



Local Analysis

Local Analysis of the Circular Economy in the Free and Hanseatic City of Hamburg

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Report in the scope of Interreg Europe Project “*REPLACE - REgional
PoLicy Actions for Circular Economy*”

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Foreword and Summary

The circular economy concept has become an influential model in line with universal goals such as the UN's Sustainable Development Goals (SDGs). Since the availability of resources is limited and it requires a serious amount of energy to extract raw material, it becomes more and more urgent to establish waste-free production loops. One of the EU-funded projects focusing on circularity is *"REPLACE – REgional PoLicy Actions for Circular Economy"* which provides the framework for this local analysis of the circular economy ecosystem in the Free and Hanseatic City of Hamburg. The underlying analytic methodology consists of six steps to assess the circular economy ecosystem: 1) RIS3, strategic areas, and SWOT analysis, 2) focus sectors & companies, 3) R&D and innovation capabilities, 4) emerging ideas, 5) existing circular economy legislation, and 6) existing funding instruments.

Overall, the analysis finds the circular economy landscape in Hamburg to be highly ambitious, established, and widespread. Several projects are working on concrete solutions for the city and the region and have successfully introduced their requests into politics and regulation. Still, the potential of the mass of circular activity in Hamburg is not fully exploited since the interconnectivity between actors, projects and institutions is rather limited. Since there is no coordinating instance, the variety of circular activities becomes visible only by researching which significantly limits the public image of circular economy in Hamburg. Establishing a networking platform to bring together actors and giving them a forum for exchange of experience might be a building block to boost visibility and shared collective effort. Linking the research institutions and universities working on circularity can be a first step that can be scaled up afterwards in case of success.

The following analysis is based on personal interviews and a desk research conducted in the second half of 2020. The draft has been presented and discussed in a virtual workshop on March 2nd, 2021 with 22 participants from research and development, NGOs, administration, innovation and SMEs. We thank everyone who has contributed to this overview of the circular economy and Hamburg and hope to see the list of activities and institutions further expanded in the future.

1. Introduction

The challenge of climate change has been named one of the crucial threats of our time and the challenge to initiate a sustainable transformation of the economy and all other parts of everyday life will be one of the major tasks of the near future. But the output side of sustainability (production of emissions such as greenhouse gases) is only one side of the coin: The full picture of sustainability in production also requires a look on the input side meaning the resources needed for a process. Since the amount of resources is limited and it requires a serious amount of energy to extract new resources, it becomes more and more urgent to design products in such way that parts cannot only be replaced so that the life cycle gets extended but also that disposed products and other kinds of waste are properly recycled and resources can flow back into a waste-free production loop.¹ Since there are at least 114 definitions of the circular economy concept, the paper at hand will not dive into detail and remain focused on a broad understanding of the concept in the following.²

The circular economy concept has become an influential model particularly for the European Union and the Chinese central and regional government. Also, a lot of leading corporations have adopted circular approaches, at least for certain products. The concept is in line with universal goals such as the UN's Sustainable Development Goals (SDGs). The promise of circular economy as a concept is that consuming patterns do not have to be changed fundamentally while still becoming sustainable which also gives circular solutions a place in the EU Green Deal and sustainable recovery in the aftermath of Covid-19.³ Particularly smaller regional entities such as cities are in focus of circularity since regional loops are an obvious starting point for further scale-up. Thereby, cities play a double-sided role when it comes to climate change and sustainability: On the one hand, urban areas will be affected more significantly by phenomena induced by climate change such as heavy rain or days of significant heat due to their highly sealed surfaces and lack of green spaces to regulate the micro climate. On the other hand, cities combine the majority of both global population and climate gas emissions. This combination makes urban areas the focus point to tackle climate change since these areas are both maker and taker of climate change.

The report at hand strives to apply a methodological framework to prepare a local analysis of the regional circular economy ecosystem using the example of the Free and Hanseatic City of Hamburg. The target is to present an extensive picture of circular economy actions in Hamburg, thereby combining the two topic of circular economy and the crucial role of cities considering climate change and sustainability. To do so, the focus region Hamburg is presented, and the underlying methodology of analysis is explained. Afterwards, the six methodological steps are executed, mapping circular economy activities in different sectors such as regulation, education or research and development (R&D). The analysis is summarised by a conclusion and a set of recommendations for the advancement of circular economy approaches in Hamburg.

1.1 Background

A lot of regulation, particularly on the European level, has already been prepared. For instance, the Circular Economy Action Plan of the European Commission is a part of the new EU Green Deal, and also the Urban Agenda for the EU presents a specific action plan on circular economy. Moreover, international organisations such as the OECD or the Ellen MacArthur Foundation have contributed a lot to promoting the idea of a circular economy. To transfer the theoretical and highly academic idea into practice, various research projects are in place looking particularly at waste management, food systems and urban material flows.⁴

The report at hand was commissioned by the Hamburg Institute of International Economics (HWWI) as a part of the engagement in the EU project “*REPLACE – REgional PoLicy Actions for Circular Economy*”. REPLACE is a European project that aims at improving management, implementation and monitoring of regional policy instruments targeted at facilitating the transition towards a circular economy. The main operative target of the project refers to the development and application of policies and actions focusing on identification, valorization, assessment, and financing of circular value chains. REPLACE provides a benchmark that regions can apply to measure the degree to which circularity is implemented in the region. Moreover, a local analysis in each participating region is to be conducted in order to assess the status quo and identify areas of further action. The analysis at hand applies the concept to the city of Hamburg.

The Free and Hanseatic City of Hamburg is Germany’s second largest city with 1,899,160 inhabitants (December 2019). The city is located in northern Germany between North Sea and Baltic Sea and is an important location for logistics with one of the largest ports globally.⁵ Regarding sustainability and circular economy, Hamburg shows high ambition and has been declared the 2011 European Green Capital by the European Commission. Generally, the city of Hamburg possesses an ambitious institutionalised climate plan recognising the fundamental challenges of climate change and the role of Hamburg when it comes to emissions and sustainability as well as a, regularly updated, strategy for sustainability including clear indicators for particular sectors which are assessed. If the targets are not met, an explanation needs to be given as well as new proposals how to overcome the problems and to meet the targets in the future. The climate strategy mostly focuses on the output side of emissions rather than the input side of resources used and closed streams of resources. Still, it is listed as a planned measure in the strategy to establish an official swap meet for materials. A first sharing site for recycling products has already been initiated by the chamber of commerce and can be used as an example. The project was planned to be conducted in the course of 2020.⁶

The recent coalition agreement of the Hamburg government from 2020 gives sustainability and green development a prominent place. It is recognised that resource efficiency plays a major role for a future-oriented, sustainably city and the ambition is exclaimed to make Hamburg a model for climate protection. A study is planned on grey energy and energy consumption in building construction to identify potential for more circular construction. Resource-efficient construction and the usage of sustainable (such as wood) and recycled

