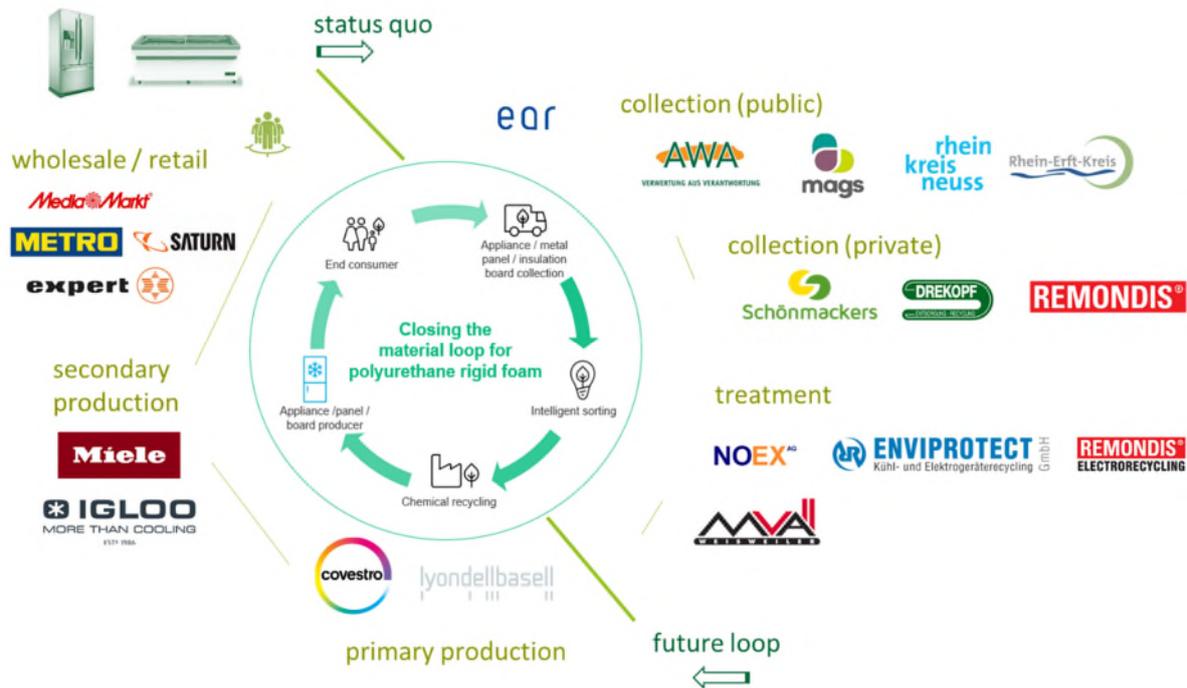


Figure 3: Loop Map - Refrigerators, Rheinisches Revier / North Rhine Westphalia, Source: own elaboration

2.1.2.2 Insulation Boards / Sandwich Panels

The waste management process for end-of-life insulation boards and sandwich panels is not as tightly regulated in Germany as for electronic devices (see: WP 3). In general, insulation boards and sandwich panels with PU hard foam make up a small proportion of the whole house insulation market which is in Germany still dominated by EPS products (*expanded polystyrol*).

Waste Management (status quo)

In Germany, end-of-life insulation boards and sandwich panels are grouped in the waste material flow for insulants and have to be separated at the demolition site and collected separately from other waste types. However, in NRW, it is almost impossible to grasp the entirety of demolition material as only demolition projects with more than 500 cubic metres of waste (bungalows, small warehouses) require a disposal concept, which impedes surveillance by local authorities (Interview D, 2022).

Collecting, Sorting and Dismantling

The vast majority of house owners and landlords employ local companies to demolish buildings and care for its disposal. One of the biggest firms doing demolition work explicitly in *Rheinisches Revier* is

A. Tenzer GmbH & Co. KG

A. Tenzer GmbH & Co. KG is a family-owned construction company with 30 employees located in Heinsberg. It offers a whole range of different services including underground work, transport of construction materials, demolition of buildings, and recycling of construction waste. Tenzer owns a specialised fleet of machines for transport and demolition work as well as a modern construction waste recycling facility (Tenzer Beton GmbH, 2023).

Most of the demolition firms commissioned by house owners and landlords however do not have transporting and recycling facilities for handling construction waste. They thus employ service

companies such as **Remondis Entsorgung GmbH**, **Schönackers Umweltdienste**, **Containerdienst van Birgelen** (in Waldfeucht, Kreis Heinsberg), or **Drekopf** that provide container services and guarantee the pickup of demolition and insulation waste as well as its further treatment regulated by law.

Thermal Treatment

After removing metal, wood and other recyclable material construction waste either goes into thermal treatment at **MVA Weisweiler** or into landfill. One of the biggest landfill disposal sites is operated by **Dürener Deponiegesellschaft** in Hürtgenwald in the middle of the *Rheinisches Revier* area. The site was opened in 2018 and is run as a pit landfill (*Grubendeponie*) using a former 19,5 hectare lignite mining area called *Maubacher Bleiberg*. The disposal site has a volumina of 10 million cubic metres measuring 90 metres of height.

Forward (future loop)

Chemical Recycling

The companies capable of chemical recycling are **Covestro** and **Lyondell Basell** – the same as in the material loop for refrigerators.

Production

The biggest producer of insulation material in construction in the region is **Xella**. Its headquarter is located in Cologne. Xella Baustoffwerke Rhein-Ruhr GmbH operates a production facility in Dormagen. Xella offers innovative and sustainable building and insulation solutions for high-quality and long-lasting buildings based on natural raw materials. However, with Multipor XELLA only sells a product for house insulation that is made out of mineral materials such as limestone and sand, not out of hard foam (Xella, 2023). Important manufacturing companies for PU hard foam insulation boards and sandwich panels in NRW are instead:

- **LD Systemprofile GmbH & Co. KG**

LD Systemprofile GmbH & Co. KG is a manufacturing and wholesale company for PIR insulation systems and sandwich panels used in construction. The company is located in Neuenkirchen-Vörden close to the border of Lower Saxony and NRW (LDS, 2023).

- **Kingspan Insulation GmbH & Co. KG** is one of the major companies in advanced insulation and building envelope solutions. The company's mission is to accelerate a net zero emissions future in construction. Kingspan has more than 19.000 employees at 198 manufacturing sites worldwide. One of its facilities is located in Ibbenbüren, NRW, in close proximity to Münster (Kingspan, 2023).

Wholesale/ Retail

Wholesale of insulation material for construction is handled by the above mentioned companies such as Kingspan. They sell directly to building firms. For retail there are several specialty markets for insulation material in the *Rheinisches Revier* area. The biggest players in the business to consumer (B2C) segment are building DIY centres:



- **Mobau** (regional building supply store) with markets in Düren, Eschweiler, Stolberg, Bedburg, Bergheim, Geilenkirchen, Mönchengladbach, and Hückelhoven.
- **OBI** with markets in Aachen, Eschweiler, Mönchengladbach, Kerpen, and Cologne.
- **Bauhaus** with markets in Aachen, Düren, Mönchengladbach, and Cologne.
- **toom** with markets in Jülich and Düren.
- **hagebaumarkt** with markets in Euskirchen and Erftstadt.

Loop Map

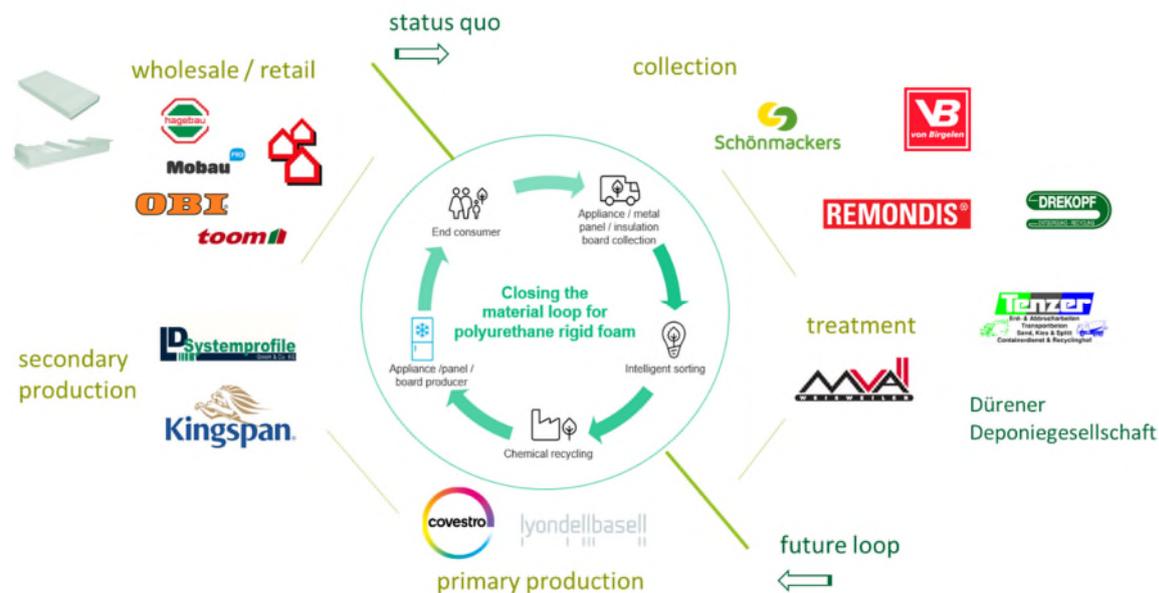


Figure 4: Loop Map - Insulation Boards / Sandwich Panels, Rheinisches Revier / North Rhine Westphalia, Source: own elaboration

2.2 Stakeholder Analysis

Building on the identification in chapter 2 it is important to now further analyse the relevance and positioning of stakeholders in the field of establishing *hubs for circularity* for PU hard foams. We do this by using two different mapping methods:

- **an interest-influence matrix** which is a commonly used technique to analyse the motivation to act and the influence of stakeholders on processes and organisations. Of special interest are stakeholders that can be identified as drivers or agents of change which are positioned in the right upper matrix field. By ascribing them colours (green/blue/red) one can also indicate if stakeholders are positive, neutral or adversary towards a certain topic, institution or process.
- **a core-periphery map** illustrating which stakeholders are shaping developments in a direct and indirect way as well as if they have a primary role in establishing processes or a secondary role in setting the frame for change on the ground.

2.2.1 Interest-Influence-Matrix

The **first matrix** (see below) is focused on the question of how much interest and influence key stakeholders have on **establishing hubs for circularity** for PU hard foam.

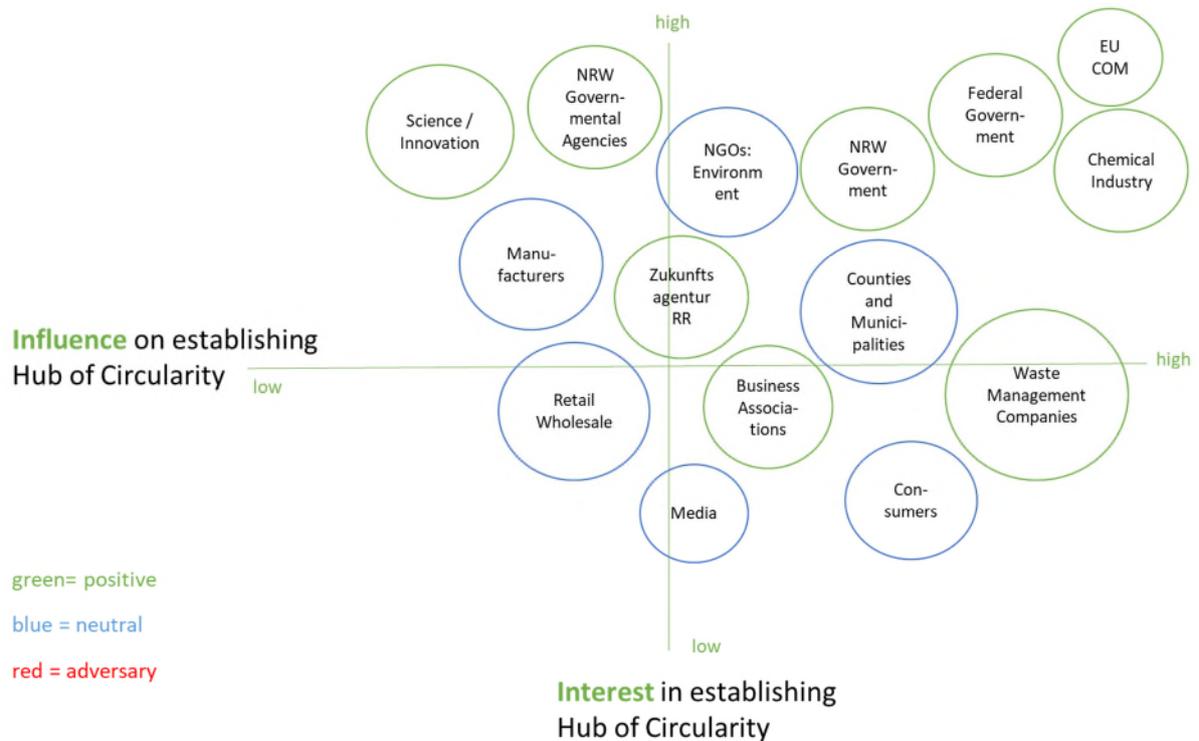


Figure 5: Interest-Influence-Matrix, Hubs for Circularity, Rheinisches Revier / North Rhine Westphalia, Source: own elaboration

The interest-influence matrix shows two interesting main findings:

- **Broad support for circularity:** There seems to be a broad general support among stakeholder groups for the establishment of *hubs for circularity*. None of the groups identified have an adversary opinion on it. Important actors can however be identified as neutral: In the case of communes, manufacturers, retail, media, and consumers this has to do with a wait-and-see attitude since it is not clear how exactly the material loops will be closed, how the pricing and value added of a circular PU hard foam material flow is. In the case of environmental NGOs a neutral position is assigned due to a sceptical view on the effects of chemical recycling as well as a premium put on waste avoidance and zero waste concepts and not on recycling.
- **Drivers of change:** A coalition of change agents can be identified. It consists of a close alliance of governmental actors which try to push forward new concepts and regulations for circular solutions in the field of plastic production with business and industry partners which develop ever more stringent strategies to become fully circular. It seems important for these drivers of change to put an increased effort into convincing wait-and-see stakeholder groups by showing the added value of creating a hub for circularity as early as possible in the process.

The **second** matrix drawn is focused on the question of how much interest and influence key stakeholders have on **introducing chemical recycling technologies**. Here the map shows differing results.

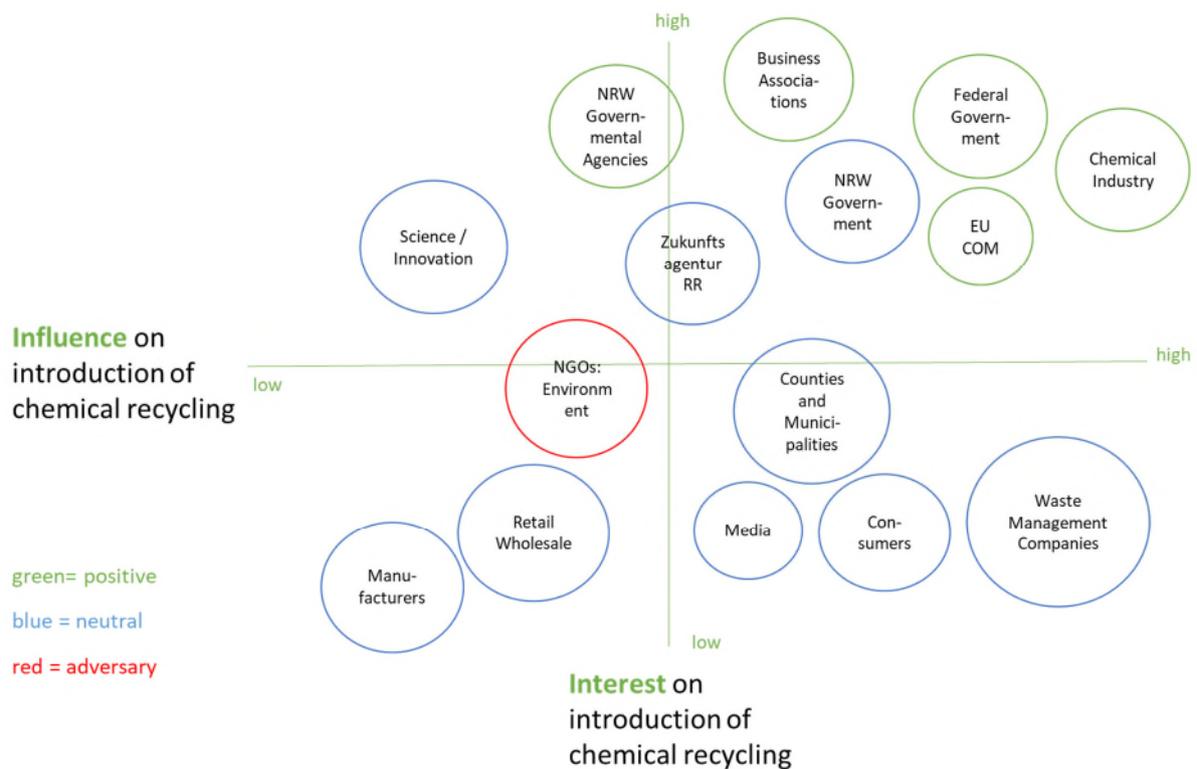


Figure 6: Interest-Influence-Matrix, chemical recycling, Rheinisches Revier / North Rhine Westphalia, Source: own elaboration

The question of introducing chemical recycling as a key technology to becoming fully circular is politically much more intensely debated than the support for becoming circular in plastic. Chemical recycling is approached with scepticism by environmental groups by citing insecurities when it comes to the high energy input needed, the possible ecological effects of possible detrimental byproducts, and high losses and quality problems of new upcycled products. Key actors in the state government in North Rhine-Westphalia are also in a wait-and-see position. The chemical industry and its aligned business associations, however, see chemical recycling as a cornerstone of a future circular plastic economy. They push for including the technology as one formally recognized recycling option - with success. The coalition agreement on the federal level (*Bundesregierung*) actively states chemical recycling as a new option in establishing circular economic solutions for the first time.

2.2.2 Core-Periphery Map (direct / indirect – primary/ secondary)

The core-periphery map structures the wide stakeholder landscape very lucidly. It is possible to grasp

- stakeholder groups that are actively setting the frame for the establishment of PU hard foam *hubs for circularity*. These are superordinate actors such as the European Commission, the federal and state governments as well as change agents in NRW that bring stakeholders together and transfer knowledge in the region (e.g. IN4climate.NRW, Kunststoffland.NRW or the roundtable on circular economy);

- stakeholder groups that have a secondary role in shaping the debate on the introduction of circular economy (e.g. NGOs and business associations) solutions and develop models and guiding knowledge (e.g. Wuppertal Institute, Chemie hoch3, UBA, or Circular Economy Initiative);
- stakeholder groups that have or will have a very direct role in creating PU hard foam *hubs for circularity* inside the region along the two different material loops – with key actors such as *Covestro, AWA Entsorgung GmbH, NOEX, Kingspan* and several retailers.