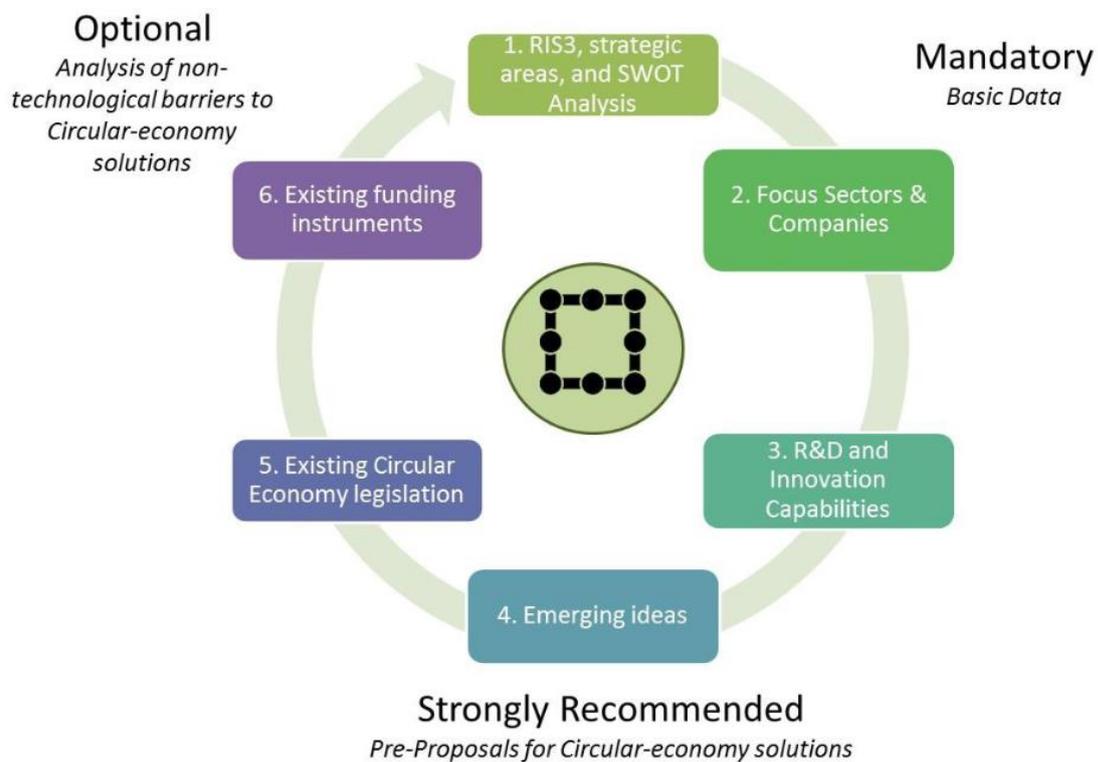
construction material (for instance RC-concrete) for public construction projects add to the target of a green transformation of the construction sector. In terms of waste and waste avoidance, reusable packing as an alternative to the linear produce-use-dispose scheme are planned to be promoted. A positive example is “recup”, a system of reusable coffee cups to avoid one-way cups. Comparable schemes shall be developed for take away food, online orders of products and in the scope of the central market. Retail companies in Hamburg will have the opportunity to apply for a new label for shopping free of packaging which is to be developed and established. In terms of recycling, the city of Hamburg obliges itself to preferably buy products with a repair option. The illegal export of electronic waste is to be prevented. The action plan for circular economy from the European Commission is explicitly supported and recognised as a guiding principle for sustainability measures in Hamburg.⁷ The previous effort to move towards a circular economy has also been recognised in a recent benchmarking of circular economy in European regions which lists Hamburg on place 12 of 169 regions in Europe.⁸

1.2 Methodology of the Analysis

The report at hand follows a Local Analysis methodology framework developed in the Horizon 2020 project “SCREEN - Synergic Circular Economy across European regioNs”. The purpose of the framework addresses the lack of a structured and formalised knowledge basis to assess the existing capabilities of circular economy on a regional level. Since regional smart specialisation strategies are recognised in the SCREEN mapping tool and specific synergies and complementarities among sectors, value chains and markets are considered, the methodology shows a high degree of practical relevance and can be used as an analytical basis to highlight and evaluate potential strategic business cases contributing to the transition towards a circular economy.

The methodology’s objective is to map the current baseline situation in a region in terms of existing technological, industrial, research and innovation, and education capabilities. This set of areas is complemented by emerging circular economy initiatives, an analysis of existing regulation in terms of circular economy and funding instruments. While the first group of categories is mandatory for the analysis, the latter are strongly recommended or optional (see Figure 1). That categorisation refers to possible subsequent analyses of local and cross-regional value chains which allow for the identification of sectors for intra-regional collaboration.⁹

Figure 1: The SCREEN Mapping Framework



Source: Albè et al. (2017), pp.5.

The methodology process is divided into 6 steps. The first 3 steps strive to prepare an overview of the existing circular economy landscape by looking at regional innovation strategies (RIS3), strategic areas and SWOT analyses, focus sectors and companies with a particularly high potential for circular solutions as well as R&D and innovation capabilities. Consequently, the 4th step is more future-oriented, focusing on emerging ideas in terms of circular economy representing possible future areas of development. While the first 3 steps are mandatory, the 4th step is strongly recommended. The final steps 5 and 6 are considered to be optional and focuses on the analysis of non-technological barriers. For this, existing legal frameworks both on national and regional level are considered (Step 5) as well as existing support instruments.¹⁰

2. Results

Below, the presented SCREEN methodology is to be applied on the circular economy in the Free and Hanseatic City of Hamburg. A thematic focus on circular construction is chosen in order to limit the broad field of circular economy and to make the analysis more focused. Where it appeared to be helpful, the regional analysis is complemented by an overview of the national status quo in Germany.

2.1 Step 1: RIS 3, Strategic Areas, and SWOT Analysis

The first step serves the purpose to collect information about the strategic positioning of a region towards circular economy. If particular RIS3 strategies are in place, these are considered. The methodology template also proposes a framework to reflect and highlight strengths, weaknesses, opportunities, and threats in the region with respect to circular economy topics. Since the structure of the SWOT analysis is designed to be open, the decision on focus and the level of detail is flexible.¹¹

The regional innovation strategy of the Free and Hanseatic city of Hamburg for smart specialisation 2014-2020 (RIS3) was issued in December 2014 and is currently undergoing an update process. The purpose of the RIS3 concept was to contribute to the EU2020 goals of smart, sustainable, and inclusive growth and the development of regional RIS3 was made a mandatory requirement by the European Commission to be eligible for funding from the structural funds. By identifying regional strengths and comparative advantages, regions should position themselves accordingly in international value chains and at the same time realise regional synergies between different actors of the innovation ecosystem.

In the case of Hamburg, the RIS3 is based on a SWOT analysis of R&D and innovation which forms the basis for the identification of specialisations. The analysis showed that Hamburg, although scoring high in certain R&D indicators and being classified an “innovation leader”, not yet reached the goal of being an innovation capital in Europe at the time in 2014. Still, the research and science ecosystem in Hamburg as a requirement for high-quality teaching and research is described to be in a good state. Research institutions in Hamburg engage in basic as well as applied research and show internationally recognised success.

The innovation ecosystem in Hamburg is differentiated in a set of clusters whose cluster organisations have been institutionalised at different times: While “*nextMedia.Hamburg*”, a cluster focusing on media, IT and telecommunication, was established in 1997, the maritime cluster Northern Germany was relatively new in 2014 being established in 2011. The other clusters classify in between: “*Hamburg aviation*” (aviation; 2011), “*Life Science Nord*” (life sciences, innovative medicine; 2004), “*Logistik-Initiative Hamburg*” (logistics, traffic; 2006), “*Gesundheitswirtschaft Hamburg*” (health economy; 2009), “*Kreativgesellschaft Hamburg*” (culture and creative industry; 2010), “*Erneuerbare Energien Hamburg*” (renewable energy; 2011). These eight clusters also form the strategic fields of specialisation for the RIS3 strategy so that

resources of research and innovation are to be focused on these priorities. Moreover, eight future fields are defined which again take up the underlying foundation of the clusters: 1) mobility, traffic and logistics, 2) energy, climate, environmental protection and marine technology, 3) health, applied food science and nutrition, 4) finances, insurance and law, 5) materials, systems, processes and procedures, 6) information and communication, 7) international trade and international cooperation, 8) creativity, education and qualification.

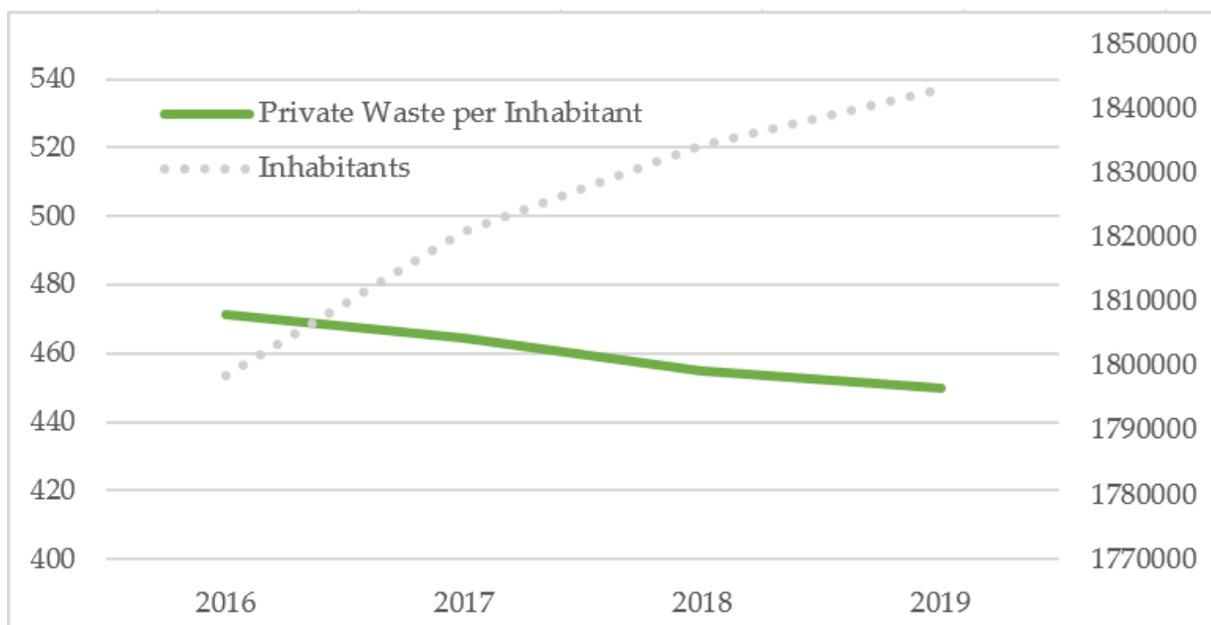
The topic of circular economy is listed in the future field energy, climate, environmental protection and marine technology among other technologies and trends such as renewable energies, energy production, energy storage technologies, energy efficiency, climate research, low-power-electronics and performance electronics, combined heat and power, offshore systems, resource potential of marine infrastructures, biological diversity/blue biotechnology, sustainable energies, environmental and resource management as well as fuel cell technology and circular economy.¹² Circular economy is not mentioned in a business context or in the future field of materials, systems, processes and procedures. However, regarding the high activity in terms of circular economy topics in Hamburg in recent years one can expect a more prominent role of the topic in the next RIS3 strategy.

2.2 Step 2: Focus Sectors & Companies

The second step of the methodology is related to identification, classification, and analysis of focus sectors of the circular economy and related best practices in the region. Apart from statistical analyses regarding the focus sectors of particular interest, companies and industrial best practices are to be identified.¹³

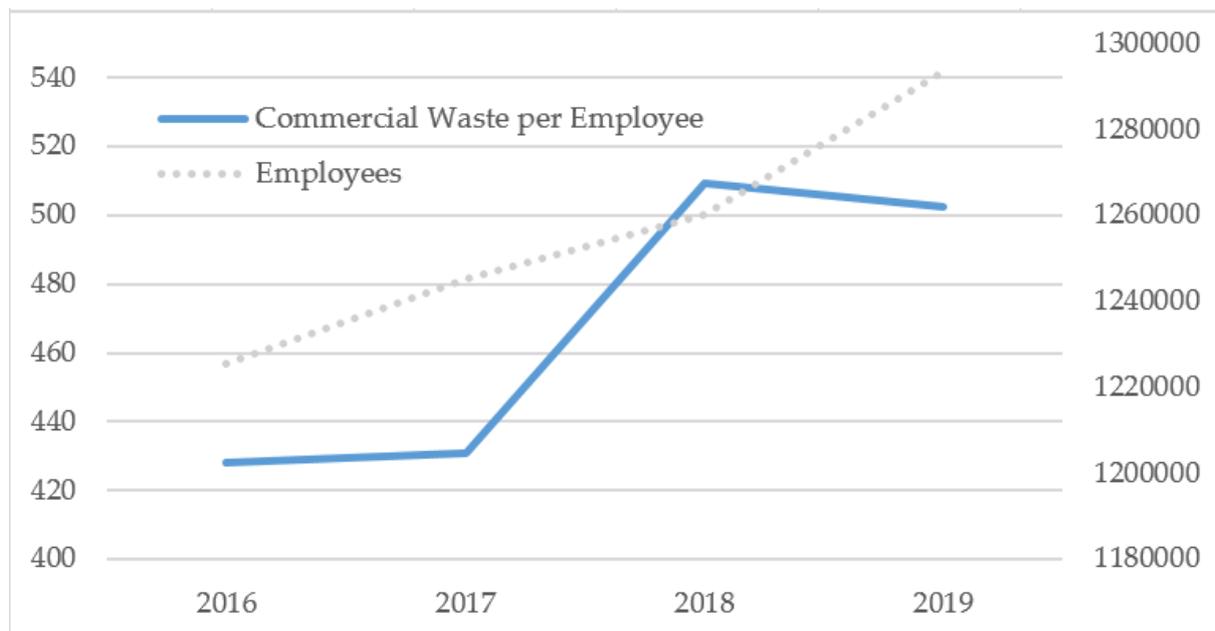
Addressing the circular economy topic from a statistical point of view shows that the volume of private waste in Hamburg shows a downward-sloping trend from 471.2kg per inhabitant in 2016 to 450kg per inhabitant in 2019 although the population increased from 1,798,654 inhabitants in 2016 to 1,843,176 inhabitants in 2019 (see Figure 2). On the other hand, the volume of commercial waste increased in recent years from 428.3kg per employee in 2016 to 502.5kg per employee in 2019 while the number of employees 1,225,400 in 2016 to 1,293,200 in 2019 (see Figure 3).¹⁴ While the development of waste reduction in private households therefore shows a promising trend of decreasing waste volume despite a growing population, a decoupling has not been accomplished in the commercial sector.

Figure 2: Development of Private Waste Volume (in kg) per Inhabitant in Hamburg



Source: Own depiction after data from the Ministry for Environment, Climate, Energy and Agriculture (2020).¹⁵

Figure 3: Development of Commercial Waste Volume (in kg) per Employee in Hamburg



Source: Own depiction after data from the Ministry of Environment, Climate, Energy and Agriculture (2020).¹⁶

When looking at the details of waste (both private and commercial) in Hamburg one can observe that the overall volume of waste has increased over the last years. Thereby, the growth rates differ depending on the waste characteristics: While the amount of separated private waste remained almost constant and even decreased as an amount per inhabitant, mixed private waste decreased both in absolute and in relative terms (see Table 1). On the other hand, separated commercial waste increased significantly as well as mixed commercial waste (see Table 2).

Table 1: Development of Private Waste Components in Hamburg

| | 2016 | | 2017 | | 2018 | | 2019 | |
|-----------------------------------|----------------|-----------------------|----------------|-----------------------|----------------|-----------------------|----------------|-----------------------|
| | Overall (Mg/a) | Per inhabitant (kg/a) |
| Separated | | | | | | | | |
| Glass | 29200 | 16,2 | 29700 | 16,3 | 30300 | 16,5 | 31000 | 16,8 |
| Paper | 98300 | 54,7 | 98600 | 54,1 | 97300 | 53 | 97100 | 52,7 |
| "Hamburger Wertstofftonne" | 36400 | 20,2 | 37300 | 20,5 | 98700 | 21,1 | 40200 | 21,8 |
| Plastics | 500 | 0,3 | 560 | 0,3 | 780 | 0,4 | 740 | 0,4 |
| Metals (part bulky trash) | 10700 | 5,9 | 13600 | 7,5 | 12890 | 7 | 11600 | 6,3 |
| Wood (part bulky trash) | 29200 | 16,2 | 30100 | 16,5 | 29760 | 16,2 | 30440 | 16,5 |
| Textiles | 7650 | 4,3 | 7100 | 3,9 | 7340 | 4 | 7030 | 3 |
| Bio waste | 65800 | 36,6 | 69100 | 37,9 | 63300 | 34,5 | 69500 | 37,7 |
| Green waste | 27600 | 15,3 | 28100 | 15,4 | 22400 | 12,2 | 23900 | 13 |
| Electronic waste | 10900 | 6,1 | 10200 | 5,6 | 11100 | 6,1 | 11200 | 6,1 |
| Sum | 316300 | 175,8 | 324400 | 178,1 | 313900 | 171,1 | 322700 | 175,1 |
| | | | | | | | | |
| Mixed | Overall (Mg/a) | Per inhabitant (kg/a) |
| Problematic waste from households | 2390 | 1,3 | 2320 | 1,3 | 2390 | 1,3 | 2470 | 1,3 |
| Bulky waste, recycling | 1450 | 0,8 | 1530 | 0,9 | 1640 | 0,9 | 1890 | 1,1 |
| Bulky waste, sorted | 29100 | 16,2 | 28900 | 15,9 | 24900 | 13,6 | 28400 | 15,4 |
| Bulky waste, energetic use | 3700 | 2,1 | 5300 | 2,9 | 10600 | 5,8 | 8100 | 4,4 |
| Street sweepings, processing | 21400 | 11,9 | 18200 | 10 | 22000 | 12 | 15400 | 8,4 |
| Street sweepings, energetic use | 11900 | 6,6 | 11400 | 6,3 | 13600 | 7,4 | 16800 | 9,1 |
| Residual waste, energetic use | 461300 | 256,5 | 453400 | 249 | 445600 | 242,9 | 433600 | 235,2 |
| Sum | 531200 | 295,4 | 521100 | 286,2 | 520700 | 283,9 | 506700 | 274,9 |