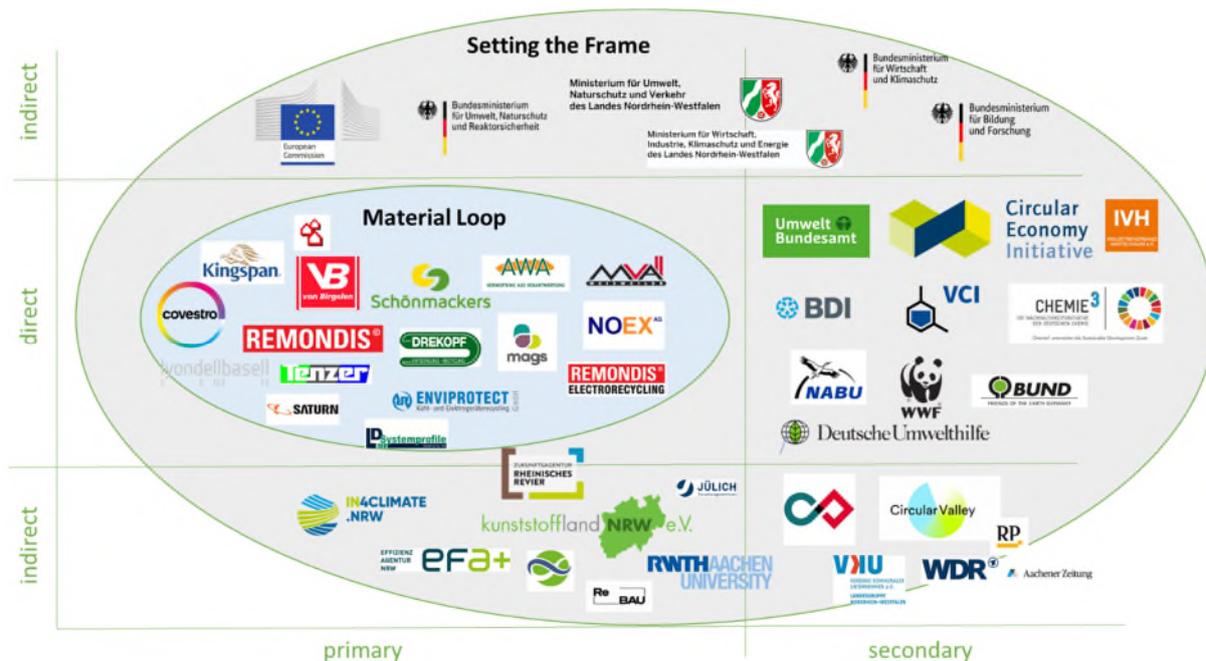


Figure 7: Core-Periphery-Map, Rheinisches Revier / North Rhine Westphalia, Source: own elaboration

There are several findings that you can take from this map:

- *Lively political debate and stakeholder landscape:* We can identify a vast group of stakeholders in Germany, in NRW and in the region that engage in conceptualising, discussing and shaping the debate on introducing circular economy solutions – ranging from governments, initiatives, environmental groups, business associations and research institutions. Striking is the significant role of intermediary governmental agencies and initiatives in NRW such as *IN4climate.NRW* or *Runder Tisch Zirkuläre Wertschöpfung* who have a dominant role in activating key actors to gain more practical knowledge on how to establish circular economy solutions on the ground.
- *A well-experienced and established field of actors in the region:* In the *Rheinisches Revier* region there is a set of very experienced actors in waste management and recycling that has established a vivid culture of cooperation and a very pronounced division of labour resulting in a very specialised and state of the art field of public and private companies. There also seems to be a chance to close the material loop for PU hard foam in the future since we

have identified core actors in every step of the material flows – except for the secondary production of refrigerators and insulation materials which are located outside of the region.

2.3 Conclusion

The Stakeholder Report for *Rheinisches Revier* reveals that there is a supportive stakeholder landscape that favours the establishment of possible PU hard foam *hubs for circularity* in the region. Stakeholders are open to introducing new ways to become circular for different material flows – currently with a focus on metal, construction material, and packaging, not yet centred on durable plastics such as PU hard foam.

On the federal level, triggered by the EU *Circular Economy Action Plan*, the German government is keen to push superordinate legislation and regulation to foster the introduction of circular economy solutions for different material flows. The most urgent task on the federal level currently is to formulate an encompassing national circular economy strategy that for the first time plans to bundle together various laws, initiatives and regulations in Germany – led by the *Federal Ministry of Environment, Nature and Consumer Protection* (BMUV). This approach is supported by a broad alliance of major political parties that express general support for the goal of establishing a circular economy and to become more independent regarding the use of raw materials.

Additionally, a broad range of national stakeholders accompany this process by engaging in formulating guidelines, position and policy papers, dialogue forums as well as CE models – including the *Circular Economy Initiative Germany*, business associations such as BDI and VCI, and environmental groups such as NABU, DUH and WWF. There are, however, differences in stakeholder positions when it comes to prioritising and designing circular economy solutions. While industry and business associations favour market-based solutions guided by an overarching legislative framework as well as an openness towards new technological paths such as chemical recycling, environmental groups put more emphasis on detailed regulation, favouring the avoidance of plastic waste over recycling and are critical of processes that lead to the same future output of plastic-based products that we are experiencing today (although they might be up- or fully recycled). Very notable is the opposition of the influential DUH towards the introduction of chemical recycling in Germany.

The stakeholder landscape in NRW is also well organised and supportive of introducing *hubs for circularity* at large. In the NRW state government, there are two key actors pushing new regulations on circular economy solutions – namely the *Ministry of Ecology, Nature and Transport* (MUNV) and the *Ministry of Economy, Industry, Climate Protection and Energy* (MWIKE). It is, however, not clear yet which ministry is responsible for the formulation of a coming state circular economy action plan.

This is slowly changing due to the leading role of various intermediate governmental agencies and initiatives that engage in knowledge transfer, networking, and best practice accumulation on circularity. It is unique for NRW to have such strong intermediating actors in the field such as *NRW.Energy4Climate*, *IN4climate.NRW*, *Effizienz-Agentur NRW (EFA)* and *Runder Tisch Zirkuläre Wertschöpfung*. They bring business, scientific and environmental stakeholders together to discuss and to engage in establishing circular economy solutions in different regions in NRW – including *Rheinisches Revier*. However, there has not yet been a focus on the possibilities that PU hard foam

upcycling can provide as an innovative and exemplary field to start establishing circular economy solutions on the ground.

In *Rheinisches Revier*, there is a strong stakeholder landscape with experienced actors that are open to introducing circularity. Led by the goal to make *Rheinisches Revier* a European model region for a sustainable use of resources, it is mainly the *Zukunftsagentur Rheinisches Revier* (ZRR) that is responsible for bringing different stakeholders together to focus on establishing pilot *hubs for circularity*. ZRR initially started fostering circular economic solutions in the regional construction business – supported by initiatives such as *Exzellenzregion Nachhaltiges Bauen*, *Healthy Building Network (HBN)*, *Aachen Building Experts*, and *ReBAU*. It is currently switching its focus on the circularity of plastic-based products but has not yet started to build networks or funding opportunities for pilot projects.

The waste management sector in the *Rheinisches Revier* region is inherently ready to engage in the introduction of *hubs for circularity* on durable plastics. There is a well-established set of public and private waste management companies that are open to new business models and to engage in circular economic solutions – with *AWA GmbH*, *mags*, *Remondis*, *Schönackers*, *Drekopf* and *Tenzer* leading the way. As one interviewee put it: “*When there is a business model that becomes apparent, stakeholders in the region will be ready to implement it.*” (Interview A, 2022). It is also important to notice that scientific organisations (e.g. *IKV at RWTH Aachen*) and chambers of commerce in the region are open to see the potential of establishing *hubs for circularity* for PU hard foam – and, specifically, to set up a demonstration unit in the *Rheinisches Revier* region.

Finally, the stakeholder report revealed that there already is a well-established industry association with *Industrieverband Hartschaum* (IVH) in Germany that gained experience with setting up a *hub for circularity* for insulation boards containing EPS (polystyrene). Their solution is called *PS Loop B.V.* – with a *PolyStyreneLoop* facility located in the Netherlands. It could be of value to exchange ideas and good practice with IVH to learn of the opportunities and challenges the companies represented in IVH faced to set up a closed material loop for plastic-based insulation material.

3. Pilot Region B: Upper Silesia / GZM

3.1 Stakeholder Identification

In the following analysis, we focus primarily on identifying key stakeholders whose role and position is important for shaping and creating a closed loop for polyurethane foam from refrigeration equipment and building materials in Metropolis GZM area . For the purposes of this document and the ongoing project, we have divided the stakeholders into two groups. The first is national stakeholders and the second is regional stakeholders. First, we are looking at stakeholders who are important actors in creating the framework for a specific project and organising hubs for the circular economy - at the national and regional levels. Second, we will focus on local stakeholders who play a key role in the material flow of polyurethane foam in the current waste management value chain, as well as prospectively, by closing the material loop in the future.

3.1.1 Setting the Frame: Key Stakeholders

European Union

European Commission

In recent years, the EU has taken steps towards a transformation towards a circular economy. Through the implementation of strategies and action plans, as well as directives, standards and other documents (Figure 8), industrial performance and consumption are being regulated and improved, based on more circular economic models. Today, circular economy is a priority of EU economic policy for the coming years and one of the key drivers for the implementation of responsible, sustainable development principles. The dynamic dissemination of the circular economy model has been particularly evident since 2014 through programmes on resource efficiency, low-carbon, competitiveness and waste reduction - Towards a circular economy: A Zero Waste Programme for Europe and Closing the loop - the EU Action Plan for a Circular Economy. The Sustainable Development Goals (SDGs) set for United Nations (UN) members in the framework of the adopted Agenda 2030 in 2015 (in particular Goals 7, 11, 12, 13, 14, 15) were also an important impetus for the development of the circular economy model. They are related, inter alia, to sustainable development, the protection of ecosystems and safeguarding the economy against resource wastage through the re-use of raw materials, i.e. important building blocks of the circular economy model chain. The Commission's 2015 communication aimed at introducing the circular economy and thereby, among other things, increasing the EU's competitiveness by protecting companies from resource scarcity and price volatility, providing new business and innovation opportunities, and more efficient ways of production and consumption. At the time, the EU's focus was on, among other things, electrical and electronic products, production processes, the life cycle of a product after its purchase by the consumer or waste management.

The Commission's 2020 Communication is another, not the first, EU document on a circular economy. For this reason, it does not discuss the circular economy in detail, but rather focuses on the most important current problems and their possible solutions. Global consumption of materials such as



biomass, fossil fuels, metals and minerals is expected to double over the next forty years, while the amount of waste generated annually is expected to increase by 70% by 2050.

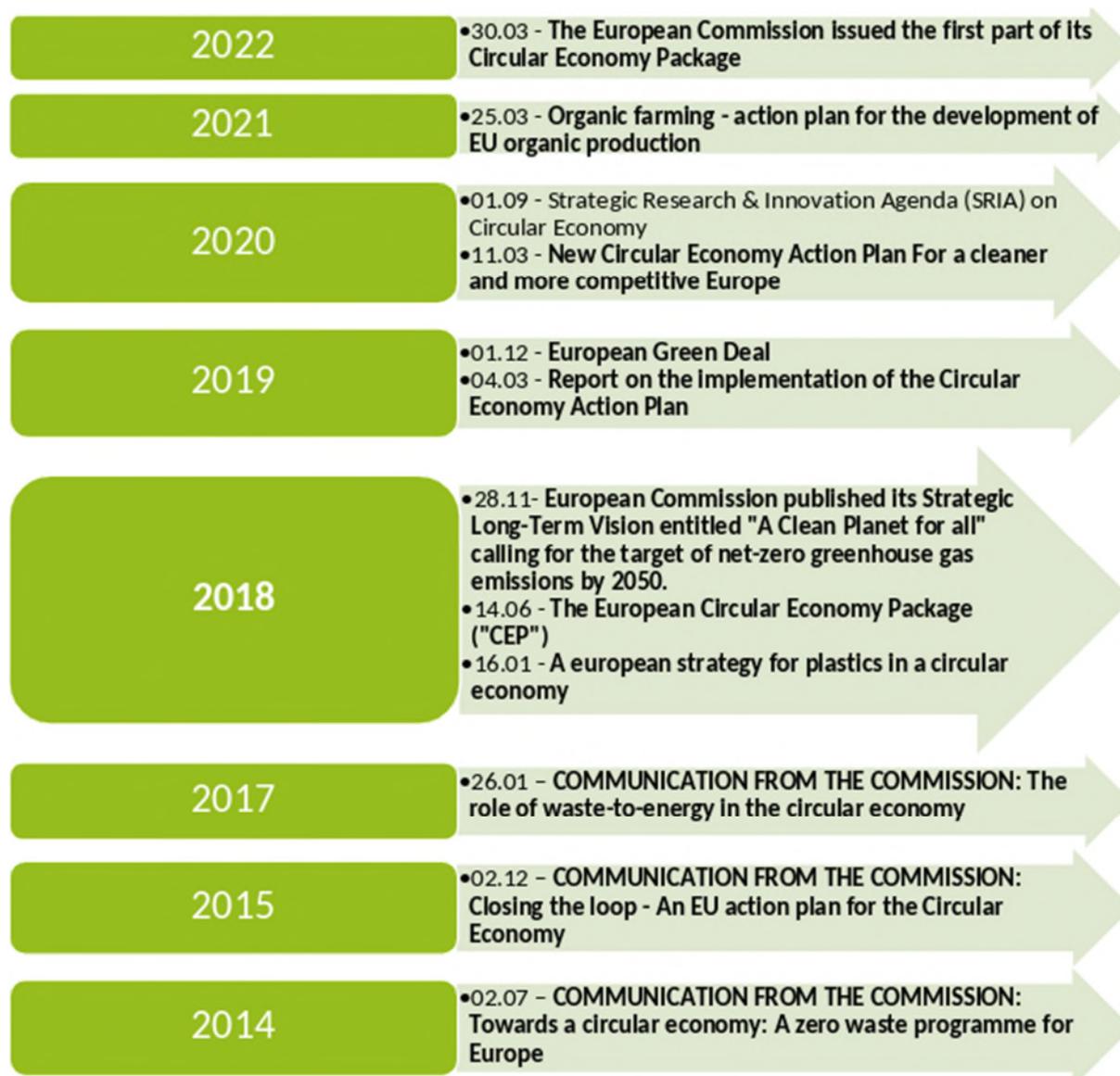


Figure 8: Selected documents at European level related to circular economy issues

Source: own elaboration

National State: Poland

Ministry of Economic Development and Technology

The Ministry of Economic Development and Technology plays a leading role in coordinating Poland's economic transformation towards a circular economy model and promotes the 'collaborative' implementation of the circular economy in Poland by involving different communities at local, regional, national, as well as EU and global levels from the world of science, the public administration sector, entrepreneurs, citizens and their cooperation.

On 10 September 2019. The Council of Ministers adopted a resolution on the adoption of the "Roadmap for the transformation towards a circular economy" .

"The Circular Economy Roadmap" is a strategic document on circular economy, covering all areas of this economic model. The implementation of the different actions foreseen in the "Map..." will be carried out by the ministers in charge of the different branches of the economy. "Map..." is also one of the projects of the Strategy for Responsible Development. It contains 5 chapters:

- Sustainable industrial production
- Sustainable consumption
- Bioeconomy
- New business models
- Circular economy implementation and monitoring

In addition, the Ministry of Development in 2019 led the establishment of a National Smart Specialisation for circular economy, focused on the development of R&D&I in the area of circular economy technologies (in particular in the area of water, non-renewable raw materials and waste) with the cooperation of entrepreneurs, scientists and public institutions. In addition, the Ministry has implemented (in cooperation with the Central Statistical Office, the Cracow University of Economics and the Institute of Mineral and Energy Economy of the Polish Academy of Sciences) the 'oto-GOZ' project between 2019 and 2021. The aim of the 'oto-GOZ' project was to develop a set of measurement indicators (the so-called circular economy indices) to assess progress in the transformation towards a closed-loop economy and to evaluate the impact of a circular economy on socio-economic development at the meso-economic (regional) and macroeconomic (national economy) levels.

Ministry of Climate and Environment

The Ministry's activities include, inter alia, climate and sustainable development issues, particularly with regard to waste management, including as part of a circular economy. The Ministry is the body responsible for shaping policies related to waste management within the country. On the initiative of the Ministry of the Environment, a pilot programme entitled Circular economy in municipalities was established in 2017, financed by the National Fund for Environmental Protection and Water Management. In addition, in April 2022, the Minister of Climate and Environment appointed a Plenipotentiary for the Circular Economy. He will be responsible for coordinating and reporting on the implementation of the circular economy in Poland. The specific tasks of the new plenipotentiary will include streamlining the ministry's activities in the area of the circular economy, including within the framework of the implementation of the 'Roadmap for transformation towards a circular economy'. In addition, he/she will be responsible for the acquisition, collection and processing of information and preparation of materials, concerning the circular economy, "necessary for the Minister's policy related to the transformation towards a circular economy". He or she will also provide the Minister of Climate with analyses and assessments of the current situation and the scope of implementation of activities, and present proposals for his or her own solutions.

Other important documents at the national level are the Strategy for Responsible Development (SRD) and the National Environmental Policy 2030 (NEP2030). The SRD was prepared by the Ministry of Development Funds and Regional Policy and was adopted by the Council of Ministers on February 14,



2017. The SOR is a medium-term strategy for the country's development, which presents goals to be achieved in the 2020 and 2030 horizons, defines indicators for their implementation, indicates how they will be achieved, and identifies the most important projects for achieving the SRD goals.

As indicated in the SRD, modern waste management, consistent with the EU waste hierarchy and aiming to implement a circular economic model, requires a change in the current approach of viewing waste as a source of resources (including the possibility of replacing primary raw materials with secondary raw materials created from waste), as well as accelerating the development of recycling. The goals and actions necessary to achieve and undertake in this regard are set forth in the National Waste Management Plan 2028 (NWMP 2028) - which is, in addition to provincial waste management plans with investment plans, the primary planning document in waste management.

Another strategic document into which NWMP 2028 fits is the "National Environmental Policy 2030 - Strategy for Development in the Area of Environment and Water Management" (NEP2030), which is the most important strategic document in the area of environment. In the system of strategic documents, NEP2030 is a clarification and operationalization of the provisions of the SOR. In the specific objective "Environment and Economy. Sustainable management of environmental resources," Waste management towards a circular economy is indicated as one of the directions of intervention. The NWMP 2028 is the primary instrument for implementing NEP2030 in this area, under which the following activities will be supported:

- 1) waste management in accordance with the waste hierarchy;
- 2) developing waste recycling;
- 3) striving to maximize the use of waste as raw materials.

Senate Special Committee on Climate Change

The Committee's tasks include considering and developing issues related to: climate neutrality, bio-availability, circular economy, climate industrial strategy, intelligent and sustainable transport, climate change adaptation, including flood and drought protection, farm-to-table strategies, participation in shaping climate policy, implementation of climate policy in Poland, energy efficiency, development and promotion of renewable energy sources, socio-economic aspects of climate transformation, climate education, management of natural resources used for energy production and air protection, climate change financing.

National Fund for Environmental Protection and Water Management

It has been initiating and supporting activities dedicated to the environment and energy transition for more than 30 years. It finances and co-finances pro-environmental projects. It has already allocated PLN 270 billion for this purpose, almost two thirds of which are its own funds. Support from the NFOŚiGW is used by entrepreneurs, local and state administrations, as well as universities, NGOs and private individuals. For years, the National Fund for Environmental Protection and Water Management has been a leader in implementing programmes to improve the climate and quality of life in Poland.

In its plans, the National Fund for Environmental Protection and Water Management clearly indicates that one of the areas of support will be projects, undertakings compliant with the circular economy idea, such as: investment undertakings concerning the development of infrastructure supporting



waste prevention, educational undertakings contributing to the implementation of circular economy principles or investment undertakings concerning circular economy in households, agriculture or manufacturing.

National Centre for Research and Development (NCBR)

NCBR is a key centre for supporting and creating innovative technological and social solutions, it creates an ecosystem of knowledge and information about them. It initiates and implements undertakings contributing to the civilisational development of the country. One of the key initiatives of NCBR, included in their strategy, is to support the creation of entities dealing with strategic technological challenges - incubators, accelerators, centres. GOZ is one of many areas of support from NCRD. In carrying out its tasks, the Center also engages in cooperation with other entities, as well as creates sector programs in direct response to the needs of entrepreneurs in specific sectors of the Polish economy. It also tries to involve Venture Capital funds in R&D financing. An important area of the Center's activity is international cooperation. Since 2011, the Center has also acted as an intermediary institution for priorities in the area of R&D support and higher education.

National Key Stakeholders – Business/Industry

Polish Association of Manufacturers and Processors of PUR and PIR Insulation (SIPUR)

The Polish Association of Manufacturers and Processors of PUR and PIR Polyurethane Insulations "SIPUR", registered in May 2009, has been striving since the beginning of its activity to represent the interests of all its members and to actively promote polyurethane insulation, to disseminate the benefits of using thermal insulation with particular emphasis on PUR and PIR foams and to ensure a market position for polyurethane insulation commensurate with its high quality.

The main areas of activity of "SIPUR" are: promotion, education, legislative matters, technical standards and insurance matters related to PU insulation.

The Association actively cooperates with state authorities, research institutes, Polish and European trade unions and associations, technical and agricultural universities. Currently, the Association brings together 29 manufacturing, trade and service companies operating in the polyurethane industry in Poland.

APPLIA Poland

APPLIA Polska is an association of household appliance employers representing manufacturers and importers of household appliances in Poland. APPLIA Polska is the new name of the organisation, which operated under the name CECED Polska from its registration in 2004 until May 2018. The association brings together 27 companies. APPLIA Poland is:

- An effective and unique representation of the white goods industry in Poland
- An active participant in social dialogue
- An expert on issues such as circular economy and energy efficiency
- Initiator of Codes of Good Practice for the white goods industry and educational campaigns.
- Centre for research and analysis of the white goods industry in Poland
- Representation of the industry in standardisation institutions - chairman of two committees in the Polish Committee for Standardisation and member of the CENELEC Administrative Board



- Founder and main shareholder of ElektroEko S.A. Electrical and Electronic Equipment Recovery Organization, the largest recovery organization in Poland
- Member of APPLiA Home Appliance Europe - association of European producers of household appliances and national organisations of this sector, National Chamber of Commerce and Confederation of Employers of Poland

Polish Green Building Council (PLGBC)

PLGBC is a non-governmental organisation that since 2008 has been on a mission to radically improve the design, construction and use of buildings in Poland so that sustainable construction becomes the norm. They co-create buildings, cities and their surroundings that allow people and the planet to continually evolve by:

- Resisting climate change and adapting to new conditions
- Applying circular economy principles
- Improving the well-being, quality of life and health of the population
- Increasing biodiversity

Currently, PLGBC, together with the Silesian University of Technology and the Green Building Council Iceland, is implementing the CIRCON project - Circular economy in construction: eco-design of circular buildings. Activities in the project include:

- Strengthening the implementation of the circular economy in the building sector.
- Development of a handbook on designing buildings according to circular economy principles
- Dissemination of knowledge on circular building design among key stakeholders in the construction sector - training.

Association "Polish Recycling"

The association 'Polski Recykling' was founded in September 2015 and brings together companies involved in waste recycling. It responds to the need to create a representation of the sector in public life. The main objective of the Association is to be a credible and responsible voice of the recycling industry by representing the common problems and interests of the industry before state administration bodies, governmental and non-governmental institutions and organisations. The Association considers the promotion of recycling as the most environmentally beneficial waste treatment process and ensuring sustainable production as an important objective. The Polish Recycling Association has been participating in the public debate on the shape of the new waste management system since December 2015, i.e. since the announcement of the Circular Economy Action Plan by the EC.

National Key Stakeholders – Science

Institute for Environmental Protection National Research Institute (IOŚ-PIB)

In accordance with its statutes, the Institute carries out scientific research and research and development work for the development of the economy, concerning environmental protection, sustainable development, combating climate change and the rational use of the environment and its



resources. The Institute also conducts research and performs assessments of the state of the environment, including as part of environmental monitoring. Report "analysis of opportunities and barriers to the management of plastic waste from separate collection of municipal waste and issues of a circular economy".

Łukasiewicz Research Network

With seven thousand employees and 22 research institutes located in 12 Polish cities, they are one of the largest research networks in Europe. They are the part of science that works for business and supports the development of Polish companies. One of the network's areas of activity is sustainable go-economy and energy, where it works on bioeconomy and material recovery, the main components of the circular economy. As part of this theme, it conducts work on, among other things, the development of technologies for raw material extraction, waste and waste water treatment, eco-design of processes and products in the pulp, paper and packaging industry, and the production of composite and biodegradable materials.

In addition, there is a Centre for Circular Economy at Łódzkie Łukasiewicz Institute of Technology, which operates within the network. Research Groups operating within the Centre for Circular Economy:

1. the Environmental Engineering Research Group
2. the Biotechnology Research Group
3. the Recycling and Composite Materials Research Group
4. eco-design and life cycle assessment section

Institute for Innovation and Responsible Development - Innowo

The Institute for Innovation and Responsible Development Innowo is a non-governmental organisation, THINK to DO TANK working in the field of supporting the development of innovation and the implementation of systemic change for sustainable socio-economic development. Innowo collaborates with various stakeholder groups such as academics, government administration, policy makers, business and the NGO community to initiate joint actions for the improvement of society and the environment. The organisation uses innovative technologies, processes and trends to chart new and better paths to a sustainable future. It supports decision-makers in identifying effective legislative and policy instruments to engage business and consumers to achieve a meaningful and sustainable shift towards sustainable production and consumption. In October 2022, Innowo in cooperation with Circle Economy prepared and published "The Circularity Gap Report Poland", which took the Polish economy under the microscope. All in the context of resource management and reuse. The result of the analysis is an indication of the so-called 'circularity gap', which shows how far we are on the way to closing the circulation of raw materials. Currently, the circularity index for the countries covered by the analyses is 8.6%. Poland, with the aforementioned 10.2%, is therefore among economies with a slightly more closed circulation of raw materials.

Projects implemented by Innowo, concerning a circular economy, include the following:

- **Polish Circular Hotspot** - a public-private platform bringing together entities that compete with each other on a daily basis, but which through cooperation and access to shared resources can increase the efficiency of their activities by implementing the idea of the circular economy. The mission of the Po-



lish Circular Hotspot is to support business, cities, governments and society in their transformation towards a circular economy through practical and scalable solutions;

- **Circular Week** - is an international series of circular economy and sustainability events and initiatives taking place across Europe. The aim of Circular Week is to promote the idea of the circular economy, support sustainable business models and establish cooperation between stakeholders: business, representatives of non-governmental and international organisations and representatives of science.

The first Circular Week took place in 2018, and subsequent editions have continued to be very successful. Each year they invite to numerous workshops, expert meetings, webinars, lectures and debates. The ceremonial end of Circular Week is the international conference Mazovia Circular Congress. The event is aimed at representatives of public administration, local government, companies, managers working in the field of sustainable development and ESG, start-ups and the media.

National Key Stakeholders – NGO (Nature/Environment)

Polish Zero Waste Association

The Polish Zero Waste Association is the first and only organisation that has focused all its activities around the promotion of waste-free lifestyles and the implementation of a circular economy.

Some of the most recognisable campaigns carried out by the Association include: the #własnymkubkiem campaign, the Warsaw Repair Café, the Hellowielo campaign or the Zero Waste Festival in Kraków. They focus on education, but above all on education that is useful in everyday life, facilitates decision-making and is a motivator for change. They pursue their mission by conducting trainings and workshops, participating in conferences and industry events, popularising and publishing.

They want to achieve their goals by, among other things, developing the knowledge base of the zero waste movement in the form of factual articles available to everyone, running cyclical information campaigns, zero waste events and festivals, and cooperating with local government units.

EKON Foundation

It was established in 2016 by Amber Eco Sp. z o.o., together with which they are the Organisers of the EKON Environmental Campaign. Its main mission is to create public awareness of waste management, in particular hazardous waste from the municipal waste stream. EKON, as a social initiative, promotes the concept of the circular economy, in which the product should be obtained and used as efficiently as possible, and the waste after it should be managed in an economically and ecologically appropriate manner, which will directly significantly reduce the amount of waste remaining to be disposed of and thus reduce the negative impact of waste on the environment. Through popular knowledge on proper waste management, the Foundation raises the awareness of the local community on proper waste segregation and contributes to building the right attitudes in society through far-reaching changes in behaviour towards the environment.

Regional Key Stakeholders - Governmental

Marshal's Office of the Silesian Voivodeship



The Office is the organisational unit with the help of which the Sejmik, the Management Board and the Marshal carry out the tasks of the Voivodeship Self-Government. Within the Office, there is the Department of Environmental Protection, Ecology and Environmental Fees, which deals, inter alia, with tasks related to the development, update, assessment and implementation of plans and programmes in the field of the environment, as well as activities related to waste management - verification of reports submitted by entrepreneurs in the BDO system.

One of the key documents prepared by the Office in the area of waste management is the Waste Management Plan for the Silesian Voivodeship for 2016-2022. The document was adopted by the Silesian Voivodeship Parliament on 24 April 2017. Its main assumption is the continuation of the construction of a modern, comprehensive and regional waste management system, allowing for the rational management of all streams of generated waste. However, the achievement of the municipal waste recycling targets resulting from the plan, including a radical reduction in the amount of landfilled waste, will not be possible without further development of selective collection at source together with systematic and systemic educational activities. An integral part of the document is the Investment Plan, which defines the municipal waste management infrastructure necessary to achieve the targets set by Polish law and EU directives. The above document lacks any guidelines or direction in terms of building a circular economy in the region.

Another key document at the voivodeship level is the Silesian Voivodeship Development Strategy "Śląskie 2030" Green Silesia, in which there is only a brief mention of the fact that the principles of circular economy are becoming more and more important and that activities including circular economy are still at the implementation stage and it is important to carry out educational activities for residents and entrepreneurs indicating the possibility of reusing products or recycling principles .

In addition, in 2018, the Marshal's Office of the Silesian Voivodeship implemented an information and education campaign under the slogan "Silesian. Recovered Energy", the main aim of which was to promote the sense of the waste hierarchy, including a less consumerist lifestyle. The campaign activities emphasised the need to move from a linear model economy to a circular economy by, among other things, promoting and supporting the construction of repair and reuse networks. The direct addressees of the activities are the employees of Silesian cities and municipalities, and the target population of the voivodeship.

Metropolis GZM

The metropolis is a statutory association of 41 cities and municipalities located in the central part of the Silesian voivodeship. One of the main tasks carried out by the GZM is the socio-economic development of the union's area. Using the economies of scale, the GZM contributes to more efficient management of local tasks that extend beyond the borders of a single municipality - for example, joint public transport for the entire area of the union. GZM operates on the basis of a Development Strategy. One of the priority activities included in the Development Strategy for Metropolis GZM for 2022-2027 with an outlook to 2035 is to support the rational management of environmental resources, as well as municipal waste and municipal sewage sludge generated, including the development of a circular economy in the face of the growing volume of waste generated and increasingly restrictive waste management standards (e.g. preparatory activities, efforts to amend regulations, other initiatives).

The Provincial Environmental Protection and Water Management Fund in Katowice (WFOŚiGW)



The WFOŚiGW is a public financial institution implementing the environmental policy of the Silesian Voivodeship. In implementing its mission, the Fund focuses on: supporting pro-environmental activities undertaken by public administration, entrepreneurs, institutions and non-governmental organisations, managing European funds earmarked for environmental protection and water management. WFOŚiGW in Katowice - the Voivodeship Fund for Environmental Protection and Water Management in Katowice was established in 1993. It is a public financial institution implementing the environmental policy of the Silesian Voivodeship. In implementing its mission, the Fund focuses on: supporting pro-environmental activities undertaken by public administration, entrepreneurs, institutions and non-governmental organisations, managing European funds aimed at environmental protection and water management. The Fund's general objective is to ensure systematic and sustainable improvement of the environment in the Silesian Voivodeship and to preserve and restore areas of high natural and landscape value on its territory. One of the priority areas is waste management and protection of the earth's surface (with the operational goal of minimising the amount of waste produced, increasing reuse and reducing landfill of residual waste, and supporting a circular economy).

Regional Key Stakeholders - Science/Competence Centres

The highly urbanized area of the Metropolis GZM is a unique place that is exceptionally conducive to modern education, scientific research and artistic projects. The metropolis has great academic potential. It is home to 24 higher education institutions, with around 89,000 students. They mainly attract residents of the Silesian Voivodeship, who account for around 80% of all students. In the academic year 2021-2022, approximately 5.6 thousand foreigners gained knowledge.

Silesian University of Technology

The Silesian University of Technology is the oldest technical university in Upper Silesia and one of the largest in the country. It was founded in 1945 as a scientific and didactic base for the most industrialized district in Poland and at the same time one of the most industrialized areas in Europe - Upper Silesia. It is an important institution of public life and plays a special culture-forming and opinion-forming role in the region.

In 15 units - 13 faculties, 2 institutes of the Silesian University of Technology - there are currently more than 60 faculties and about 200 specialisations, covering the entire range of engineering activities. Among them are postgraduate studies "Circular economy and cleaner production in practice" at the Faculty of Materials Science and Metallurgy.

Currently, the Silesian University of Technology educates over 18,000 students. The university offers first-cycle studies (engineering and bachelor's degree), second-cycle studies - master's degree, education at doctoral school called "Joint Doctoral School" and postgraduate studies. Studies are conducted in full-time and part-time form. Candidates also have the opportunity to undertake free of charge education in one of almost 30 courses in English.

The Institute for Ecology of Industrial Areas (IETU)

The IETU is a research institute attached to the Minister of Climate Affairs. The research and services offered by IETU focus on the environmental challenges posed by industrialized and urbanized areas in the context of circular economy, resource efficiency, climate change adaptation and mitigation. The main objective of the research in the field of waste and resource management is to develop new



knowledge, methods and tools (know-how) to support the extraction and use of resources available in waste streams for waste management planning according to a circular economy model and the optimisation of raw material and energy recovery.

The Institute of Energy and Fuel Processing Technology (ITPE)

ITPE participates in the implementation of economic priority research projects dedicated to the efficient use of fossil, renewable and alternative fuels. The Institute's expertise focuses on the thermal processing of various fuels by gasification, pyrolysis and combustion.

The main recipients of the Institute's know-how are companies in the energy, coking and waste management industries, as well as small and medium-sized enterprises and governmental and municipal institutions. The Institute conducts priority research into the efficient use of fossil, renewable and alternative fuels. The Institute's area of specialisation focuses on their thermochemical processing in gasification, pyrolysis and combustion processes. The Institute's research work focuses on the development of low- and zero-emission heat and power generation technologies, including both clean coal technologies, CO₂ capture and utilisation technologies and renewable energy technologies.

Park Naukowo-Technologiczny Euro-Centrum

The Euro-Centrum Science and Technology Park is an innovation centre that supports entrepreneurship in the development of energy-efficient technologies and energy conservation in buildings. Since its inception in 2007, it has been pursuing the idea of energy-efficient construction, focusing on rational energy management and the use of renewable energy sources. It cooperates with leading research centres and universities in the country and the region, carrying out joint research and implementation projects in the area of energy efficiency, RES and circular economy. It monitors the latest trends in the renewable energy industry and provides specialist advice, using the results of the Energy Efficiency Technology Market Observatory operating here.

In addition, it conducts training and research activities, providing laboratories equipped with environmentally friendly renewable energy installations and laboratories where research is conducted in connection with energy-efficient construction, including: The park was established as a result of the transformation of the park into an eco-friendly, environmentally friendly RES installation and laboratories where research into energy-efficient construction is carried out, including the determination of the efficiency and effectiveness of solar panels, the determination of the thermal properties of buildings and quality tests on building materials.

As a park created as a result of transformation and development of post-industrial areas, it draws on its experience in energy transformation in cooperation with a wide range of stakeholders representing administration, business and science. It is also a place open to residents. Very important in the activities of the Euro-Centrum Science and Technology Park is ecological education, passing on knowledge and encouraging the implementation of sensible energy use practices and care for the environment.

3.1.3 Material Loops: Key Stakeholders



As the subject of the project is the management of PU hard foam, which is a component of refrigeration equipment and insulation materials used in construction, the chapter will identify the key stakeholders from the point of view of building a circular economy for these products.

3.1.3.1 Refrigerators

Waste Management

Management of waste electrical and electronic equipment is regulated by the Act of 15 September 2015 on Waste Electrical and Electronic Equipment (Journal of Laws of 2020, item 1893, as amended). The Act regulates the rights and obligations of businesses bringing equipment to the market, collecting, transporting and processing waste electrical and electronic equipment. Electrical and electronic waste is produced mainly by households and is therefore included in the municipal waste stream. Their collection is handled by municipalities and shops which introduce the equipment.