Source: Own depiction after data from Ministry of Environment, Climate, Energy and Agriculture (2020).¹⁷

Table 2: Development of Commercial Waste Components in Hamburg

| | 2016 | | 2017 | | 2018 | | 2019 | |
|------------------------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|----------------|---------------------|
| | Overall (Mg/a) | Per employee (kg/a) |
| Separated | | | | | | | | |
| Glass | 7120 | 5,8 | 7420 | 6 | 12900 | 10,2 | 17330 | 13,4 |
| Paper | 139200 | 113,6 | 133200 | 107 | 152100 | 120,7 | 171500 | 132,6 |
| Plastics | 11800 | 9,6 | 13600 | 10,9 | 11800 | 9,4 | 10550 | 8,2 |
| NE-metals | 5400 | 4,4 | 2990 | 2,4 | 8810 | 7 | 4180 | 3,2 |
| FE-metals | 49700 | 40,6 | 50800 | 40,8 | 56400 | 44,8 | 50900 | 39,4 |
| Wood AI-AIII | 52600 | 42,9 | 50800 | 4,8 | 65100 | 51,7 | 73400 | 56,8 |
| Wood AIV | 4800 | 3,9 | 4040 | 3,2 | 4260 | 3,4 | 8220 | 6,4 |
| Textiles | 180 | 0,1 | 320 | 0,3 | 300 | 0,2 | 130 | 0,1 |
| Bio waste | 20900 | 17,1 | 22600 | 18,2 | 20600 | 16,3 | 22800 | 17,6 |
| Green waste (incl. leaves) | 83000 | 67,7 | 90800 | 72,9 | 90700 | 72 | 97500 | 75,4 |
| Electronic waste | 3560 | 2,9 | 4470 | 3,6 | 4430 | 3,5 | 3500 | 2,7 |
| Sum | 378300 | 308,7 | 381000 | 306 | 427400 | 339,2 | 460000 | 355,7 |
| | | | | | | | | |
| Mixed | Overall (Mg/a) | Per employee (kg/a) |
| Packaging | 46500 | 37,9 | 51300 | 41,2 | 43800 | 34,8 | 13000 | 10,1 |
| Commercial waste (until 2017) | 92680 | 75,6 | 98700 | 79,3 | | | | |
| Commercial waste for pretreatment | | | | | 126150 | 100,1 | 132500 | 102,5 |
| Commercial waste for energetic use | | | | | 40690 | 32,3 | 40720 | 31,5 |
| Commercial waste for disposal | 7400 | 6 | 5500 | 4,4 | 3600 | 2,9 | 3600 | 2,8 |
| Sum | 146600 | 119,6 | 155500 | 124,9 | 214200 | 170 | 189800 | 146,8 |

Source: Own depiction after data from the Ministry of Environment, Climate, Energy and Agriculture (2020).¹⁸

Particularly the increasing amount of commercial waste underlines a high sense of urgency for instance in terms of circular construction in order to reduce the amount of waste from construction projects. Since the city of Hamburg is expected to keep growing as a consequence of strong urbanisation processes and at least 10,000 new housing units are to be constructed annually the topic can be expected to further increase in relevance.¹⁹ On national level, the same trend of increasing amount of construction waste is observable.²⁰ Moreover, a share of about 10 per cent of construction waste was put to landfill sites in 2014.²¹ In this context, the EU project CIRCuiT strives to introduce circular approaches in the construction sector in Hamburg (see 2.3 for further details). The sense of urgency and the recent activity in this sector make circular construction also a focus in the scope of this report.

Apart from statistics, Hamburg lists a number of relevant companies and institutions working on circular economy topics. A selection of interesting institutions is to be given subsequently as a set of examples of good practices.

Focusing on the topic of urban waste and to establish circular loops, a “*center for resources and energy (ZRE)*” will be established in Hamburg until 2023. The center will be constructed on a former area of an incinerator and will be including several facilities for waste treatment such as a sorting facility for household waste, biogas facilities or facilities for energy production. The energy demand of the facility will be provided by heat and biogas generated as by-products of waste treatment.²²

Moreover, the physical branches of “*Stilbruch*”, a group of second-hand stores, have been adapted to deal with electronic waste in the scope of the FORCE project (see 2.3). Here, old electronic devices are collected, repaired and recycling measures are prepared. It is examined whether manual dismantling of electronic devices simplifies their recycling. To do so, materials such as plastics, aluminium, iron and stainless steel are collected separately and precious materials such as copper, gold, silver or palladium are collected, analysed and recycled by Aurubis, one of the project partners.

A stronger focus on consultancy is taken by “*EPEA – Part of Drees & Sommer*” (Environmental Protection Encouragement Agency) in Hamburg, founded by Michael Braungart, one of the developers of the cradle-to-cradle design principle. EPEA Hamburg is a consultancy company which was founded in 1987 and has been working on sustainable products, processes, buildings, and urban quarters since while applying the cradle-to-cradle design principle in different situations with a holistic approach. EPEA’s goal is to support different actors from economy, public sector, and science in implementing circular processes and innovative product development. The focus sectors are loops in production processes, buildings and cities with knowledge from chemistry, biology, environment and property management.²³ As an addition, an association “*Cradle-to-Cradle e.V.*” has been founded as a regional group of the Cradle to Cradle NGO.²⁴

The technological aspect of circular economy implementation good practices is addressed, among others, by a newly developed app to allow companies to capture their waste, conduct orders online and prepare a documentation of waste according to required regulations. The app is in a test phase and is limited to companies active in the “*Umweltpartnerschaft*” (environmental partnership). The app has been developed by the network company Resourcify together with the Umweltpartnerschaft.²⁵

The Umweltpartnerschaft is a voluntary initiative established in 2003 by the Senate of the city of Hamburg and now lists about 1,250 Hamburg-based member companies from different sectors and of different sizes. Member companies strive to engage in sustainability within their organisation and can make use of a network to exchange good practices and receive external support and consultancy for sustainable management. The Umweltpartnerschaft initiative is supported by the chamber of commerce Hamburg, the chamber of crafts Hamburg, the IVH Industrieverband Hamburg e.V. and Hamburg Port e.V.²⁶

Apart from established institutions and companies, Hamburg also hosts a vivid startup environment which covers green and circular topics and shows a high proximity to topics of biobased material and further strong research topics present in Hamburg. In this context, the Hamburg-based Startup “*LignoPure*” which focuses on plastic-free products from alternative renewable resources on has been awarded a national StartGreen Award 2019 for green startups.²⁷ Moreover, a virtual platform with the name “*cirplus*” to bring together supply and demand for recyclates and plastic waste in order to facilitate a circular usage has been established as a startup. Its focus group involves the complete value chain of plastics. The platform is available on a nation-wide and even international scale but has been founded in Hamburg with support of different universities.²⁸ Several other startups are being founded and start operating in different thematic areas of circularity, green products, and sustainability in general.²⁹

2.3 Step 3: R&D and Innovation Capabilities

The third step strives to identify, classify, and analyse R&D and innovation capabilities within a region. The step involves a general overview as well as R&D, innovation capability and education capability. Moreover, a list of past and ongoing projects relevant for the circular economy is to be prepared as well as information about pilot plans and facilities in the region focused on circular economy solutions. Finally, the regional education system is to be examined for courses and skills requested in circular economy businesses.³⁰

In the following, an overview about different projects on circular economy topics is to be presented (including European / national / regional projects) before the relevant R&D institutions and their involvement with the circular economy are listed.

Projects

“BIOREFINE-2G – Development of 2nd Generation Biorefineries – Production of Dicarboxylic Acids and Bio-based Polymers Derived Thereof”³¹

- Funding source: Seventh Framework Programme
- Budget: 6.9 million Euro
- Duration: 10/2013 – 09/2017
- Nationalities of the consortium: Germany, Norway, Portugal, Spain, Sweden
- Regional partners: IFU Institut für Umweltinformatik Hamburg GmbH
- Abstract: The existing 2nd generation biorefineries utilize less than 20% of the biomass feedstock for ethanol production, and major side-streams are produced such as pentose and lignin waste streams, that are respectively used for biogas and energy production. Converting the carbon from these waste streams into added-value products would increase the otherwise low profitability and improve the environmental benefits of the biorefineries. The suggested project BioREFINE-2G aims at developing commercially attractive processes for efficient conversion of pentose-rich side-streams from biorefineries into dicarboxylic acids, which can be used as precursors for bio-based polymers including biodegradable polymers. The project covers the whole value chain, from characterization of side streams from forest and other non-food feedstocks, development of novel robust industrial yeast cell factories, fermentation and downstream process development, to polymerization methods development for the production of biodegradable polymers applicable as plastics, coatings or adhesives, scale-up and demonstration and to life cycle and economic viability analyses.

“CIRCuiT – Circular Construction in Regenerative Cities”³²

- Funding source: Horizon 2020
- Budget: 9.8 million Euro

- Duration: 01.06.2019 – 31.05.2023
- Nationalities of the consortium: Denmark, Finland, Germany, Great Britain
- Regional Partners: City of Hamburg; supporting partners: Hamburg University of Technology (TUHH), Otto Dörner, Otto Wulff, Eggers Tiefbau
- Target sectors: F41 – Construction of buildings; E38 – Waste collection, treatment and disposal activities, materials recovery; E39- Remediation activities and other waste management services
- Abstract: Demonstration of three innovative solutions: dismantle buildings to reuse materials; transformation and refurbishment; and design for disassembly and flexible construction. Development of urban planning instruments to support cities in implementing circular construction solutions. Implementation of a Circularity Hub, a data platform to evaluate progress of circular economy and regenerative capacity. Creation of a knowledge sharing structure, the CIRCuiT Academy, to promote upscaling of solutions.

“DECISIVE – A DECentralized management Scheme for Innovative Valorization of urban biowaste”³³

- Funding source: Horizon 2020
- Budget: 8.7 million Euro
- Duration: 09/2016 – 02/2021
- Nationalities of the consortium: Belgium, Denmark, France, Germany, Italy, Spain
- Regional partners: Technical University Hamburg (TUHH)
- Abstract: The growing attractiveness of cities leads to increasing population, thus rising energetic and food demands in urban areas. This makes urban waste management increasingly challenging, both in terms of logistics and environmental or health impacts. To decrease the cities’ environmental impacts and to contribute to a better resilience of urban areas towards energy or food supply crisis, waste management systems have to be improved to increase recycling of resources and local valorization. In this context, the DECISIVE project proposes to change the present urban metabolism for organic matter (foods, plants, etc.), energy and biowaste to a more circular economy and to assess the impacts of these changes on the whole waste management cycle. Thus, the challenge will be to shift from a urban “grey box”, implying mainly goods importation and extra-urban waste management, to a cooperative organization of intra- and peri-urban networks enabling circular local and decentralised valorization of biowaste, through energy and bioproducts production. Such a new waste management paradigm is expected to increase the sustainability of urban development by: (1) promoting citizens awareness about waste costs and values; (2) promoting renewable energy production and use in the city; (3) developing an industrial ecology approach that can promote the integration between urban and peri-urban areas, by providing valuable agronomic by-products for urban agriculture development and so improving the balance of organic products and waste in the city; (4) developing new business opportunities and jobs.

“DIBICHAIN – Digitales Abbild von Kreislaufsystemen mittels einer Blockchain”³⁴

- Funding source: German Federal Ministry of Education and Research
- Budget: 643,284 Euro
- Duration: 07/2019 – 06/2022
- Nationalities of the consortium: Germany
- Regional partners: Altran Deutschland
- Abstract: DIBICHAIN aims to investigate the application of blockchain technology for the digital representation of product cycles in contrast to other distributed ledger technologies (DLT). DLT, i.e. distributed data storage, is a novel technology for storing data securely and transparently for many users. First of all, the main differences between the individual DLTs will be highlighted in order to subsequently evaluate the suitability of the individual technologies for the selected case study. The aim is to deepen the knowledge base for the application of a block chain for a circular economy in order to enable further and more in-depth research projects that will open up the full potential for DLT in this context. A software demonstrator is to be developed, which contains the following application scenarios using the case study of the "Bionic Partition".

“FORCE – Cities cooperating for circular economy”³⁵

- Funding source: Horizon 2020
- Budget: 2.9 million Euros
- Duration: 01.09.2016 – 31.08.2020
- Nationalities of the consortium: Denmark, Germany, Italy, Portugal
- Regional Partners: City of Hamburg, Stadtreinigung Hamburg, HafenCity University (HCU), Hamburg University of Applied Sciences (HAW), Aurubis AG
- Target sectors: C24 – Manufacture of basic metals; E38 – Waste collection, treatment and disposal activities, materials recovery; E39 – Remediation activities and other waste management services
- Abstract: Horizon 2020 cooperation project between the cities of Hamburg, Copenhagen, Lisbon, and Genoa having a specific material stream as a focus point in each city. The Hamburg-based partners are Stadtreinigung Hamburg, Aurubis AG, Senate Chancellery of Hamburg, Consist ITU Environmental Software GmbH, HafenCity University and Hamburg University of Applied Sciences (HAW). Together, they focus on collection, capture, utilisation and possible further usages of (old) electronic devices in order to maintain their resources within the resource circle. On the other hand, Copenhagen deals with plastics, while Lisbon looks at biomass and Genoa on wood waste.

“LOOP Ports – Circular Economy Network of Ports”³⁶

- Funding source: EIT (European Institute of Innovation & Technology)

- Duration: 10/2018 - 11/2020
- Nationalities of the consortium: Denmark, France, Germany, Italy, Netherlands, Spain
- Regional partners: University of Hamburg (UH); network partner: Port of Hamburg
- Abstract: The main goal of the LOOP-Ports project is to facilitate the transition to a more circular economy in the port sector, where products, materials and resources are maintained in the economy for as long as possible, and the waste generation minimised. This project will contribute to the transition of the European economy towards closed-loop systems through the creation of a circular economy network of ports, which will provide an innovation ecosystem around the port activity and stimulate circular economy initiatives in ports. The network will focus on high-emitting materials, mainly metals, plastics, cements, and biomaterials.

“REPAiR – REsource Management in Peri-urban Areas: Going Beyond Urban Metabolism”³⁷

- Funding source: Horizon 2020
- Budget: 5.0 million Euro
- Duration: 09/2016 – 12/2020
- Nationalities of the consortium: Belgium, Germany, Hungary, Italy, Netherlands, Poland
- Regional partners: HafenCity University (HCU), Gertz Gutsche Rügenapp, Bauer Resources GmbH, Stadtreinigung Hamburg
- Target sectors: E38 – Waste collection, treatment and disposal activities, materials recovery; E39- Remediation activities and other waste management services
- Abstract: Implementation of Peri-Urban Living Labs (PULLs) with key stakeholders. Development of an innovative geodesign decision support environment (GDSE) to create integrated, place-based eco-innovative spatial development strategies promoting the use of waste as a resource. Launch of the initiative ‘Campania più verde, Campania più controllati’ (Greener Campania, safer Campania), together with the Campania Regional Authority.