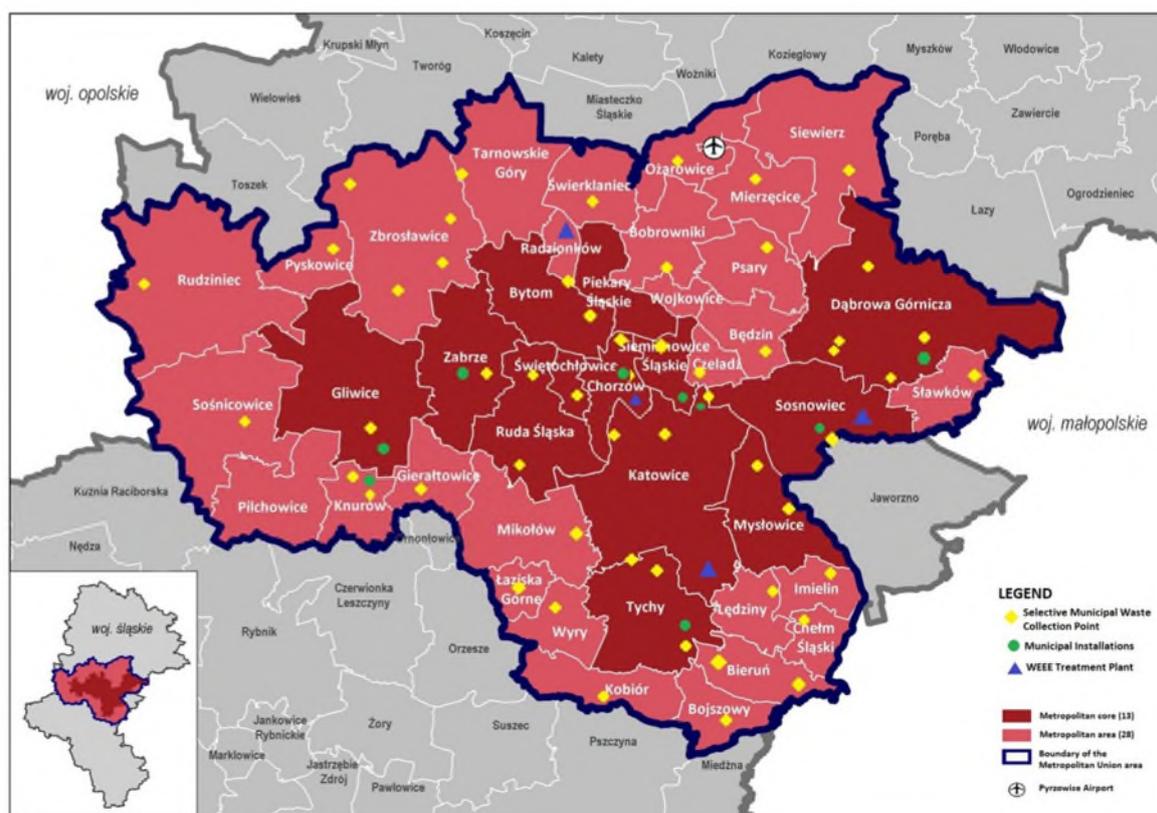


Figure 9: Collecting in GZM area, Source: <https://infogzm.metropoliagzm.pl/mapy/Mapy.html>

In the GZM area there are (see fig.9):

1. 9 municipal waste treatment facilities, called municipal facilities according to the nomenclature of the Waste Act;
2. 48 stationary municipal selective waste collection points;
3. 18 municipal waste collectors from municipalities,

which are involved in the collection of electrical and electronic waste. In addition, in the area of the GZM there is a significant number of collection points where electrical and electronic waste can also be handed over, but the stream collected by individual points is not significant.

In the GZM area, electronic waste is collected:

1. through municipal separate collection points as part of the lump-sum fee paid by the resident to the municipality;
2. by shops when purchasing new electronic equipment;
3. by mobile waste collection directly from properties where residents live (also as part of a flat-rate fee);

Of these 18 municipal waste collectors, the 3 largest companies, in terms of volume of waste collected, are:

Alba Poland

Alba Poland is part of the multinational ALBA Group - a market leader in the fields of waste management and recycling, environmental protection and recyclable materials (ALBA Group operates in more than 200 companies in Europe, the United States of America and Asia, with more than 9,000 employees. A total of 7 companies within the ALBA Group operate in the GZM area. ALBA is a local market leader in waste collection, transport and recovery, summer and winter road maintenance, greenery maintenance, cleaning services and customer service. ALBA operates installations for the recovery of mixed municipal waste collected from households, sorting plants for secondary raw materials, installations for construction and demolition waste, installations for alternative fuels.

REMONDIS Poland

REMONDIS Polska is part of the REMONDIS Group, the world's largest recycling, services and water management company, with operations in more than 30 countries in Europe, Africa, Asia and Australia. REMONDIS Poland has been present in Poland since 1992. It has more than 50 plants and branches throughout the country. It is the largest national company in the field of recycling, services and water management. It offers a wide range of services for municipalities and residents, but also for industry, trade and commerce. Recycling is at the heart of its solutions for secondary raw materials and waste materials. REMONDIS takes care of waste collection in the 11 municipalities belonging to the GZM.

MPGK Katowice

The Municipal Public Utilities Company Ltd. in Katowice, as part of its core statutory activities, has been providing the following services for many years:

- Summer and winter road cleaning
- Collection and transport of waste
- Waste processing
- Motor vehicle diagnostics

Sorting and Dismantling



After collection by waste management companies commissioned by municipalities, waste electrical and electronic equipment is sent for handling to plants located in other provinces. The nearest such plant is located in Bolęcin near Chrzanów in the Małopolskie Voivodeship. It not only processes, but also collects refrigerators from the whole of southern Poland. In addition to the plant in Bolęcin, there are five other such facilities across the country.

BIOSYSTEM S.A.

BIOSYSTEM S.A., in October 2012, opened Poland's most modern Waste Electrical and Electronic Equipment Recycling Plant in Bolęcin near Chrzanów. The plant is fully automated and employs 150 people. At the Bolęcin plant, approximately 1,000 tonnes of PU foam are obtained annually (nationwide, approximately 6,000 tonnes are produced from used refrigerators). It is compressed and used almost entirely in thermal waste conversion processes.

The Bolęcin plant receives waste from practically the whole country. Suppliers of waste equipment include large retail chains, entrepreneurs, private individuals, PSZOKI (Selective Municipal Waste Collection Points) and collection points. In addition, Biosystem also provides an electro-waste collection service with its own transport.



Figure 10: Thermal Treatment (Incineration), Biosystem S.A., Source: own elaboration

After treatment of the collected waste, waste PU foam is produced, which is almost entirely managed in thermal waste treatment processes as a sub-fraction of RDF fuel managed in dedicated municipal waste incineration plants or cement plants. A small amount of waste, thanks to mechanical recycling, is used as absorbent material (sorbent) where hydrocarbons are involved, e.g. removal of oil stains in warehouses.

Fortum Zabrze

Fortum originates from Finland and operates in Sweden, Norway, the Baltic States, Poland, Russia and India, among others. At the end of 2018, a combined heat and power plant in Zabrze - EC Zabrze - was commissioned. The CHP plant is powered by three different fuels - coal, RDF and also bio-mass. This is the first time that RDF will be used in a Polish CHP plant. In this way, EC Zabrze fits perfectly into the circular economy, in which what could end up in landfills ends up in the CHP plant after processing and is used to generate heat and electricity. The modern plant supplies nearly 70,000 households in Zabrze and Bytom with district heat. The capacity of the new plant is 225 MW of fuel input (thermal power: 145 MW, electrical power: 75 MW). The assumed annual heat production is 730 GWh, while

electricity production is 550 GWh. The CHP plant commissioned in Zabrze is the most modern installation of its kind in the Finnish company's assets. There are also municipal waste incineration plants operating in the country, also producing heat and electricity, e.g. in Szczecin, Białystok, Kraków, Poznań, Warsaw and Rzeszów.

SARPI Dąbrowa Górnicza sp. z o.o.

SARPI Dąbrowa Górnicza, owned by the French group SARP Industries SA, part of the Veolia concern, operates one of the most modern and largest industrial and hazardous waste incineration plants in Poland. It provides comprehensive waste disposal services for industrial, institutional and municipal customers. It operates a technological process combined with energy recovery, ensuring full environmental safety at all stages of disposal. In 2003, they opened Poland's most modern thermal transformation installation, which can neutralise more than 800 categories of waste, including 377 hazardous ones. According to the integrated permit, they can dispose of 50,000 tonnes of waste per year.

There is no cement plant in the GZM area that thermally manages RDF waste. The nearest cement plant to which this type of waste is directed is in the north of the voivodeship (Rudniki) and in the Opolskie, Małopolskie and Łódzkie voivodeships - directly bordering on the Silesian voivodeship.

Forward (future loop)

Chemical recycling

Within the GZM, there is currently no entity that is engaged in the in chemical recycling of (long-living) plastics. On the other hand, several large PU companies can be identified nationally that could potentially be involved in the topic of chemical recycling of foam. These include companies such as Covestro, BASF, BorsodChem, Dow, Polychem System, PCC Prodex or Huntsman.

Covestro

Covestro is one of the world's leading manufacturers of high-tech polymer materials for key industries. Covestro's materials and innovative solutions can be found in almost all areas of modern life. The company places a strong emphasis on innovation and develops and delivers continually new solutions that benefit both society and the environment. Covestro's products include raw materials for polyurethane foam, which in its flexible form is mainly used for furniture, mattresses and car seats; in its rigid foam form it is used to insulate buildings and refrigeration equipment. Covestro also produces high-performance polycarbonates, which are used for automotive parts, roof structures, medical devices and much more. Specialised chemicals, including raw materials for coatings, adhesives and films, complete the portfolio.

Production

There are 35 factories in Poland where white goods are manufactured. These factories could use the semi-finished products recovered in the recycling process. In 2021, 3.9 million refrigerators were produced in Poland. According to APPLiA Poland's estimates, around 94% of the volume of large household appliances is exported. **There is no refrigerator plant operating directly in the GZM area, but already in its immediate vicinity - in the Lower Silesian Voivodeship - there are 3 companies that are among the leading refrigerator manufacturers in Poland (see table 1).**



No.	Company name	Address	Voivodeship	Logo
1.	BSH Sprzęt Gospodarstwa Domowego Sp. z o.o.	Żmigrodzka 143, 51-130 Wrocław	dolnośląskie	
2.	LG Energy Solution Wrocław sp. z o.o	ul. LG 1A, Biskupice Podgórze 55-040	dolnośląskie	
3.	WHIRLPOOL POLSKA SP. Z O.O.	ul. Bora- Komorowskiego 6 51-210 Wrocław	dolnośląskie	

Table 1: Refrigerator manufacturers in Lower Silesian Voivodeship

Source: Own elaboration

Retail

There are approximately 1,200 RTV/AGD shops of the five largest distribution companies in Poland. Largest RTV/AGD shops: Media Expert (Terg); Euro-RTV-AGD (Euro-Net); Media Markt (Media Saturn Holding); NeoNet.

Media Expert has shops in Katowice, Ruda Śląska, Chorzów, Bytom, among others.

Euro-RTV-AGD with shops in Tarnowskie Góry, Gliwice, Sosnowiec

Media Markt with outlets in Będzin, Katowice, Zabrze

NeoNet with shops in Mysłowice, Sosnowiec, Dąbrowa Górnicza, Tychy and Piekary Śląskie

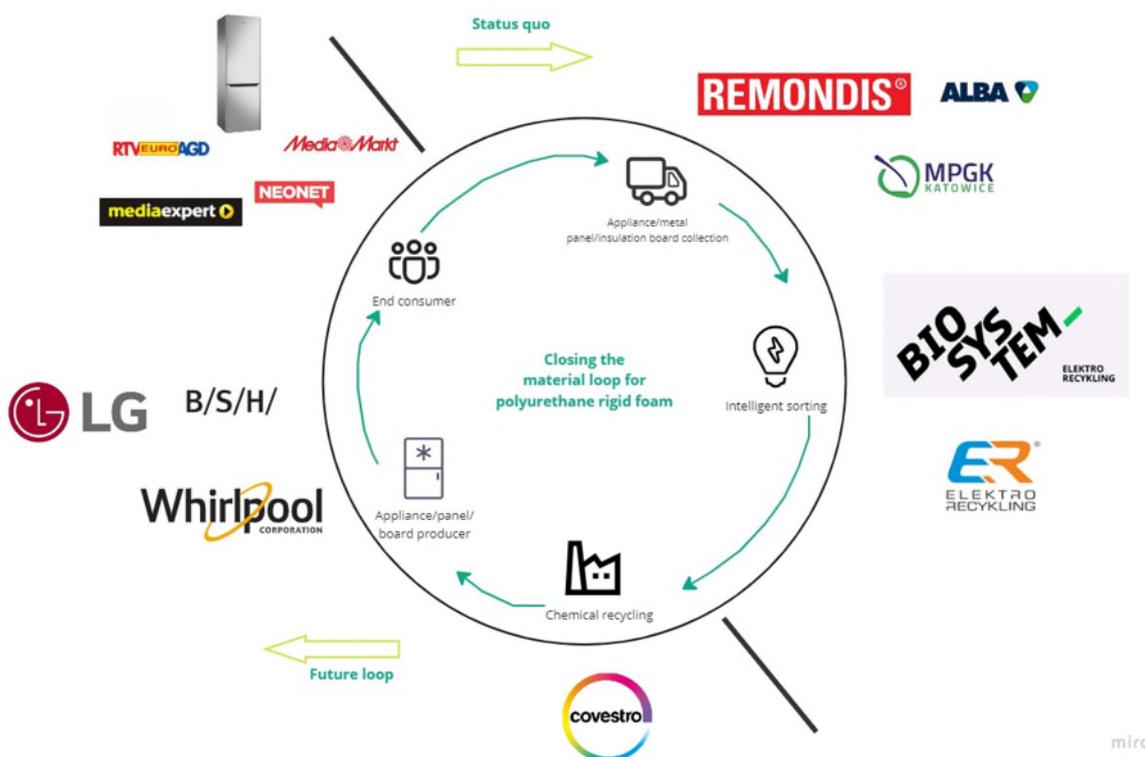


Figure 11: Loop Map – refrigerators, Source: Own elaboration

3.1.3.2 Insulation Boards/Sandwich Panels

Currently, Poland does not have a management system dedicated to end-of-life insulation boards and sandwich panels. Generally speaking, PU insulating boards and sandwich panels fall into the larger category of construction and demolition waste.

Waste Management (status quo)

On 1 January 2023, regulations were to come into force to bring Polish law in line with EU standards related to environmental protection. According to the new provision (Article 101a) of the Waste Act: *Construction and demolition waste shall be collected and collected selectively, with a separation into at least: wood, metals, glass, plastics, gypsum, mineral waste, including concrete, brick, tiles and ceramic materials and stones.*

This meant that construction waste would no longer be put into one bag or container, but segregated on site. The same will apply to renovation waste. Importantly, the change was not intended to cover the collection of construction and demolition waste from households - the rules here remain as before. The obligation to separate waste into a minimum of six fractions was only supposed to apply to companies carrying out investments.

However, due to the adoption of the Act on Special Protection of Certain Recipients of Gaseous Fuels in 2023 (this enforces amendments to the Act on Amendments to the Act on Waste), the effective date of the regulations concerning the collection of construction waste has been postponed by two years, i.e. until 31 December 2024.

As a result, separating this fraction from construction and demolition waste is difficult. An important incentive for separate collection of this type of waste would be to collect it free of charge, as construction companies have to pay fees for collection and management of construction waste.

Collecting, Sorting and Dismantling

In the GZM area, the collection of renovation and construction waste takes place:

1. on the basis of individually concluded contracts between service providers and clients;
2. through municipal selective waste collection points;

The vast majority of house and building owners use local companies when demolishing. There are dozens of companies providing demolition services in the GZM. At the same time, it should be noted that, at the moment, most of the buildings that go for decommissioning are older structures in which sandwich panels or insulation have not yet been used. Consequently, the construction waste stream from demolition will only contain a small amount of PUR foam board material. This waste fraction is also collected by the waste collectors listed in section 2.2.1 (Collecting).

In addition, the largest demolition companies include AkpeGroup Ltd. The company employs about 30 people and deals with manual demolition and mechanical demolition of all types of buildings, production halls, industrial warehouses, factories and dismantling of steel structures not only in the region but also nationwide.

There is no plant in the GZM area for the disposal of insulation material from construction waste.

Thermal Treatment

If waste containing PU foam has been separately collected or has been sorted out at municipal installations (see 2.2.1), it forms a component of RDF fuel and is managed at thermal waste treatment plants and cement works.

Forward (future loop)

Chemical Recycling

Covestro

Production

One of the leading manufacturers of sandwich panels and polystyrene foam in Poland, which could use semi-finished products recovered in the recycling process, operates in Silesia - it is Paneltech Sp. z o.o., based in Chorzów. Paneltech is a manufacturer, operating on the Polish market since 1989. It specialises in the production of high-quality building materials, including, among others, sandwich panels, polystyrene foam and industrial doors. It exports its products to almost 30 countries around the world. The company's offer also includes specialised services in the field of:

- general contracting of industrial and livestock buildings;
- assembly of sandwich panels, cold storage doors and steel constructions;
- welding and processing of metal sheets and PUR foam filling.

In addition to Paneltech, another major sandwich panel and insulation manufacturer operates in the region - Ostrowski Sp. z o.o. from Nieborowice. The company has more than 20 years of experience



on the market. The company's range of products using PUR foam includes, among others: door panels, window extensions or panels for building winter gardens.

Wholesale/Retail

The retail and wholesale distribution of sandwich panels and insulation is carried out through the above-mentioned direct manufacturing companies and local building depots.



Figure 12: Loop Map – insulation boards and sandwich panels.

Source: Own elaboration

In addition, Figure 13 and 14 summarize the flows of materials (waste) in the development cycle.

Obtaining foam materials for electronic appliances (Figure 7) and building materials (Figure 6) are varied. In both cases, the collection process and material flows are structured and organized. In the case of electronic appliances, a distinction should be made between the possibility of obtaining foams for individual and institutional customers. In the context of creating a circular foam, individual customers have several options for returning used electronic goods depending on the further waste treatment process. Thus, they can return the goods to the store where they purchase new equipment and to collecting companies (which are a part of a recycling organization), which waste is then transferred to WEEE Processing Plants for electronic waste in GZM, or outside GZM. Customers can also return the goods to mobile selective collection points, the Municipal Waste Collection Point (PSZOK), or to a company collecting waste at the request of the Commune, which then transfers the waste to the municipal waste installation for sorting and preparation for transport plants, and which

then go to WEEE Processing Plants. In this link of the value chain, the foam is prepared for producers (shredding and sorting), or the waste is not finally processed. In turn, the institutional customer directs the waste to collecting companies, to the store where it purchases new equipment, or to a company collecting waste at the request of the Commune. The further flow of materials is consistent with the flow of materials for individual customers.

The value chain is different in the case of building materials. In this case, we are dealing with two perspectives: independently performing construction works (individual customer) or by an external company (institutional customer). In the first case, it is the dismantling of the foam for private users, which waste goes to PSZOK (after exceeding the limit, waste goes to waste collection companies). Then the waste goes to municipal waste installation for sorting and preparation for transport processing plants and then to Processing Plants for construction waste in GZM, or outside GZM. In this link of the value chain, the foam is prepared for producers (shredding and sorting), or the waste is not finally processed. In turn, in the case of performing construction works by an external company, waste is managed by the institutional user of building materials. We are dealing here with dismantling the foam for institutions, which then goes to waste collection companies. Further entities forming the value chain are consistent with entities for the individual customer.