“REPLACE - REgional PoLicy Actions for Circular Economy”³⁸

- Funding source: Interreg Europe
- Budget: 1.9 million Euro
- Duration: 08/2019 – 01/2024
- Nationalities of the consortium: Belgium, Germany, France, Greece, Italy, Netherlands, Poland, Portugal
- Regional Partners: HWWI, City of Hamburg (associated partner)
- Target sectors: Public administration and officials
- Abstract: REPLACE aims at improving management, implementation and monitoring of regional policy instruments targeted at facilitating the transition towards a CE, while boosting sustainable development: the main operative target refers to the development and application of policies and actions focusing on identification, valorization,

assessment and financing of circular value chains, resulting in new local and interregional projects. REPLACE will develop a replicable framework for regional benchmark on circularity excellence level.

REPLACE wants to fulfil a synergic use of funding for CE, connected to RIS3, to enhance innovation and competitiveness, as well as economic and employment performances while increasing effectiveness of policy instruments. In fact, REPLACE has an innovative horizontal cross-cutting approach, not focusing on one or more specific aspects of CE, but dealing with the lack of an effective and shared strategy for CE at regional level.

“RISKCYCLE – Risk-based management of chemicals and products in a circular economy at a global scale”³⁹

- Funding source: Seventh Framework Programme
- Budget: 1.1 million Euro
- Duration: 09/2009 – 08/2012
- Nationalities of the consortium: Brazil, China, Denmark, France, Germany, India, Italy, Netherlands, Spain, Sweden, Turkey, Vietnam
- Regional partners: Hamburg University of Applied Sciences (HAW)
- Abstract: The project brought international experts together to define the future research and development needs for risk-based hazardous chemicals management. In particular, RISKCYCLE looked at the ecological design of consumer products, as well as their production, use and reuse on a global scale. The project used methods such as life-cycle assessment, risk assessment and risk-reduction strategies, environmental impact analysis and material flow analysis for this task. Researchers compiled large data sets on usage, risks, chemical properties and labelling, and additives in consumer and industrial products for public use. RISKCYCLE focused on the role of these additives in textiles, electronics, plastics, leather, paper and lubricants, identifying the top five additives for each sector. These data were collated into a database, now available on the project website. Researchers also compiled the project findings into two book volumes: 'Risk-based management of chemical additives I' and II. In addition, RISKCYCLE held numerous workshops and meetings where partners were called on to exchange project results and information about their institutions and fields of work. The project has made information about the risks of hazardous chemicals and additives in products and the risk reduction measures for substances widely available.

“Smart Recycling”⁴⁰

- Funding source: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
- Budget: 60,899 Euro
- Duration: 07/2020 – 12/2020
- Nationalities of the consortium: Germany

- Regional partners: Hamburg University of Applied Sciences (HAW)
- Abstract: The project aims towards developing concepts for the combination of highly innovative technologies such as intelligent and learning sensor, learning (mobile) robots and cooperative robot teams. These are analysed according to their applicability in the circular economy. To increase recycling, resource efficiency and reduction of CO₂-emissions, an automated, robot-supported sorting of lumpy waste is to be enabled which is not possible until now.

“WASTE-EI – Waste Education Initiative”⁴¹

- Funding source: Erasmus+
- Budget: 49,102
- Duration: 09/2017 – 09/2020
- Nationalities of the consortium: Estonia, Croatia, Germany, Great Britain, Romania
- Regional partners: Hamburg University of Applied Sciences (HAW)
- Abstract: Using innovative approaches, Waste-EI will investigate best practices in waste education delivered across five EU regions, with the aim of sharing best practices and encouraging citizens to improve the quality and volume of valuable resources available for recycling. Delivered by universities and industry, the objective of the project is to change behaviour and ensure that regions maximise recycling in the most cost-effective way through a combination of teaching, educational resources, ICTs and tours to waste treatment facilities. The regions covered by the partnerships represent approximately seven million residents and five million tonnes per annum of municipal solid waste (MSW), with a variety of recycling approaches. Resource efficiency and the transition to circular economy principles will be central to all of the outputs, ensuring consumer behaviour and materials recovery are included in the project design. All outputs and ideas will be disseminated throughout the partnership and other established networks to maximise the wider impact of the project.

“Wertstoff-Initiative” and “Hamburg bottle”⁴²

- Nationalities of the consortium: Germany
- Regional partners: Technical University Hamburg (TUHH, science partner), Stadtreinigung and Veolia (resource providers and treatment of old bottles), Unilever (producer) and Budnikowsky (retailer)
- Target sectors: E38 – Waste collection, treatment and disposal activities, materials recovery; E39- Remediation activities and other waste management services
- Abstract: The project aims towards establishing a regional loop in Hamburg with a High Density Polyethylen (HDPE). By developing a bottle for shampoo or detergents which is to be produced from 100 per cent recycled plastic, five regional partners have been working on the topic since 2019. The plastic is to be gathered in Hamburg in garbage bins of private households (*“Hamburger Wertstofftonne”*) and the bottles only to be sold in Hamburg establishing a closed regional loop.

Research Institutions

“Elbcampus – competence center of the chamber of crafts Hamburg”

The Elbcampus offers a study course on waste economy, circular economy and city cleaning. The course is awarded a “meister” degree in Germany and allows for leading positions in waste treatment and further development in that field. Apart from topics of business administration, natural sciences and technical essentials, the course involves specific learnings on waste treatment, waste disposal and recycling. Focus group of the study programme are qualified employees from the specific sector wishing to further specialise and to qualify for leading positions.⁴³

“HafenCity University (HCU)”

The HCU is involved in different European cooperation projects (see above). Apart from that, the urban development department focuses on circular economy topics, for instance in the subject *“Stadtplanung und Regionalentwicklung”* (city planning and regional development). This department focuses on 1) challenges for urban locations and 2) innovative approaches for sustainable development of large cities and metropolitan areas and integrated circular topics accordingly from a governance perspective.⁴⁴ Moreover, the study course “city planning” (bachelor level) includes circular economy content.

Hamburg University of Applied Sciences (HAW)

The HAW is partner in several EU-funded and national projects on the circular economy (see above). In these projects, the approach is mostly technical and involve the faculty of life sciences. Moreover, the circular economy is present in the work of certain departments: The department of design connects circular topics with 1) illustration, 2) fashion, costume and textile design, 3) communication strategy, 4) clothing – technique and management.⁴⁵ Moreover, the faculty for life sciences works on fields related to the circular economy such as 1) sustainable development / sustainability, 2) climate change and climate protection, 3) climate and health, 4) nature protection, 5) environmental protection techniques.⁴⁶ Apart from that, several study courses focus also on circular economy topics. For instance, “illustration” (design, bachelor level), “fashion, costume, and textile design” (design, bachelor level), “environmental engineering” (engineering, bachelor level) and “biotechnology” (biotechnology, bachelor level).

Hamburg University of Technology (TUHH)

The TUHH is partner in different EU and national research projects (see above) and has a research field of recycling and circular economy at the Institute of Environmental Technology and Energy Economics. The research field divides into several subcategories:

- Recycling of metals from industry waste and old electronic devices. Since extraction of new resources and virgin material is an energy-intensive and emission-related process, recycling becomes increasingly important also from an economic perspective. Since WEEE/EAG (old electronic devices) is one of the fastest growing waste stream and the status quo is of that kind that collection is inefficient (only about 30 per cent of the volume end up in an adapted collecting and recycling system) new processes for collection and treatment are to be developed.⁴⁷
- Biotechnological processes for recovery of metals. The research activities focus on the recovery of precious metals contributing to economically and ecologically positive effects.⁴⁸
- Polymer recycling. In order to reduce the amount of virgin material needed to produce plastics, it is the goal to research the differing quality of plastic samples to identify measures of recycling without deteriorating physico-chemical qualities.⁴⁹

Apart from that, the working group *“energy systems and production procedures”* works on a circular economy for phosphorus, particularly in animal food. By certain adaptations of fodder it shall be ensured that problems of high phosphorus concentrations in animal excrements and therefore on agricultural areas are avoided.⁵⁰ Moreover, the TUHH offers several study courses which include circular economy topics, for instance *“energy and environmental engineering”* (engineering course, bachelor level) or *“construction and environmental engineering”* (engineering, bachelor level).

University of Hamburg (UH)

The UH is partner in circular economy related projects (see above).

2.4 Step 4: Emerging Ideas

The fourth step of the methodology aims to list the most innovative emerging activities in view of new circular economy businesses and initiatives. These are not to be confused with best practices since these should show some evidence of benefits and impacts and should already be implemented whereby emerging ideas represent opportunities for regional circular economy.⁵¹

In the following, the authors use an overview of events related to the circular economy as an indicator for ideas that are discussed in the Hamburg region. Although the list does not raise a claim for completeness, it shows that circularity is intensively discussed in terms of waste management and in relation to existing clusters such as logistics.

Events

A Table in design and business innovation for the circular economy was hosted by Sustainable Design Center e.V. in February 2016. The main focus was to identify good practices from the Netherlands, for instance in terms of incubators for the circular economy.⁵²

On April 19th, 2018 a “*circular economy mapping event*” was hosted in Hamburg by the Hamburg University of Applied Sciences (HAW). The event happened in around 70 participating cities internationally and was about mapping examples, discovering synergies and promoting connections in terms of circular economy.⁵³

On October 10th, 2018 a conference “*resource management and circular economy in city regions*” was organised in Hamburg as part of the Horizon 2020 project REPAiR (see under Step 3). The conference’s focus was to highlight the topic of resource management and circular economy. This was achieved by presenting research projects, urban and regional activities, and civic initiatives and allowing for a discussion between different stakeholder groups.⁵⁴

A summit on waste in Hamburg was organised on February 7th, 2019 by Stadtreinigung Hamburg. A focus point was the discussion about a center for resources and energy (ZRE) which is to be developed until 2023 (see 2.2).⁵⁵

A Seminar “*Circular economy, cradle2cradle, innovation*” organised at the NIT Northern Institute of Technology Management in Hamburg was hosted on May 11th, 2019. The institute offers training workshops for students and professionals. The seminar focused on introducing the concepts of circular economy and cradle to cradle innovation and their relevance for the different disciplines in innovation management.⁵⁶

A logistic-related meeting on “*circular economy – are linear supply chains yesterday’s news?*” has been organised on May 21st, 2019 in Hamburg. The meeting also served a training purpose for the logistic branch being organised by the “*Nordakademie*”.⁵⁷

Presentation on “*sustainable ports and circular economy challenges*” held on May 29th, 2019 at Kühne Logistics University in Hamburg about the relation between port city stakeholders and

the potential application of the circular economy approach to sustainable ports by proposing a circular framework.⁵⁸

On November 26th, 2019, the Master of International Business and Sustainability at the University of Hamburg (UH) dedicated its annual public debate the topic “*circular economy: how to move away from linear thinking*”. The debate hosted three expert speakers from Cradle-to-Cradle e.V. Hamburg, Cirplus and the Lead Manager Sustainability at Tchibo. Findings: The collaboration between parties (circular network of private sectors, consumers, governments and NGOs) can be very powerful and innovations and startups can accelerate the expansion of the concept of circularity.⁵⁹

A two-day forum (“*T.R.E.N.D.*”) was organised by Stadtreinigung Hamburg on February 4th and 5th, 2020. Topic of 2020 was the circular economy including an analysis of the status quo and the presentation of several good practices from different sectors being presented by experts. The event was complemented by a public exhibition giving institutions and companies the opportunity to present themselves and improve their networks. The next forum will be held in 2022.⁶⁰

Within the scope of the national research project DIBICHAIN a branch meeting with presentations and workshops was held on February 19th, 2020 on “*competitive business models in the circular economy a & blockchains*”.⁶¹

2.5 Step 5: Existing Circular Economy Legislation

The fifth step focuses on existing or under development legislation regarding the circular economy both on the regional and the national level. Policy implementation mechanisms can involve education, information and awareness raising actions as well as collaboration platforms, incentive mechanisms or business support schemes.⁶²

In the case of Hamburg, a new regulation on waste disposal from 2017 introduced an “*recycling offensive*” for waste producers and owners as well as treatment institutions in order to ensure that a higher degree of waste can be recycled. Among others, the new regulation dictates to gather waste separately and only in certain occasions in a mixed way. If a separate gathering of waste is not possible, a pre-treatment is mandatory as well as documentation of all waste streams.⁶³ The topic of circular economy is regionally regulated in the “*Hamburgisches Abfallwirtschaftsgesetz (HmAbfG)*” (Hamburg waste law) applying the national “*Kreislaufwirtschaftsgesetz*” (circular economy law) on Hamburg. Thereby, the Hamburg-related law obliges the responsible public authorities to ensure a separated collection of waste, to develop and apply new measures to sustainably exploit waste and to include recycled products in use cases as long as these measures are not linked with excessively increasing cost.⁶⁴

The national law serves the purpose to promote the circular economy to spare natural resources and to protect humans and environment in the scope of producing and exploitation of waste.⁶⁵ The recent update, including the respective EU directive into national law, has modernised the German waste law in different ways: for instance, a new waste hierarchy of five steps was introduced (avoidance, reuse, recycling, other exploitation such as energetic recovery, waste disposal). Moreover, new measures for waste avoidance, improvement of resource efficiency and the regulation on the shared responsibility between public and private in waste disposal are introduced.⁶⁶

Moreover, Hamburg is adapting its regional regulation to introduce circular approaches when it comes to waste and resources. For instance, regulation is adapted in such way to simplify construction projects using wood. A concrete example is a 19-storied building which is planned to be constructed in the Hafencity in Hamburg. The recent coalition agreement of the new regional government, formed in 2020, further underlines the potential of circular construction and includes the intention to prepare a study on the usage of sustainable (such as wood) and recycled construction material (such as RC-concrete). Stricter regulation on packaging and the avoidance of non-reusable packaging is announced.⁶⁷

2.6 Step 6: Existing Funding Instruments

The sixth step relates to funding instruments already in place in the regions. The regional overview is complemented by an overview about national funding instruments.⁶⁸

Since 2017, using wood for construction is also supported financially: In the case of residential buildings, every kilogram of wood is rewarded with a grant of 30 cents while non-residential buildings receive even 80 cents per kilogram wood. In the latter case, particularly kindergartens, sport clubs and workshops have been supported but the grant scheme can also be applied in cases of addition of stories on top of existing buildings. The public *“Investitions- und Förderbank Hamburg (IFB)”* offers particular seminars and information events on wood as a construction material in different environments.⁶⁹

Already in 2011 Hamburg initiated a project on integrated product policy (*“Integrierte Produktpolitik”*) to introduce an extensive view of the complete value chain of a product and how to design that in a sustainable way.⁷⁰

Moreover, the programs *“Unternehmen für Ressourcenschutz”* (companies for resource protection) as well as *“PROFI Umwelt”* and *“PROFI Umwelt Transfer”* address circular topics in regional companies. The first program focuses on production, service, and craft companies in Hamburg to exploit saving potential regarding energy, water, and resources by initiating voluntary investments in resource efficiency measures.⁷¹ The other programs are offered by IFB and funds individual (PROFI Umwelt) or cooperation projects (PROFI Umwelt Transfer) for the development of innovative products, processes or services contributing to climate and environmental protection. The focus is on resource and material efficiency as well as improvements in the circular economy.⁷²

To promote the circular economy by financial support on a national basis, the German *“Kreditanstalt für Wiederaufbau (KfW)”* together with four other national support banks and institutes from Poland, France, Italy, and Spain launched a shared initiative. Its focuses on development and implementation of circular economy projects and programs in the EU and aims towards a financial volume of 10 billion Euro over five years until 2023.⁷³

Moreover, new research funds by the national Ministry of Education and Research to be granted to support research and development projects on the topic of *“resource efficient circular economy – plastic recycling technologies”* have been announced.⁷⁴ Particular Federal States in Germany have also implemented regional support schemes to direct EU funds to innovative circular economy projects.⁷⁵

3. Conclusion and Limitations

The paper at hand presents the findings of a local analysis of the circular economy in the Free and Hanseatic City of Hamburg. It is based on a mapping tool developed within the Horizon 2020 project “*SCREEN - Synergic CirculaR Economy across European regioNs*”. The purpose of the framework addresses the lack of a structured and formalised knowledge basis to assess the existing capabilities of circular economy on a regional level. The methodology shows a high degree of practical relevance and can be used as an analytical basis to highlight and evaluate potential strategic business cases contributing to the transition towards a circular economy.