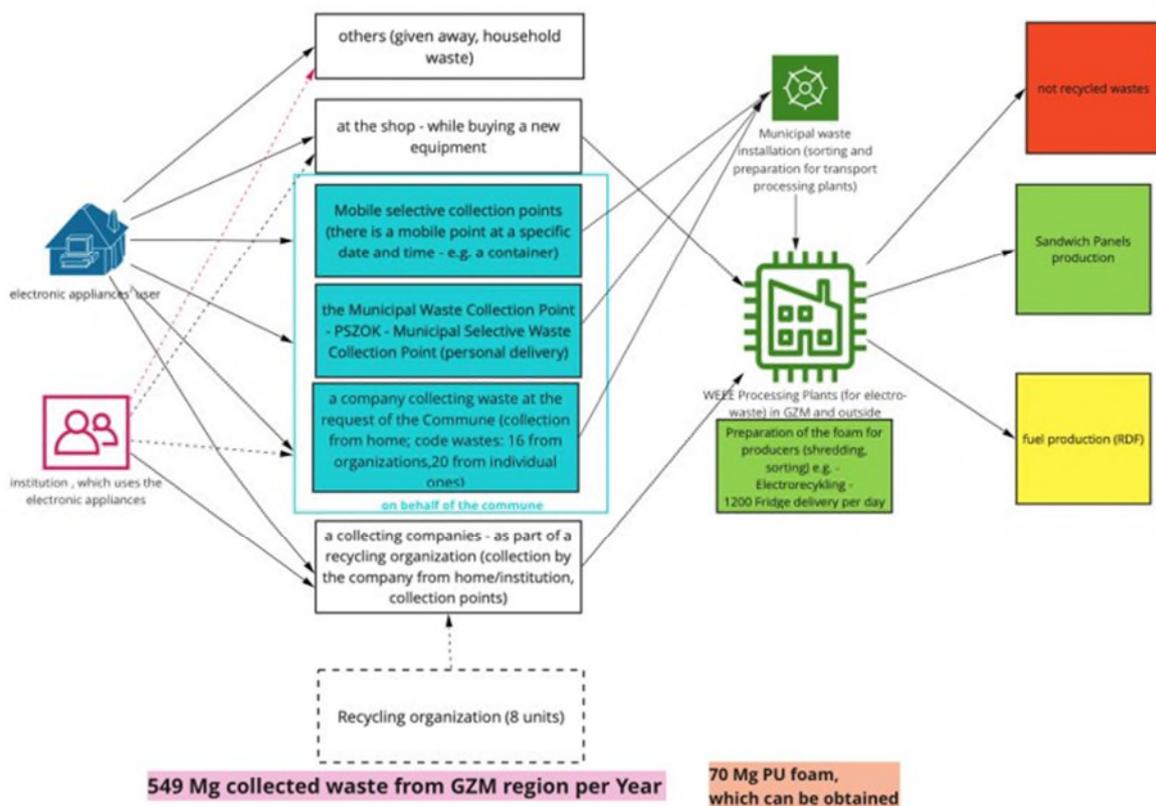


Figure 13: Reverse Logistics for PU waste from electronic devices, Source: own elaboration

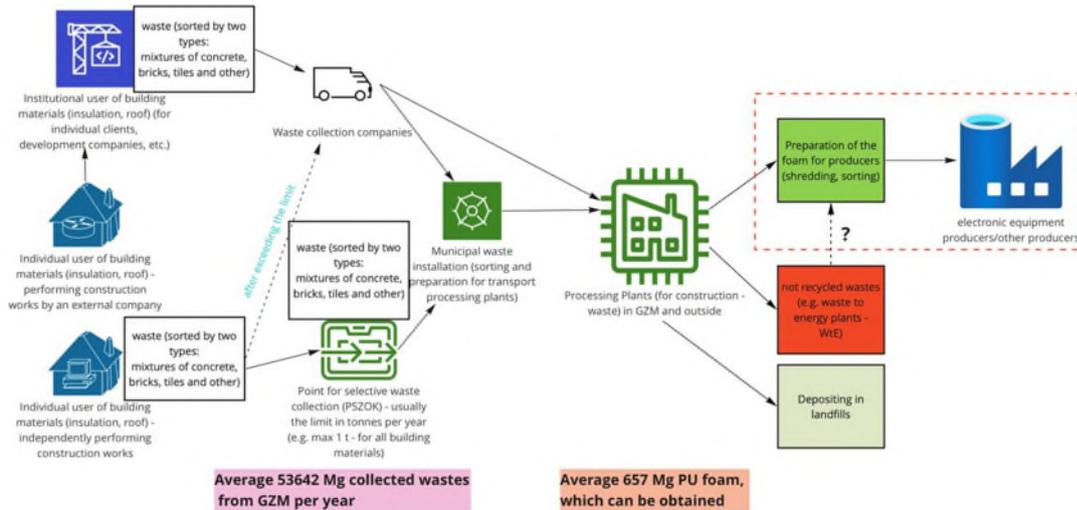


Figure 14: Reverse Logistics for PU waste from construction, Upper Silesia / GZM, Source: own elaboration

3.2 Stakeholder Analysis

Introduction: Analyzing stakeholders by using mapping tools

3.2.1 Interest-Influence-Matrix

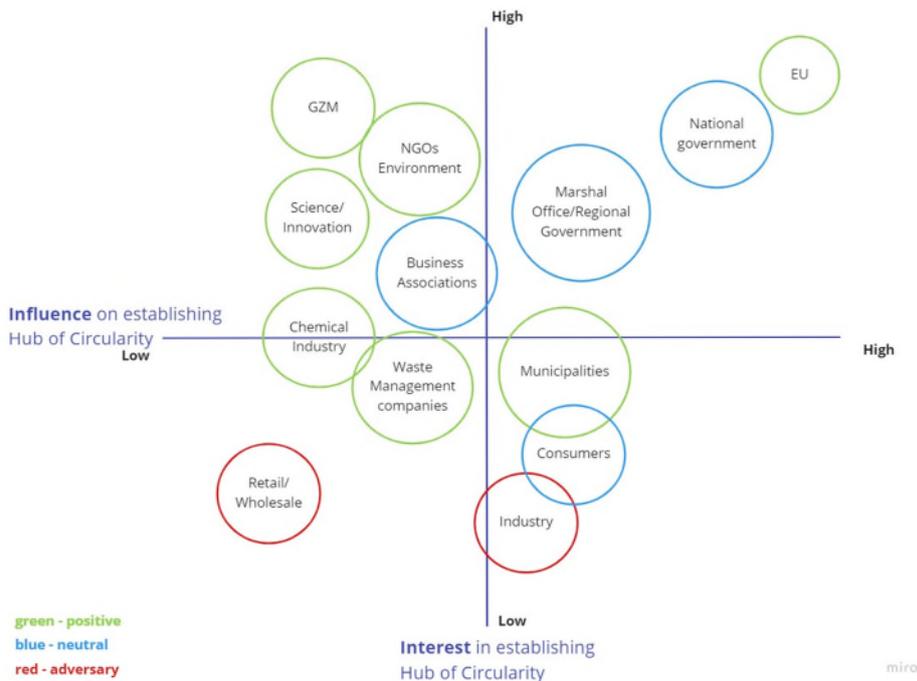


Fig. 15. Stakeholders interest- influence matrix map, Upper Silesia / GZM, Source: own elaboration

Analysis of Map



The interest-influence matrix shows several preliminary results:

- most stakeholder groups seem to support the idea of establishing a closed-loop hub, but we also identified two groups that may be opposed to it;
- The attitude of key, from the point of view of establishing the hub, stakeholders (national and regional government) is neutral, which could significantly delay the process of change. These are the entities that are responsible for creating regulations/policies without which the transition to a circular economy will be much slower.
- a sizable portion of stakeholders characterized by positive attitudes towards the introduction of circular economy solutions do not have as strong an influence on the establishment of policies that could make this possible;
- negative attitudes on the part of industry and sales may be due to the need to incur additional and increased financial expenditures in the case of the introduction of closed-loop for polyurethane foam.

The above map illustrates a fairly wide dispersion of stakeholders both in terms of influence, interest and attitude toward the establishment of a circular hub for PU foam. Looking at the matrix, there is a distinct lack of leader(s) who could set the pace and dynamics for change toward circularity.

3.2.2 Core-Periphery Map

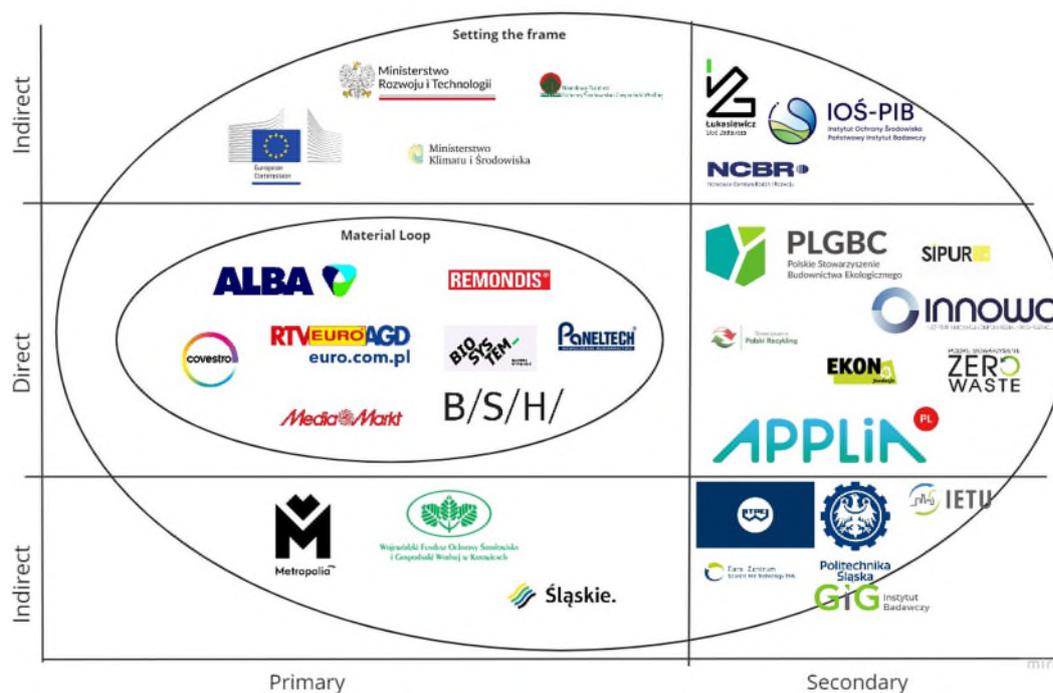


Figure 15: Stakeholders core – periphery map, Upper Silesia / GZM, Source: own elaboration

Core-Periphery Map (Direct / Indirect – Internal / External)

Analysis of Map

The core-periphery map organizes the broad stakeholder landscape.



- groups of stakeholders that are actively creating the framework for the emergence of hubs for circularity in the region. These include overarching stakeholders such as the European Commission and, at the national level, the Ministry of Development and Technology and the Ministry of Climate and Environment, as well as the Marshal's Office operating in the region, the GZM Metropolis or the Provincial Fund for Environmental Protection and Water Management.
- Stakeholder groups that have a secondary role in shaping the debate on the introduction of solutions and development of circular economy models are, among others, non-governmental organizations, business associations and scientific and research institutes (PLGBC, APPLiA, SIPUR, IETU, IOŚ-PIB)
- stakeholder groups that have or will have a direct stake in creating hubs for the circular economy in the region along two different material loops - with key actors such as Alba, Remondis, Biosystem and Paneltech.

3.3 Conclusion

The stakeholder landscape is very diverse - there are many players with varying degrees of influence. Among them, however, there is no clear leader who will not only drive change, but also help create a closed system. At present, only the individual elements of the whole system connect with each other in short segments. In addition to political decisions, business decisions are also important, especially those of multinational companies operating in the country.

The construction of closed circuits will be feasible if the obligation to create them comes directly from the law, and the obliged entities will be able to take advantage of widely available sources of financing.

4. Pilot Region C: Amsterdam Metropolitan Area (AMA)

4.1 Stakeholder Identification

The first task of this analysis is to identify key stakeholders that can have a significant influence on shaping and establishing PU hard foam hubs for circularity in the Amsterdam region. We divide the stakeholder identification in two separate parts. First, we look at stakeholders that are important actors in setting the frame for the concrete design and organisation of hubs for circularity – nationally and regionally. Second, we take local stakeholders into focus that have an important role in the material flow of PU hard foam – in the current waste management value chain as well as prospectively by closing the material loop in the future.

4.1.1 Setting the Frame: Key Stakeholders

European Union

European Commission

The European Commission is a key driver in the transition towards establishing a circular economy in Europe. It adopted the first circular economy action plan in December 2015. It included 54 actions at the time which have since been delivered or are being implemented. In 2018, the EU followed up with a European Strategy for plastics in a circular economy laying the foundations to a new plastics economy, where the design and production of plastics and plastic products fully respect reuse, repair and recycling needs and more sustainable materials are developed and promoted.

In March 2020, the EU Commission adopted the new Circular Economy Action Plan (CEAP) as one of the main building blocks of the European Green Deal. The new action plan continuously announces initiatives along the entire life cycle of products. As part of the EU Industrial Strategy, the Circular Economy Action Plan focuses on sectors that use the most resources and where the potential for circularity is high: a Circular Electronics Initiative, new mandatory requirements for recycled plastic content, and a Strategy for a Sustainably Built Environment.

The EU has legislated Waste Electrical and Electronic Equipment (WEEE) management since 2002. The WEEE Directive (Waste from Electrical and Electronic Equipment), passed in 2012, established the obligation to collect WEEE separately for sorting and recycling. It sets a detailed framework for Extended Producer Responsibility and aims to provide incentives to improve the design of electrical and electronic equipment to facilitate recycling. One of the obstacles in reaching collection targets is that considerable amounts of WEEE are diverted to other undocumented WEEE flows. Unwanted WEEE flows need to be reduced and steered into the formal WEEE management regime. The exports for reuse and illegal exports are hardly monitored in most countries due to the lack of trade codes for used-EEE items.

Additionally, the EU Commission has put forward a regulation on Ecodesign for Sustainable Products. It sets new requirements to make products more durable, reliable, reusable, upgradable, repairable, easier to maintain, refurbish and recycle, and energy and resource efficient. In addition, product-specific information requirements will ensure consumers know the environmental impacts of their



purchases. It notably addresses consumer electronics (smartphones, tablets, solar panels); the fastest growing waste stream.

The EU has also established the Circular Cities and Regions Initiative (CCRI). The CCRI is funded by Horizon 2020 and Horizon Europe. The CCRI works with designated cities and regions to combine knowledge sharing technical and financial support towards achieving the EU Circular Economy Action Plan 2020. The Amsterdam Metropolitan Area has been selected by the European Commission to participate in the Circular Cities and Regions Initiative (CCRI) as one of the 30 selected cities and regions in their leading position in the field of circular economy.



National State: Netherlands

Federal Government

The national government of Netherlands is elected, with the most recent election being held in 2021. The leading parties have formed a coalition government, with a formal coalition agreement (Coalitieakkoord 2021-2025). The ruling political parties each have their own approach to environment and sustainability, and together in the coalition agreement they together lay out the vision and goals on environment and sustainability.



Individually, each of the coalition parties have their vision for the environment and sustainability as outlined below. While their party platforms are general, and do not have specific proposals for circular economies, together in their coalition agreements for governing there are specific environmental initiatives and circular economy initiatives.

- **People's Party for Freedom and Democracy (VVD):** The VVD supports the goals of the Paris climate accords, and strives to comply with the agreement by 2030. The VVD believes that Netherlands can achieve the objectives with smarter and cheaper techniques than were laid out in the Paris agreement.
- **Christian Democratic Alliance (CDA):** The CDA party believes that we should try and preserve the environment, and that responsibility for this is a combined responsibility at all levels of government, including the EU, the Netherlands national government, provincial/regional governments, and civic administrations. The party has a strong eco-friendly policy and supports sustainable development and circularity.
- **Democrats '66 (D66):** D66 has a strong commitment to the environment and sustainability. Their goals include for the Netherlands to become the largest producer of wind energy in Europe and become a net exporter of electricity, to decrease the use of natural resources by 30% by 2025, and exceed the agreed climate goals of the Netherlands.

- **Christian Union (CU):** The CU party is considered the greenest political party in Netherlands, according to Greenpeace. The party has a strong environmental policy, with a focus on sustainable and green energy.

The Coalition Agreement (Coalitieakkoord 2021-2025, 2021) for of the national coalition further outlines their overall plan, including initiatives on climate, the environment and circularity:

- Climate change is the challenge for our generation. Good climate policy offers opportunities to build a sustainable and strong economy and create new jobs. We are preparing the Netherlands for the future – climate-neutral, fossil-free and circular – with a clean energy supply and green industrial policy. The Netherlands is a prosperous country that wants to be among the leading groups in Europe in the transition to a green economy. Industry and business.
- The industry of the future runs on clean energy and bio-raw materials and makes circular products. It is our ambition to be at the forefront of this transition to a green industry. This requires a green industrial policy. This is an approach of reciprocity between governments, the business community and society. Not on the basis of non-commitment, but on the basis of firm, binding tailor-made agreements, we ensure that the Dutch industry in Europe and worldwide sets the sustainable standard. In this way we strengthen the business climate and maintain sustainable employment for the Netherlands.
- We are coming up with a renewed National Housing and Building Agenda. This includes agreements on the number of homes to be built and the preconditions for construction, such as capacity for permits and sufficient construction personnel. We accelerate housing construction by stimulating innovations. This will scale up the construction of prefab homes. We also encourage circular construction. With the construction agenda, we are also removing obstacles to climate-proof and nature-inclusive construction.
- We support innovative start-ups and scale-ups and focus our mission-driven innovation policy on the three major transitions: climate and energy, digitization and key technologies, and the circular economy. ('Coalitieakkoord 2021-2025', 2021. p. 6-7)

Ministerie van infrastructuur en Milieu (Ministry of Infrastructure and Water Management)

This ministry is responsible for environmental matters within Netherlands, and is the key driver toward achieving a fully circular economy by 2050. Key legislation and policies include:

Environment and Planning Act of the Netherlands: Almost all national legislation on the environment is incorporated into the Environmental Management Act, and it based on EU environmental legislation. The act provides an integrated approach to environmental management in the Netherlands, and provides the legal framework by defining the roles of national, provincial, regional and municipal governments. (*The Environment and Planning Act of the Netherlands, 2021*)

The Netherlands Circular in 2050: This program, lead by the Ministry of infrastructure and Water, lays out the plan for development and realization of the goal of Netherlands being completely circular by 2050. This covers all raw materials, including petroleum-based products and plastics. (*Nederland Circulair in 2050, no date*)



Raw Materials Agreement (2017): This agreement lays out an initiative to run the Dutch economy on reusable raw materials. The agreement is between the national government and 180 other organizations representing the business community, trade unions, and environmental organizations. (*Grondstoffenakkoord, 2017*)

Circular Economy Implementation Program (2019-2023): This national initiative outlines concrete actions and projects for the period 2019-2023 regarding five transition agendas to meet the overall Netherlands Circular 2050 goal. (*Uitvoeringsprogramma Circulaire Economie 2021-2023*. No date)

National Waste Management Plan 2017-2029 Draft Second Amendment: This detailed plan lays out the revised waste management framework directive for the country. The plan aims to ensure as many products and materials as possible are managed through the waste cycles and may be reused. (*Landelijk afvalbeheerplan 2017-2029, 2020*)

Region: Amsterdam Metropolitan Area

As detailed in the Regional Readiness Report: Amsterdam Region, the Amsterdam Metropolitan Area (AMA) is made up of seven subregions, 2 provinces, 30 municipalities, and the Transportation Authority Amsterdam. Together, this group operates as one with unified planning and policies. Within the AMA, greater Amsterdam is the dominant partner, and key driver of policy direction and vision.

The government of greater Amsterdam is elected, with the most recent election being held in 2022. The leading parties have formed a coalition government, with a formal coalition agreement, **Amsterdam Agreement 2022-2026** (Amsterdams Akkoord, 2022). The ruling political parties each have their own approach to environment and sustainability, and together in the coalition agreement they together lay out the vision and goals on environment and sustainability.

Individually, each of the coalition parties (PvdA, GroenLinks, D66) have their vision for the environment and sustainability:

- **PvdA:** believes that achieving the EU's climate and environmental goals requires a new policy based on circular economy.
- **GroenLinks:** advocates for solving environmental problems, especially climate change, by stimulating durable and sustainable alternatives.
- **Democrats '66 (D66):** has a strong commitment to the environment and sustainability. Their goals include for the Netherlands to become the largest producer of wind energy in Europe and become a net exporter of electricity, to decrease the use of natural resources by 30% by 2025, and exceed the agreed climate goals of the Netherlands.

The elected coalition parties ruling Amsterdam in their coalition agreement set out the plans agreed upon by the coalition for the next 4 years. These include actions on safety, the environment, housing, and responsible growth. Specifically, in the coalition agreement they agree that climate change is among the single greatest challenges in human history, and to continue to work towards a 60% reduction in use of raw materials in the region by 2030 and to continue with environment and circular economy plans in place from previous administrations, specifically the Climate Neutral and Agenda Circular roadmaps.

Concerning the governance of the individual municipalities of the AMA, they have agreed on a **Roadmap Circular Procurement and Commissioning Towards 100%** (*Roadmap Circular Procurement and Commissioning Towards 100%. 2020*) which provides a methodology to move to a fully circular procurement goal within the AMA to ensure all municipalities are working towards only supporting Circular Economies in the operation of their individual municipalities.

 Municipality
 Amsterdam




Other Related Government Bodies

Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland, RVO): The RVO is an executive body of the Dutch Ministry of Economic Affairs and Climate Policy and operates at the national level. The RVO helps entrepreneurs and organizations to invest, develop, and expand their businesses and projects. RVO helps business owners run sustainable, agricultural, innovative or international businesses. The Netherlands Enterprise Agency also helps them arrange grants, find business partners, access the right expertise, and comply with legislation and regulations. (Netherlands Enterprise Agency, 2023).



Versnellingshuis (Netherland Circular): Established in 2019, this organization works with businesses to help find experts and knowledge in the area of Circular Economy, helps them become aware of and understand legislation relating to circularity, and helps to connect the businesses with sources of funding. (Versnellingshuis Netherland Circular, no date).



Port of Amsterdam: The Port of Amsterdam is a major hub in the region for circularity, and currently hosts 30 major circular enterprises. The aim of the Port of Amsterdam is to become the major hub for Circular Economy in Europe. Currently the Port of Amsterdam supports the drive to a Circular Economy by providing R&D facilities for biobased and circular innovation, as well as the ability to allocate space for enterprises in-volved in circular projects. (Port of Amsterdam, no date).

The port also has a strategy to become carbon-neutral by 2025. In the current plan for the AMA to become completely circular by 2050 (Metropoolregio Amsterdam Grondstoffen Atlas, 2018), the Port of Amsterdam has been designated at the main location for circular enterprises.

Port of Amsterdam

Waterschap Amstel Gooi en Vecht: Manages the water in the region to prevent floods and ensure supply of water for agriculture, urban living, and other purposes. Bylaws define what you may and not do in and around the water. (Waterschap Amstel Gooi en Vecht, no date).



Hollands Noorderkwartier: Works to ensure clean and healthy surface water by working with municipalities in Noord Holland, along with industry, the public, and recreational users. Manages guidelines for waste waters. (Hollands Noorderkwartier. No date).



Business, Environmental and Societal Associations, Other Stakeholders

NGOs

Stichting Open Wecycle: Stichting Open organizes the collection and recycling of electrical appliances and lighting. Stichting Open collaborates with municipalities, retailers, schools, clubs and associations, and consumers to enable the responsible collection of e-wastes. (Stichting Open Wecycle. No date)



Cirkelstad: Circle City is an NGO established to bring together public and private entrepreneurs in order to enable circularity in the construction industry. Circle City provides expertise, matches requests for expertise with community experts and companies, builds partnerships between companies and communities, and supports circular projects. (Cirkelstad, no date)





Amsterdam Economic Board: The Amsterdam Economic Board works with businesses, academic and research institution, and authorities with the aim of creating a smart, green, and healthy metropolis. (Amsterdam Economic Board, no date.)



Industry Associations

Bouwend Nederland and Bouwend Nederland Amsterdam: Bouwend Nederland is the association of construction and infrastructure companies in the Netherlands. This association provides training and other services to members, government advocacy, advice to members on initiatives and regulations, and future development in the industry. Bouwend Nederland Amsterdam is the regional chapter of the overall association. (Bouwend Nederland. No date.)



Vereniging Afvalbedrijven: The Waste Management Association represents the entire waste chain in the Netherlands. This includes prevention, collection, transport, sorting, cleaning, processing, recycling, incineration, and landfill. The association supports circularity and the reduction in use of primary materials through innovation and development within the industry. The association works with members to gather information on best practices, build partnerships between waste collectors, recyclers, and industry, and links government with the waste industry. (Vereniging Afvalbedrijven. No date)



Transitieteam Circulaire Bouweconomie: The Circular Construction Economy is a collaboration between government and business with the aim to make the entire built environment circular before 2050. This organization reports to the ministries of Internal Affairs (Construction) and Infrastructure and Water Management. (Transitieteam Circulaire Bouweconomie. No date)

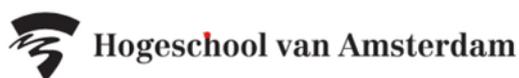


Science / Academic / Research Institutions

TU Delft: Academic institution, with a focus on technical academics, including many areas related to construction of materials and buildings. Through the Circularity Lab, TU Delft connects technical expertise with external stakeholders and networks to support projects leading to the Circular Economy. (TU Delft. No date)



Hogeschool van Amsterdam (HvA/AUAS): Academic institution, with a focus on applied sciences. One particular area of expertise is circularity. The HvA provides research and projects supporting the move to Circular Economy through knowledge centres and professorships in Urban Economic Innovation, Circular Design and Entrepreneurship, and the Centre for Economic Transformation. (Hogeschool van Amsterdam. No date)



AMS Institute: The Amsterdam Institute for Advanced Metropolitan Solutions focuses on creating sustainable metropolitan solutions by combining research, innovation and educational activities. TU Delft and Wageningen University are partners in AMS. (AMS Institute. No date)



Metabolic Netherlands: Metabolic provides expertise and consulting services using a systems approach to transition the economy to a fundamental sustainable state that is regenerative and circular by design. (Metabolic Netherlands, no date)



Polymer Science Park: The Polymer Science Park is the (open) innovation- and knowledge-center for applied plastics technology. As a development- and meeting-place for the business community and knowledge partners, they provide laboratory facilities, facilitate innovative projects and implement them. They respond to current developments such as Circular Economy and Smart Technology. (Polymer Science Park. No date)



4.1.2 Material Loops: Key Stakeholders

The following is a list of key stakeholders in the circular framework of for refrigerators and for insulation boards / sandwich panels.

4.1.2.1 Refrigerators

Production

Production and importing of refrigerators is managed following guidance of (W)EEE regulations. The waste management process for end-of-life of refrigerators is regulated in Netherlands. The national government has regulations in place for:

- registration of producers and importers that place electrical and electronic equipment on the market in Netherlands with the National (W)EEE Register
- producers being required to set up and manage the waste management system for end-of-life of the products
- data collection of the amounts of electrical and electronic equipment placed on the market;
- setting up waste collection containers, sites or facilities and the pick-up of waste equipment;
- charge fees for the public services rendered.

The municipalities still collect waste equipment and provide the citizens with collection/recycling depots.

The following are the main producers or importers of refrigerators to Netherlands.

Coolblue



Samsung



Electrolux



Bosch



Miele



Siemens Home



Gamko



SMEG



Transportation

In addition to transportation provided by the retailers, the following are the primary non-retail companies involved in the delivery of refrigerator and white goods in the Amsterdam region.

Vonk & Co



Dynalogic



PostNL At Home



TSN Groen



Retail

The following are the main retailers of refrigerators to consumers in Netherlands, and the Amsterdam region.

BCC



Media Markt



BOL



Coolblue



Expert



Wehkamp



E-commerce Specialists

Commercial / Horeca

The following are the main retailers of commercial refrigerators in Netherlands, and the Amsterdam region.

Horecagemak



HOS BV



Coolgo

Maxima Holland



Tefcold



Carrier



Foster Refrigerator



Viessmann Refrigeration Systems



Collecting / Waste Management

Waste disposal of consumer goods, including white goods / refrigerators is managed by regional policies for the pick-up and disposal of the units. WEEE mandates apply with respect to the correct recycling and disposal of the units.



Consumers can return unwanted refrigerators to the point of sale location or other facilities set up by the producers, through the delivery system for a new refrigerator, or through arrangement with the municipality.

In the Netherlands in 2019 approximately 1 million refrigerators/freezers were recycled. Of this amount approximately 640,000 were recycled to industry standards. This included recovery of coolants, metals, easily removable plastics and electronics. Remainders were chipped and disposed of in the waste incinerators which generate energy. This is an area for further exploration in this project to determine accurate numbers of properly disposed of refrigerators as well as the outcome of the units not accounted for in the proper disposal and recycling process.

There are over 60 commercial waste collection / disposal companies operating in the Netherlands, with the following operating in the Amsterdam region. The majority of these are also involved in recycling.

Additionally, the main recycler in the Port of Amsterdam is Recycling Service Centrum (RSC) which handles cardboard/paper, non-ferrous metals, wood, plastic, textiles, and electronic items covered by the (W)EEE.

Waste Handlers, and Waste-related Companies

The following companies are major waste or recycling handlers in the Amsterdam region, or service companies to the industry in the Netherlands.

Alba Netherlands

ALBA provides waste collection and recycling solutions.



Renewi

Renewi is a waste management company that advocates a Waste-to-Product philosophy, whereby they extract value from recycling rather than disposal of waste in landfill or incineration. Renewi has processing locations within the Port of Amsterdam as well as west of Amsterdam.



Coolrec Netherlands

Coolrec is a major recycling company, processing WEEE materials, including refrigerators, heat pumps, and electronics, as well as plastics and metals. Coolrec has two locations in Netherlands; in Dordrecht for the processing of refrigerators, and in Waalwijk for the processing of plastics and metals.





Seenons

Seenons is a technology company, providing IT software to match waste to the right processor. It also can prioritize, based on volumes, the logistics by assigning the correct type and size of vehicle to transport the waste to the correct recycler. Seenons is located in Amsterdam.



GP Groot

GP Groot is a collection and recycling company specializing in circular building materials, soils, concrete, asphalt, and office products. GP Groot is located west of Amsterdam, in Haarlem.



Bronneberg

Bronneberg is a service company to the recycling industry providing specialized equipment for the dismantling and extraction of recyclable elements. This includes equipment for the extraction of WEEE waste, refrigerators, and building materials. Bronneberg is located in Helmond, Netherlands.



Mobius

Mobius is a waste management company and waste broker, specializing in papers, cardboard, and food production and service wastes.



Salentijn

Salentijn is a recycler of plastics, creating secondary products for the recycled plastics. Salentijn is located in Echt, Netherlands.





Beelen Group (Bnext.nl)

Beelen specializes in the dismantling of buildings, removal of used building materials, and efficient recycling of the materials in order to allow for reuse as much as possible, with an ambition to circularity. Beelen is located in Hardewijk, just east of Amsterdam. Beelen group will change their name to Bnext.nl in 2023.



Triboo

Triboo is a recycler of a wide range of materials, including plastics, fibres, e-waste, papers, cardboard, and wood, and a manufacturer of products incorporating the recycled materials. Triboo is located in Zevenhuizen, in close proximity to Rotterdam.



Bedrijfsafval Amsterdam

Bedrijfsafval supplies waste containers and waste removal services on a contract basis. Bedrijfsafval is located in Diemen, just east of Amsterdam.



Pre Zero

Pre Zero supplies waste containers and waste removal services on a contract basis. Pre Zero analyses the waste of customers and supplies appropriate bins for pre-sorting of waste. Pre Zero collects wastes and delivers it based on type to the appropriate recyclers in an effort towards zero waste. Pre Zero is located in the Port of Amsterdam.



Spaarnelanden



Spaarnelanden supplies waste containers, waste removal services and pre-sorting of wastes to remove recyclable materials. Spaarnelanden collects wastes and delivers it based on type to the appropriate recyclers in an effort towards zero waste. Spaarnelanden is located in Haarlem.



Recycling Service Centrum

RSC is a major sorting and recycling center located in the Port of Amsterdam. Wastes, including Cardboard, paper, metals, wood, plastics, textiles, WEEE, are sorted and made available to customers.



BRBS Recycling

BRBS Recycling makes a constructive contribution to transparent and future-proof resource management in the Netherlands. A Circular Economy is achieved by designing and producing materials suitable for a next life. BRBS Recycling makes every effort, through effective sorting and recycling, to prevent these materials from being incinerated or landfilled after use. Promoting a solid market for secondary raw materials is indispensable here. BRBS Recycling is based in Zaltbommel, Netherlands.

Loop Map

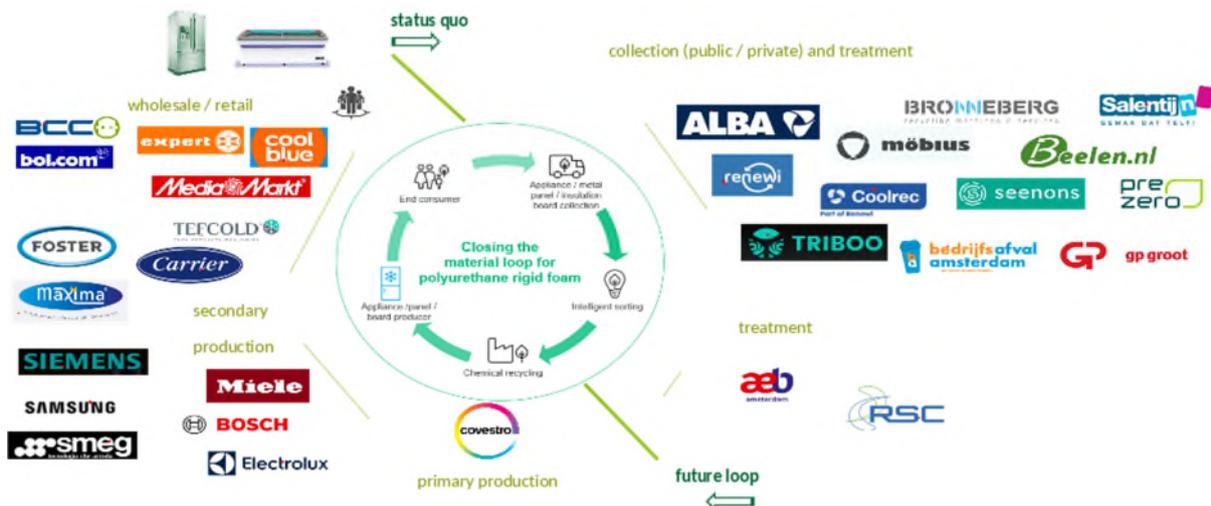


Figure 16: Loop Map, Refrigerators, Amsterdam Metropolitan Area, Source: own elaboration

4.1.2.2 Insulation Boards / Sandwich Panels

Construction



The following are the main producers / suppliers / importers of insulation panels and laminate flooring.

Dura Vermeer



Rockwool



BAM



Heijmans



Volker Wessels Materieeldienst



Bnext



Ballast Nedam



Knauf



Unilin



Kingspan



Van Wijnen



Raab Karchers Greenworks



Retail

Praxis



Gamma



Hubo**Bouwcenter****Hornbach****Collection / Waste Management**

Construction wastes in the Amsterdam region are managed on a commercial basis with disposal managed by the construction firms, or contracted out to waste disposal firms.

There are over 60 commercial waste disposal companies operating in Netherlands, with a subset operating in the Amsterdam region. These include the following (previously described):

- Alba Netherlands
- Renewi
- Seenons
- GP Groot
- Bronneberg
- Mobius
- Salentijn
- Beelen/Bnext
- Triboo
- Bedrijfsafval Amsterdam
- Pre Zero
- Spaarnelanden

Loop Map

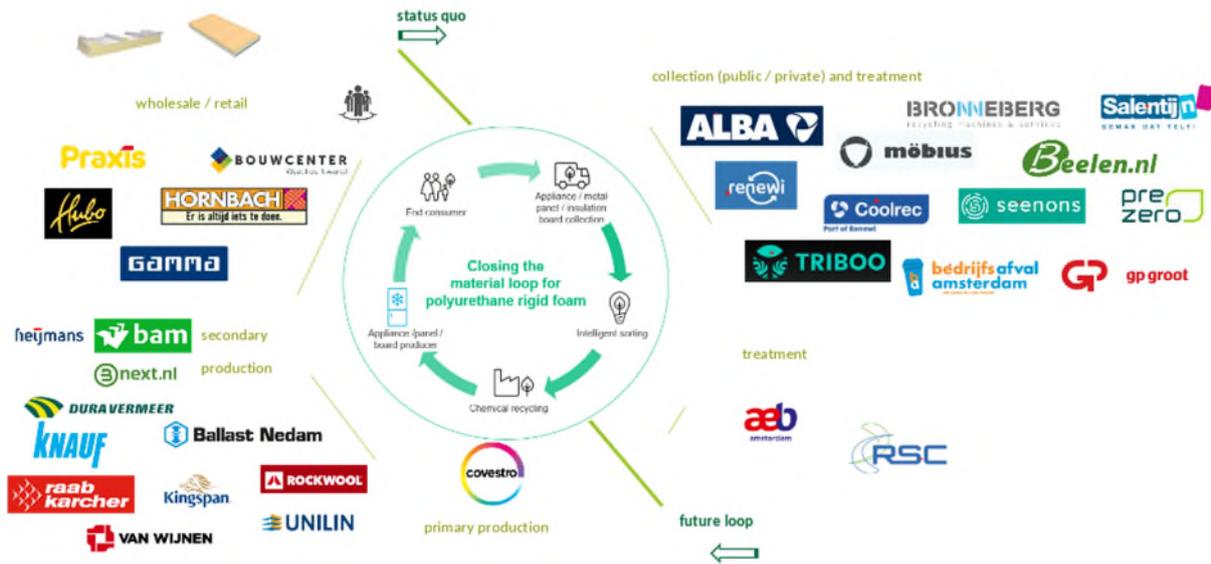


Figure 17: Loop Map, Insulation Boards / Sandwich Panels, Amsterdam Metropolitan Area, Source: own elaboration

4.2. Stakeholder Analysis

The move to a Circular Economy is underway in Netherlands, in support of the EU initiatives (Refer to Regional Readiness Report Amsterdam Region). National initiatives strongly support circularization, and the minimization and eventual elimination of waste. These efforts are strongly supported in the Amsterdam Region, with strong policies and designation of areas in the Port of Amsterdam for circular enterprises. This is illustrated on the Interest / Influence Matrix that follows with government organization in position of strong influence and strong interest.

Further, in the Amsterdam region there is strong public support for environmental and social initiatives, demonstrated by the election of coalition partners in recent elections that have strong environmental policies. This support allows the Amsterdam Metropolitan Area to put in place Circular Economy plans that will change the structure of the region and of the port area, with the goal of being completely circular by 2050.

The move to a Circular Economy by way of EU initiatives such as the (W)EEE have been in place already which require producers and importers of regulated items to register, set up a recover and recycling program, etc. This is in place for refrigerators, though not for PU foam insulation materials and laminates. As there are still unknowns in this area, groups such as the waste management companies, retailers/wholesalers, business associations and consumers are plotted on the matrix as being neutral at this point, and having varying degrees of influence on the eventual outcome at this time.

4.2.1 Interest-Influence-Matrix

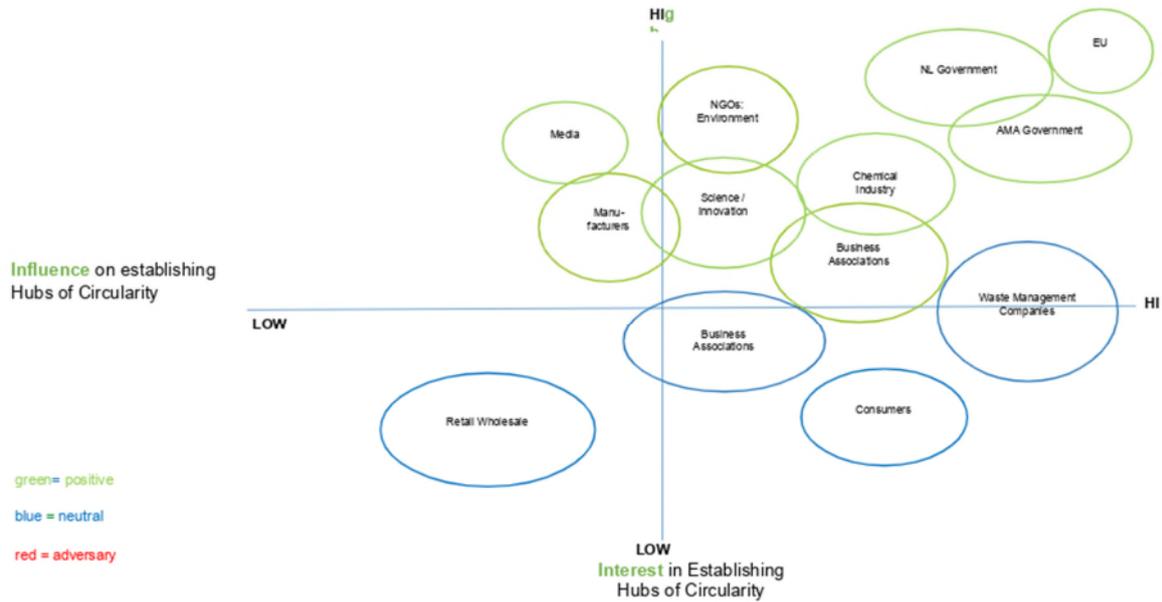


Figure 18: Interest-Influence Map, Hubs for Circularity, Amsterdam Metropolitan Area, Source: own elaboration

4.2.2 Core-Periphery Map (Direct / Indirect – Internal / External)

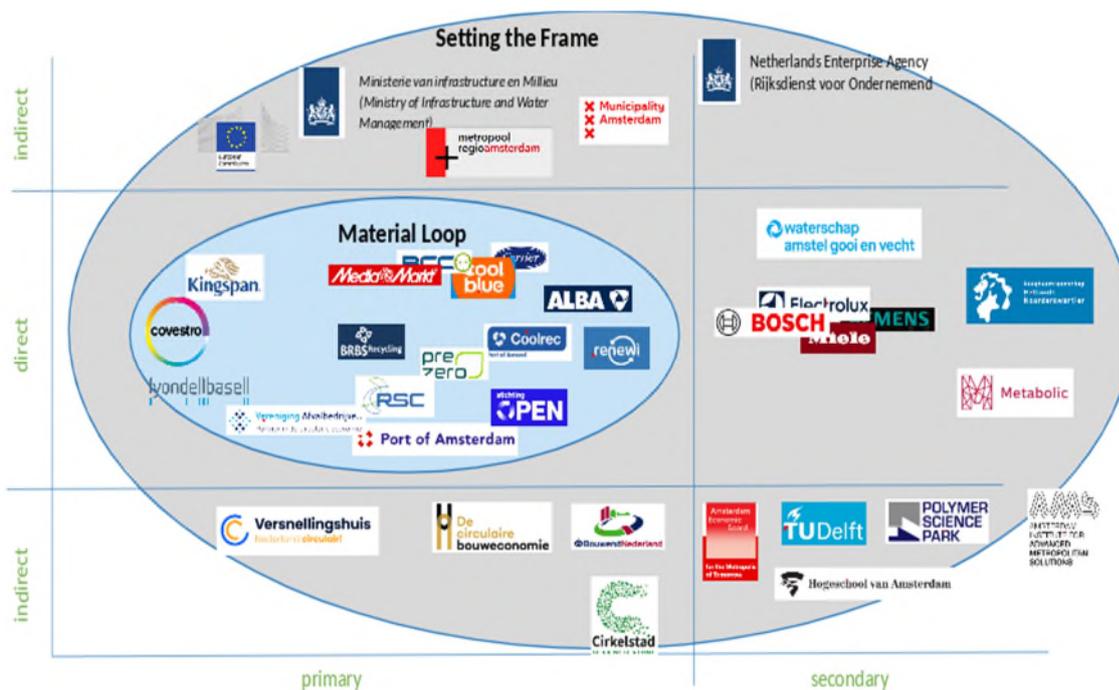


Figure 19: Core-Periphery Map, Amsterdam Metropolitan Area, Source: own elaboration



5. Joint Conclusion

The purpose of this report was to identify and analyse key stakeholder groups in each of the pilot regions for developing a better understanding which actors could be of interest for a potential introduction of regional PU hard foam *hubs for circularity*.

In each of the pilot regions we registered a **broad and diverse stakeholder landscape** which generally supports the introduction of circular economic solutions. Opposition towards establishing a circular economy (CE) is rare. Pushed by standards that are set by the European Union, key stakeholders know that a change towards a circular economy is coming - and is already happening on the ground. However, when it comes to **setting the frame** with national policies and regulations, with public debates and knowledge transfer we see stark **differences in the three regions**.

In the *Amsterdam Metropolitan Area (AMA)* the move to setting up circular economy solutions is well under way - and sustained by a broad societal agreement on minimising waste and saving resources. Guided by a clear policy goal of becoming circular in 2050, a concrete CE implementation program and an ambitious national waste management plan, the Netherlands are set to go fully circular. Strong political support can also be seen on the regional level - with an ambitious Amsterdam Agreement for AMA and specific policy initiatives such as *Amsterdam Circulair 2020-2025 Strategie* or the roadmap for circular procurement and commissioning. These activities are supported and pushed by a broad set of stakeholders in business, NGOs and science who act as important drivers of change. Strong and very circular economy targeted NGOs such as *Stichting Open Wecycle* or *Cirkelstad* exist as well as a deep scientific knowledge base clustered, for example, around the *Polymer Science Park*. Another important innovation driver will be the *Zero Waste Lab* that creates a physical space for new enterprises in the CE business in the *Port of Amsterdam* - with five circular firms already operating there.

In the *Rheinisches Revier* area, there is also a broad support for the introduction of a circular economy. We were able to identify a vast group of stakeholders that engage in conceptualising, discussing and shaping the debate on introducing circular economy solutions – ranging from governments, initiatives, environmental groups, business associations and research institutions. However, on the national and state government level, there are so far only statements of intent on adopting binding circular economy action plans. They have not yet been put to work. A strength on the state and regional level seems to be the significant role of intermediary governmental agencies and initiatives such as *IN4climate.NRW* or *Runder Tisch Zirkuläre Wertschöpfung* who have a dominant role in activating key actors to gain more practical knowledge on how to establish circular economy solutions on the ground. With the *Zukunftsagentur Rheinisches Revier (ZRR)*, there also is a key coordinating body for the transition to sustainability in the region as well as a new incubator focused on circular solutions with *Circular Valley* in close proximity to *Rheinisches Revier*.

For *Upper Silesia / GZM Metropolis*, the report identified a general support of key stakeholder groups for the introduction of circular economy solutions - with especially the national *Ministry for Climate and Environment* as well as the *Ministry of Development and Technology* carefully detecting circular economy as an upcoming key political issue. On the regional level, the same is true for the *Marshall's Office*, *GZM Metropolis* or specific institutions such as the *Provincial Fund for Environmental Protection and Water Management*. However, in Poland as well as in the Upper Silesia region, key stakeholders in government and industry pursue a wait-and-see approach on the future plan to establish *hubs for*



circularity. This neutral approach is strikingly different to Amsterdam and *Rheinisches Revier* and could delay the circular economy transition substantially. Overall, in Poland as well as in *Upper Silesia/GZM*, we could identify a lack of clear and continuous leadership of key stakeholders that are hesitant to move the transition forward. This leadership is also not demanded forcefully by environmental groups as it is the case in the Netherlands and in Germany. Thus, there currently seems to be a lack of public pressure to swing in the direction of substantial change towards a circular economy.

A deeper look at the **state of the art of waste management** in the three analysed regions shows that in the *Amsterdam Metropolitan Area*, in *Rheinisches Revier* as well as in *Upper Silesia/GZM*, reliable networks of waste management companies and collection points are in place to gather e-waste, white goods and construction waste containing polyurethane hard foam. However, while the logistics for refrigerators is very structured and formal, the same is not true for the material flow of construction waste. The latter seems to be not fully documented and regulated in all three regions.

In the AMA, we observe overall a dense stakeholder landscape of enterprises engaged in the collection, dismantling and recycling of refrigerators and construction waste that have experience in adjusting to new waste management requirements. However, the main path for handling refrigerators and insulation boards with PU hard foam is still to put it into incineration and use it thermally for (mostly cheap) local heat and electricity production. For a potential future closing of the material loop of PU hard foam, an industrial symbiosis with Covestro facilities could be of interest for the AMA since it is located in close proximity to the chemparks in *Rheinland*.

In the *Rheinisches Revier* region, there is a set of well-experienced and established actors in waste management and recycling that has established a very pronounced division of labour resulting in a specialised and state-of-the-art field of public and private companies – with *AWA GmbH*, *mags*, *Remondis*, *Schönackers*, *Drekopf* and *Tenzer* leading the way. As one interviewee put it: “*When there is a business model that becomes apparent, stakeholders in the region will be ready to implement it*” (Interview A, 2022). There also seems to be a chance to close the material loop for PU hard foam in the future since we have identified core actors in the wider Rhineland area for every step of the material flows – except for the secondary production of refrigerators and insulation materials. As well as for the AMA, the three main chemparks in the Rhineland could be important hubs for chemical recycling in the future - with the potential to set up demonstration units.

In *Upper Silesia / GZM*, we observe a professional but complex stakeholder landscape in waste management and recycling due to a high degree of local fragmentation. However, in Poland we find all stakeholders necessary to close the material loops for PU hard foam in refrigerators and insulation boards. In proximity of less than 200 kilometres from Katowice, there are collection points, treatment facilities, chemical industry and production sites for new products. Thus, the Polish region could be a model region for establishing completely closed regional hubs for circularity - driven by main international waste management companies such as *ALBA* or *Remondis*. The main challenge is that businesses - amongst them important industry associations such as *SIPUR* - still hesitate to put more effort into finding circular solutions for plastic products and material flows.

Conclusively, two other important aspects can be observed at this point. First, it will be important in every region to closely analyse how the debate on the advantages and perceived risks of **chemical recycling** will develop. Especially in Germany, leading environmental groups seem to hold a negative view on pyrolysis in plastic recycling. They not only criticise the high energy input and unknown by-

products but also put much more emphasis on introducing binding zero-waste strategies that focus on sufficiency and waste avoidance instead of chemical recycling solutions (see Regional Readiness Report). Furthermore, key stakeholder groups in all three pilot regions are currently **not focused on** the recycling of durable plastics such as **PU hard foam**. The interviews we conducted with experts in the field suggest that there currently is no attention on the material flows of interest in this research project as well as an insufficient level of knowledge about this specific form of plastic - even in key waste management companies and business associations. Thus, much more information is needed to put PU hard foam into focus and on the (public) agenda.



6. Reference List

Pilot Region A: Rheinisches Revier

Interviews

Interview A: Cornelius Laaser, Dr. Michael Oberdörfer and Dr. Sascha Dargazanli, Ministry of the Environment, Nature and Transport of the State of North Rhine-Westphalia, 10. November 2022.

Interview B: Dr. Iris Rieth-Menze, team leader project management for industry and production, NRW.Energy4Climate/IN4climate.NRW, 1. November 2022.

Interview C: Markus Wolff and Thomas Wendland, Chamber of Industry and Commerce Aachen (*IHK Aachen*), 15 November 2022.

Interview D: Anette Harings, project coordinator for the department of structural change (*Stabsstelle Strukturwandel*), City of Mönchengladbach / Anna Engelpracht, leader of environmental management at the municipal waste services of Mönchengladbach, *mags - Mönchengladbacher Abfall-, Grün- und Straßenbetriebe*, 14 November 2022.

Sources

ABE (2023) Start - AACHEN BUILDING EXPERTS e.V. Available at: <https://aachenbuildingexperts.de/> (Accessed: 9 March 2023).

BDI (2023) Ressourceneffizienz und Kreislaufwirtschaft - BDI. Available at: <https://bdi.eu/umwelt-und-nachhaltigkeit/ressourceneffizienz-und-kreislaufwirtschaft/> (Accessed: 9 March 2023).

BDI (2016) Our committee work. Available at: <https://english.bdi.eu/article/news/committee-work-and-structure/> (Accessed: 9 March 2023).

BDI (2018) Mit Kunststoff die Zukunft gestalten. Available at: <https://bdi.eu/artikel/news/mit-kunststoff-die-zukunft-gestalten/> (Accessed: 9 March 2023).

BDI (2021) Six Steps to a Circular Economy. Available at: <https://english.bdi.eu/article/news/six-steps-to-a-circular-economy-green-deal/> (Accessed: 9 March 2023).

BUND (2014) Kreislaufwirtschaft: Ressourcen effizienter nutzen. Available at: <https://www.bund.net/themen/aktuelles/detail-aktuelles/news/kreislaufwirtschaft-ressourcen-effizienter-nutzen/> (Accessed: 9 March 2023).

Bundesministerium für Bildung und Forschung (2019) "Ressourceneffiziente Kreislaufwirtschaft muss unser Ziel sein" - BMBF. Available at: <https://www.bmbf.de/bmbf/shareddocs/reden/de/ressourceneffiziente-kreislauf-irtschaft-muss-unser-ziel-sein.html> (Accessed: 9 March 2023).

Bundesministerium für Wirtschaft und Energie (2019) Rohstoffstrategie der Bundesregierung: Sicherung einer nachhaltigen Rohstoffversorgung Deutschlands mit nichtenergetischen mineralischen Rohstoffen. Available at: https://www.bmwi.de/Redaktion/DE/Publikationen/Industrie/rohstoffstrategie-der-bundesregierung.pdf?__blob=publicationFile&v=4 (Accessed: 9 March 2023).

Bundesumweltministerium (2023) Kreislaufwirtschaft. Available at: <https://www.bmu.de/themen/wasser-ressourcen-abfall/kreislaufwirtschaft> (Accessed: 9 March 2023).

CDU/CSU (2021) Das Programm für Stabilität und Erneuerung.: GEMEINSAM FÜR EIN MODERNES DEUTSCHLAND. Available at: <https://www.csu.de/common/download/Regierungsprogramm.pdf>.



CDU/CSU (2022) Rohstoffversorgung sicherer machen – Stoffkreisläufe schließen. Available at: <https://dserver.bundestag.de/btd/20/013/2001338.pdf> (Accessed: 9 March 2023).

Chemiehoch3 (2023) Nachhaltigkeitsdreieck & unsere Initiative | Chemie³. Available at: <https://www.chemiehoch3.de/nachhaltigkeitsdreieck/> (Accessed: 9 March 2023).

Chemiehoch3 (2022) Leitfaden Kreislaufwirtschaft | Chemie³. Available at: <https://www.chemiehoch3.de/handlungshilfen/leitfaden-kreislaufwirtschaft/> (Accessed: 9 March 2023).

CIRCO (2022) Effizienz-Agentur NRW becomes first CIRCO Hub in Germany. Available at: <https://www.circonl.nl/effizienz-agentur-nrw-becomes-first-circo-hub-in-germany/> (Accessed: 27 March 2023).

Circular Economy Initiative (2023) Circular Economy Initiative Deutschland (CEID) — Circular Economy Initiative. Available at: <https://www.circular-economy-initiative.de/de-circular-economy-initiative-deutschland> (Accessed: 9 March 2023).

Circular Valley e.V. (2022) Circular Valley, 9 March. Available at: <https://circular-valley.org/start#partners> (Accessed: 9 March 2023).

Cornelius Laaser, Michael Oberdörfer, and Sascha Dargazanli, MNUV, 10 November 2022.

Covestro (2023) Sustainable Future at center stage | Covestro. Available at: <https://www.covestro.com/en/company/strategy/strategic-pillars> (Accessed: 9 March 2023).

Deutsche Umwelthilfe (2023) Deutsche Umwelthilfe e.V.: Chemisches Recycling. Available at: <https://www.duh.de/projekte/chemisches-recycling/> (Accessed: 9 March 2023).

Deutsche Umwelthilfe (2018) Plastikstrategie für Deutschland: Forderungen an die Bundesregierung. Available at: https://www.duh.de/fileadmin/user_upload/download/Projektinformation/Kreislaufwirtschaft/181126_DUH_Plastikstrategie_f%C3%BCr_Deutschland_Stand_September.pdf (Accessed: 9 March 2023).

Die Gruenen (2021) Bundestagswahlprogramm 2021. Available at: <https://www.gruene.de/artikel/wahlprogramm-zur-bundestagswahl-2021> (Accessed: 9 March 2023).

Die Gruenen-NRW (2022) ZUKUNFTSVERTRAG FÜR NORDRHEIN- WESTFALEN.

DIE LINKE (2021) Wahlprogramm zur Bundestagswahl 2021. Available at: https://www.die-linke.de/fileadmin/download/wahlen2021/Wahlprogramm/DIE_LINKE_Wahlprogramm_zur_Bundestagswahl_2021.pdf (Accessed: 9 March 2023).

Drekopf (2023) Start - Drekopf Entsorgung. Available at: <https://www.drekopf.de/> (Accessed: 9 March 2023).

DWI Leibniz Institut (2023) Biobasierte Polyurethane für Beschichtungen, 9 March. Available at: <https://www.dwi.rwth-aachen.de/projekt/biobasierte-polyurethane-fuer-beschichtungen> (Accessed: 9 March 2023).

EAR (2023) Who we are. Available at: <https://www.stiftung-ear.de/en/about-us/who-we-are?L=1%27%27A%3D0> (Accessed: 9 March 2023).

Energy4Climate, N.R. (2023a) Official website of the State Agency for Energy and Climate Protection. Available at: <https://www.energy4climate.nrw/en/> (Accessed: 9 March 2023).

Energy4Climate, N.R. (2023b) IN4climate.NRW - NRW.Energy4Climate. Available at: <https://www.energy4climate.nrw/industrie-produktion/in4climatenrw> (Accessed: 9 March 2023).

Energy4Climate, N.R. (2022) Newsroom - NRW.Energy4Climate. Available at: <https://www.energy4climate.nrw/aktuelles/newsroom/neues-projekt-nrwzirkulaer-erstellt-umsetzungsstudie-zum-chemischen-recycling> (Accessed: 9 March 2023).

Enviprotect (2023) Recycling Kühlgeräte | Enviprotect Kühl- und Elektrogeräterecycling GmbH. Available at: <https://www.enviprotect.de/leistungsbereiche/recycling-kuehlgeraete> (Accessed: 9 March 2023).

FDP (2021) DAS PROGRAMM DER FREIEN DEMOKRATEN ZUR BUNDESTAGSWAHL 2021. Available at: https://www.fdp.de/sites/default/files/2021-06/FDP_Programm_Bundestagswahl2021_1.pdf (Accessed: 9 March 2023).



HBN (no date) HealthyBuildingNetwork. Available at: <https://healthybuildingnetwork.com/de/> (Accessed: 9 March 2023).

IHK NRW (2021) Das bewegt die NRW-Wirtschaft: Schwerpunkt ZIRKULÄRES WIRTSCHAFTEN. Available at: <https://www.ihk-nrw.de/blueprint/servlet/resource/blob/5364976/4359fb940474a3387cef45ca7536feb6/ihk-nrw-update-zirkulaeres-wirtschaften-2021-data.pdf>.

IKV Aachen (2023) Institut für Kunststoffverarbeitung | Forschung für die Praxis. Available at: <https://www.ikv-aachen.de/> (Accessed: 9 March 2023).

IKV Aachen (2022) Handlungsempfehlungen für eine Nationale Kreislaufwirtschaftsstrategie veröffentlicht. Available at: <https://www.ikv-aachen.de/neuigkeiten/detailseite-neuigkeiten/news/news/detail/handlungsempfehlungen-fuer-eine-nationale-kreislaufwirtschaftsstrategie-veroeffentlicht/> (Accessed: 9 March 2023).

Industrieverband Hartschaum e.V. (2021a) RECYCLING, 9 March. Available at: <https://www.ivh.de/umwelt/recycling/> (Accessed: 9 March 2023).

Industrieverband Hartschaum e.V. (2021b) EPS-Leitfaden: für Weiterverwertung & Recycling. Available at: https://www.ivh.de/wp-content/uploads/EPS-Leitfaden-Weiterverwertung-Recycling-12-2021_IVH_VDPM.pdf (Accessed: 9 March 2023).

Industrieverband Hartschaum e.V. (2022) Der Industrieverband Hartschaum (IVH) nimmt die von Parl. Staatssekretär Chris Kühn MdB (Bündnis 90/ Die Grünen) ausgesprochene Einladung in den Dialog zur Kreislaufwirtschaftsstrategie an, 9 March. Available at: <https://www.ivh.de/ider-industrieverband-hartschaum-ivh-nimmt-die-von-parl-staatssekretaeer-chris-kuehn-mdb-buendnis-90-die-gruenen-ausgesprochene-einladung-in-den-dialog-zur-kreislaufwirtschaftsstrategie-an/> (Accessed: 9 March 2023).

Kingspan (2023) Dämmung | Kingspan DE, 8 March. Available at: <https://www.kingspan.com/de/de/produkte/daemmung/> (Accessed: 9 March 2023).

Kunststoffland nrw (2022) bundeswirtschaftsminister-habeck-die-bedeutung-der-chemischen-und-der-kunststoffindustrie-ist-nicht-hoch-genug-einschaetzbar. Available at: <https://www.kunststoffland-nrw.de/aktuelles/news/details/bundeswirtschaftsminister-habeck-die-bedeutung-der-chemischen-und-der-kunststoffindustrie-ist-nicht-hoch-genug-einschaetzbar> (Accessed: 9 March 2023).

Kunststoffland nrw (2023a) Über uns | Kunststoffland NRW. Available at: <https://www.kunststoffland-nrw.de/ueber-uns> (Accessed: 9 March 2023).

Kunststoffland nrw (2023b) Wirtschaftspolitische Forderungen. Available at: https://www.kunststoffland-nrw.de/fileadmin/News/2022/Wirtschaftspolitische_Forderungen_kunststoffland_NRW_FIN.pdf.

LDS (2023) LD Systemprofile: Sandwichpaneele, Sandwichelemente, Trapezprofile, Dämmsysteme, 2 March. Available at: <https://www.ld-systemprofile.de/> (Accessed: 9 March 2023).

LyondellBasell (2023) Standort Wesseling | LyondellBasell. Available at: <https://www.lyondellbasell.com/de/wesseling-site/> (Accessed: 9 March 2023).

mags (2023) mags - Mönchengladbacher Abfall-, Grün- und Straßenbetriebe AöR. Available at: <https://mags.de/> (Accessed: 9 March 2023).

Metropole Ruhr (2023) Resource Efficiency. Available at: <https://www.business.ruhr/en/invest/lead-markets-1/resource-efficiency> (Accessed: 9 March 2023).

Miele (2023) Miele Werk Euskirchen (Technology Center Drives). Available at: <https://www.miele.de/c/miele-werk-euskirchen-4922.htm> (Accessed: 9 March 2023).

Ministerium für Umwelt, Naturschutz und Verkehr des Landes NRW (2023) Umweltministerium NRW: Abfall- und Kreislaufwirtschaft. Available at: <https://www.umwelt.nrw.de/umwelt/umwelt-und-ressourcenschutz/abfall-und-kreislaufwirtschaft#:~:text=Das%20Umweltministerium%20verfolgt%20das%20Ziel,selbstverst%C3%A4ndlich%20eine%20zentrale%20Rolle%20ein> (Accessed: 9 March 2023).



Ministerium für Wirtschaft, Industrie, Klimaschutz und Energie des Landes NRW (2022a) Auf dem Weg zu geschlossenen Kreisläufen - Ministerin Neubaur setzt Ihre Circular Economy-Tour durch NRW fort. Available at: <https://www.wirtschaft.nrw/auf-dem-weg-zu-geschlossenen-kreislaeufen-ministerin-neubaur-setzt-ihre-circular-economy-tour-durch> (Accessed: 9 March 2023).

Ministerium für Wirtschaft, Industrie, Klimaschutz und Energie des Landes NRW (2022b) Auftaktveranstaltung zum Start der neuen Förderperiode der Europäischen Territorialen Zusammenarbeit. Available at: <https://www.wirtschaft.nrw/auftaktveranstaltung-zum-start-der-neuen-foerderperiode-der-europaeischen-territorialen> (Accessed: 9 March 2023).

MVA Weisweiler (2023) MVA Weisweiler | Moderne Technik für Mensch und Umwelt - MVA Weisweiler. Available at: <https://www.mva-weisweiler.de/> (Accessed: 9 March 2023).

NABU (2023a) Kreislaufwirtschaft in Deutschland - NABU. Available at: <https://www.nabu.de/umwelt-und-ressourcen/abfall-und-recycling/kreislaufwirtschaft/29818.html> (Accessed: 9 March 2023).

NABU (2023b) Veranstaltungen Ressourcenschutz - NABU. Available at: <https://www.nabu.de/umwelt-und-ressourcen/abfall-und-recycling/veranstaltungen/index.html> (Accessed: 9 March 2023).

NOEX (2023) Unser aktuelles Firmenprofil – NOEX AG | Grevenbroich. Available at: <https://www.noex.ag/firmenprofil/> (Accessed: 9 March 2023).

Plastics Europe (2023) Über uns - Plastics Europe DE. Available at: <https://plasticseurope.org/de/uber-uns/> (Accessed: 9 March 2023).

Rebau (2023a) Regionale Ressourcenwende in der Bauwirtschaft. Available at: <https://rebau.info/rebau/#firstElement> (Accessed: 9 March 2023).

Rebau (2023b) Kompetenzzentrum für kreislaufgerechtes und ressourceneffizientes Bauen. Available at: <https://rebau.info/rebau/#kompetenzzentrum> (Accessed: 9 March 2023).

Remondis (2023) Willkommen // REMONDIS Entsorgung. Available at: <https://www.remondis-entsorgung.de/> (Accessed: 9 March 2023).

Remondis (2022) Overview // REMONDIS Electrorecycling. Available at: <https://www.remondis-electrorecycling.de/en/our-technology/dismantling-lines/overview/> (Accessed: 9 March 2023).

Runder Tisch ZW (2023) Zirkuläre Wertschöpfung – Runder Tisch. Available at: <https://www.zirkulaere-wertschoepfung-nrw.de/zirkulaere-wertschoepfung/> (Accessed: 9 March 2023).

Runder Tisch ZW (2021) Charta des Runden Tischen Zirkuläre Wertschöpfung NRW. Available at: <https://www.zirkulaere-wertschoepfung-nrw.de/wp-content/uploads/2022/02/Charta-der-zirkulaeren-Wertschoepfung-NRW.pdf>.

RWTH Aachen (2023) RWTH AACHEN UNIVERSITY Rezykliergerichtetes Bauen - Deutsch, D:20221201000000+01'00'. Available at: <https://www.rb.rwth-aachen.de/cms/~hpbo/RB/> (Accessed: 9 March 2023).

Schoenmackers (2023) Ihr Entsorgungsfachbetrieb in NRW | Für privat und Gewerbe, 9 March. Available at: <https://www.schoenmackers.de/> (Accessed: 9 March 2023).

SPD (2021) Das Zukunftsprogramm der SPD: Wofür wir stehen. Was uns antreibt. Wonach wir streben... Available at: <https://www.spd.de/programm/zukunftsprogramm/> (Accessed: 9 March 2023).

Tenzer Beton GmbH (2023) Tenzer Beton GmbH, 11 September. Available at: <http://www.tenzer.de/> (Accessed: 9 March 2023).

Umweltbundesamt (2020) Leitsätze einer Kreislaufwirtschaft. Available at: <https://www.umweltbundesamt.de/publikationen/leitsaetze-einer-kreislaufwirtschaft> (Accessed: 9 March 2023).

Umweltbundesamt (2022) Resources Commission at the German Environment Agency (KRU). Available at: <https://www.umweltbundesamt.de/en/topics/waste-resources/resources-commission-at-the-german-environment> (Accessed: 9 March 2023).



Verband der chemischen Industrie e.V. (2017) Gute Ideen für Kreislaufwirtschaft in NRW ausgezeichnet. Available at: <https://www.vci.de/nrw/presse-services/presse/gute-ideen-fuer-kreislaufwirtschaft-in-nrw-ausgezeichnet.jsp> (Accessed: 9 March 2023).

Verband der chemischen Industrie e.V. (2022a) Chemisches Recycling als Baustein einer zirkulären Wirtschaft. Available at: <https://www.vci.de/ergaenzende-downloads/vci-ped-position-chemisches-recycling-als-baustein-einer-zirkulaeren-wirtschaft.pdf> (Accessed: 9 March 2023).

Verband der chemischen Industrie e.V. (2022b) Chemisches Recycling als Baustein. Available at: <https://www.vci.de/themen/zirkulaere-wirtschaft/chemisches-recycling.jsp> (Accessed: 9 March 2023).

VKU (2021): LANDESFACHTAGUNG NORDRHEIN-WESTFALEN 27. UND 28. OKTOBER 2021 IN PADERBORN, available at: https://www.vku.de/fileadmin/user_upload/Verbandsseite/Sparten/Abfall/Landesgruppenfachtagung/Prgramm_LGFT_NRW_A4.pdf

Wuppertal Institut (2023) Circular Economy - Wuppertal Institute for Climate, Environment and Energy, 30 July. Available at: <https://wupperinst.org/en/research/divisions/circular-economy> (Accessed: 9 March 2023).

WWF (2023) Modell Deutschland Circular Economy. Ein anspruchsvolles Vorhaben, das Deutschland braucht. Available at: <https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Unternehmen/WWF-Modell-Deutschland-CE-Projektaufakt.pdf>.

Xella (2023) Multipor Mineralfämmplatten | Xella, 7 March. Available at: https://www.xella.de/de_DE/marken/multipor (Accessed: 9 March 2023).

ZEW (2023) ZEW Entsorgung | Startseite. Available at: <https://www.zew-entsorgung.de/> (Accessed: 9 March 2023).

ZRR (2021) WIRTSCHAFTS- UND STRUKTURPROGRAMM FÜR DAS RHEINISCHE ZUKUNFTSREVIER 1.1.

Pilot Region B: Upper Silesia / GZM

Informacje o Strategii na rzecz Odpowiedzialnego Rozwoju [Information about the Strategy for Responsible Development], <https://www.gov.pl/web/fundusze-regiony/informacje-o-strategii-na-rzecz-odpowiedzialnego-rozwoju>, (Accessed: 25 January 2023).

Institute for Innovation and Responsible Development, <https://www.innowo.org/>, (Accessed: 25 January 2023).

Jędrzcak, A., den Boer, E., Kamińska-Borak, J., Szpadt, R., Krzyśków, A., Wielgosiński, G. 2021. Gospodarka odpadami komunalnymi w Polsce, raport.

National Center for Research and Development, www.ncbir.gov.pl, (Accessed: 25 January 2023).

Polish Association Zero Waste, <https://zero-waste.pl/>, (Accessed: 25 January 2023).

Polish Green Building Council, <https://plgbc.org.pl/>, (Accessed: 23 January 2023).

Polityka Ekologiczna Państwa 2030 (PEP2030) - Portal Interoperacyjności i Architektury - Portal Gov.pl (www.gov.pl)

The Institute for Ecology of Industrial Areas (IETU), <http://ietu.pl/oferta-badawcza/gospodarka-odpadami-i-zasobami/> (Accessed: 23 January 2023).

The research team from Metropolis GZM, WUEB and Euro-Centrum visited the BIOSYSTEM S.A. on 9 December 2022.

Pilot Region C: Amsterdam Metropolitan Area

Amsterdams Akkoord. (2022). Available at:

https://assets.amsterdam.nl/publish/pages/886925/amsterdams_akkoord_250622.pdf

Amsterdam Economic Board. (no date). Available at: <https://amsterdameconomicboard.com/en>

Amsterdam Institute for Advanced Metropolitan Studies. (no date). Available at: <https://www.ams-institute.org>



Bouwend Nederland. (no date). Available at: <https://www.bouwendnederland.nl>

Cirkelstad. (no date). Available at: <https://www.cirkelstad.nl>

Coalitieakkoord 2021-2025 VVD, D66, CDA en ChristenUnie. (2021). Available at: <https://open.overheid.nl/documenten/ronl-f3cb0d9c-878b-4608-9f6a-8a2f6e24a410/pdf>

The Environment and Planning Act of the Netherlands. (2021). Available at: <https://iplo.nl/publish/pages/191405/environment-and-planning-act-of-the-netherlands-june-2021.pdf>

Grondstoffenakkoord: Intentieovereenkomst om te komen tot transitieagenda's voor de Circulaire Economie. (2017). Available at: <https://open.overheid.nl/documenten/ronl-e7081689-7484-40ac-b339-bcb2af364769/pdf>

Hogeschool van Amsterdam. (no date). Available at: www.hva.nl

Hollands Noorderkwartier. (No date). Available at: <https://www.hhnk.nl/keur>

Landelijk afvalbeheerplan 2017-2029. (2020). Available at: <https://open.overheid.nl/documenten/ronl-28fc22d5-95c5-4352-a94d-2e690fc477fb/pdf>

Metabolic Netherlands. (no date). Available at: <https://www.metabolic.nl>

Metropoolregio Amsterdam Grondstoffen Atlas. (2018). Available at: <https://www.metropoolregioamsterdam.nl/wp-content/uploads/2019/10/Grondstoffenatlas-MRA.pdf>

Netherlands Enterprise Agency. (2023). Available at: https://business.gov.nl/partners/netherlands-enterprise-agency/?msclkid=a130d6cce18f150a1f06b50a99776e00&utm_source=bing&utm_medium=cpc&utm_campaign=16.%20DSA%20%7C%20NL&utm_term=business.gov.nl&utm_content=Catch%20all

Nederland Circulair in 2050. (No date). Available at: <https://open.overheid.nl/documenten/ronl-a6ce8220-07e8-4b64-9f3d-e69bb4ed2f9c/pdf>

Polymer Science Park. (no date). Available at: <https://www.polymerciencepark.nl>

Port of Amsterdam, (no date). Available at: <https://www.portofamsterdam.com/nl>

Roadmap Circular Procurement & Commissioning Towards 100%. (2020). Available at: https://mraduurzaam.nl/wp-content/uploads/2020/01/MRA_CirculairInkopen_ENGdef01.pdf

Stichting Open Wecycle. (No date). Available at: <https://www.stichting-open.org/en/>

Transitieteam Circulaire Bouweconomie. (no date). Available at: <https://circulairebouweconomie.nl>

TU Delft. (no date). Available at: <https://www.tudelft.nl>

Uitvoeringsprogramma Circulaire Economie 2021-2023. (No date). Available at: <https://open.overheid.nl/documenten/ronl-669a180a-7f09-4336-890c-633cf2c3b852/pdf>

Vereniging Afvalbedrijven. (no date). Available at: <https://www.verenigingafvalbedrijven.nl>

Versnellingshuis Nederland Circulair. (No date). Available at: <https://versnellingshuisce.nl>

Waterschap Amstel Gooi en Vecht. (no date). Available at: <https://www.agv.nl>