The analysis for the case of Hamburg is related to the Interreg Europe project “*REPLACE - REgional PoLicy Actions for Circular Economy*”. REPLACE is a European project that aims at improving management, implementation and monitoring of regional policy instruments targeted at facilitating the transition towards a circular economy. The main operative target of the project refers to the development and application of policies and actions focusing on identification, valorization, assessment, and financing of circular value chains.

The findings of the local analysis in Hamburg can be summarised as a highly ambitious regional circular economy environment. The recent coalition agreement of the Hamburg government from 2020 gives sustainability and green development a prominent place. It is recognised that resource efficiency plays a major role for a future-oriented, sustainably city and the ambition is exclaimed to make Hamburg a model for climate protection. A study is planned on grey energy and energy consumption in building construction to identify potential for more circular construction. Resource-efficient construction and the usage of sustainable (such as wood) and recycled construction material (for instance RC-concrete) for public construction projects add to the target of a green transformation of the construction sector. In terms of waste and waste avoidance, reusable packing as an alternative to the linear produce-use-dispose scheme are planned to be promoted. In terms of recycling, the city of Hamburg obliges itself to preferably buy products with a repair option. The illegal export of electronic waste is to be prevented. The action plan for circular economy from the European Commission is explicitly supported and recognised as a guiding principle for sustainability measures in Hamburg.

The six steps of the underlying methodology to perform a local analysis on Hamburg can be summarised as following:

Step 1: In the RIS3 strategy, the topic of circular economy is listed in the future field energy, climate, environmental protection and marine technology among other technologies and trends such as renewable energies, energy production, energy storage technologies, energy efficiency, climate research, low-power-electronics and performance electronics, combined heat and power, offshore systems, resource potential of marine infrastructures, biological diversity/blue biotechnology, sustainable energies, environmental and resource management as well as fuel cell technology and circular economy.

Step 2: When looking at statistics of waste (both private and commercial) in Hamburg one can observe that the overall volume of waste has increased over the last years. Particularly the increasing amount of commercial waste underlines a high sense of urgency for instance in terms of circular construction in order to reduce the amount of waste from construction projects. Since the city of Hamburg is expected to keep growing as a consequence of strong urbanisation processes and at least 10,000 new housing units are to be constructed annually the topic can be expected to further increase in relevance. Moreover, Hamburg lists a number of relevant companies and institutions working on circular economy topics. A selection of interesting institutions is to be given subsequently as a set of examples of good practices. For instance, a centre for resources and energy (ZRE) focusing on the topic of urban waste and to establish circular loops will be established in Hamburg until 2023.

Step 3: The number of research projects on circular economy topics in Hamburg is high. Various projects on European, national, and regional level work on several specific fields of circularity, such as loops for electronic waste, circular construction, circular ports or circular blockchain technologies. These projects are mostly connected to the various research organisations and universities in Hamburg. Almost all universities are engaged in at least one circular economy project and several universities have also included the topic in their teaching, either as modules in existing courses or in specific courses.

Step 4: In order to get an idea of emerging ideas in Hamburg, organised events related to circular economy topics have been used as an indicator. Although the list does not raise a claim for completeness, it shows that circularity is intensively discussed in terms of waste management and in relation to existing clusters such as logistics.

Step 5: In terms of legislation, a new regulation on waste disposal from 2017 introduced an “recycling offensive” for waste producers and owners as well as treatment institutions in order to make sure that a higher degree of waste can be recycled. The topic of circular economy is regionally regulated in the “Hamburgisches Abfallwirtschaftsgesetz (HmAbfG)” (Hamburg waste law) applying the national “Kreislaufwirtschaftsgesetz” (circular economy law) on Hamburg. Moreover, Hamburg is adapting its regional regulation to introduce circular approaches when it comes to waste and resources. For instance, regulation is adapted in such way to simplify construction projects using wood. The recent coalition agreement of the new regional government, formed in 2020, further underlines the potential of circular construction and includes the intention to prepare a study on the usage of sustainable (such as wood) and recycled construction material (such as RC-concrete). Stricter regulation on packaging and the avoidance of non-reusable packaging is announced.

Step 6: Looking at funding instruments reveals that national funding for research on circular economy is available from the Ministry of Education and Research and financial funding from public banks is offered for development and implementation of circular economy projects and programs. Hamburg-related funding is available for instance of support to include wood in construction projects. The support program is complemented by seminars and workshops on the topic.

However, the methodology is limited in its scope to fully cover the topic of circular economy. One of the general problems of the circular economy concept is the apparent restriction to waste management topics. Thereby, circularity is about the complete value chain of a product also including design and production rather than solely how to deal with the remains after a product's life has ended. This limitation holds for most tools to monitor the circular economy on a regional level and the methodology applied here is no exception. Knowing about the imperfection of the methodology the local analysis will not be able to draw the full picture of the circular economy in Hamburg. Topics such as changing consumption patterns and societal shifts, sustainable mobility, sharing concepts, energy efficiency or new design approaches in production companies to allow for reuse and refurbishment have not been covered. Since the scientific debate on developing a measurement methodology for these aspects of circularity is still ongoing, we chose to apply a basic methodology which can be updated in a further step. Therefore, the local analysis at hand can raise no claim to completeness. Nevertheless, we see it as a contribution to an ongoing debate and look forward to suggestions of advancements and updates of activities.

4. Recommendations

Overall, the circular economy landscape in Hamburg is established and widespread. Several projects are working on concrete solutions for the city and the region and have successfully introduced their requests into politics and regulation. Still, the potential of the mass of circular economy in Hamburg is not yet fully exploited. A set of recommendations has been gathered in a regional stakeholder workshop on March 2nd, 2021 and covers several areas to further improve the visibility, implementation and connectivity of the circular economy in Hamburg.

Platform and coordination

It is described to be complicated to get in contact with companies so that the introduction of circular innovations requires a high amount of personal commitment of company owners in the first stage. Institutions such as the Umweltpartnerschaft can play an important role to raise awareness among companies for green topics and their benefits and should therefore be further promoted. However, it is regarded as important to establish additional capacity for circularity consulting to give counsel on funding possibilities, good practices and contacts and can organise trainings or workshops.

Moreover, there is no such thing as an overview about circular economy players in Hamburg and no established network between them. By now, there is no coordinating instance or database and the variety of circular activities in Hamburg becomes visible only by extensive researching. This significantly limits the public image of circular economy in Hamburg. Establishing a networking platform to bring together actors and giving them a forum for exchange of experience might be a building block to boost visibility and shared collective effort. Linking the research institutions and universities working on circularity can be a first step that can be scaled up afterwards in case of success.

Visibility

An important point to raise awareness on circular economy and its variety is to improve the visibility. Hamburg lacks concrete locations associated with the circular economy so that by now the topic remains theoretical. In this context, it was discussed to establish a noticeable “lighthouse” such as a Circular Innovation Hub or a “Circular Hamburg” event to gain attention even on a supraregional level. Local hubs should complement this kind of central lighthouse to underline that circular economy is also a local topic related to everyday life of everyone rather than just an abstract political idea.

Rebranding circularity

One of the problems of the circular economy remains its association with waste and waste treatment although the concept is much broader than that. It is not universal knowledge that circularity also involves product-related topics such as design or behavioural topics of consumption patterns and can contribute to sustainability in much more ways than just recycling of waste. To overcome this narrow view, it is recommended to show good practices of the variety of circular economy in Hamburg. A “Hamburg Declaration” could also publicly present an own definition of circular economy and contribute to raise the public awareness of circularity to the level of other sustainability topics such as energy or climate protection.

Introduce incentives

Particularly on company level there are still prejudices against circularity, particularly regarding potentially higher costs and the effort of rethinking business models. In order to overcome these barriers, not only consultation plays a role but also financial incentives to cover part of the additional cost. This is particularly important for NGOs, social and cultural actors as well as companies in an early stage and startups which require an innovation ecosystem that the updated regional innovation strategy for smart specialisation (RIS3) in Hamburg will further shape. Also, other non-financial incentives such as circularity labels or public awareness are considered to be important to get companies involved in the circular economy.

Circular education

Education plays a major role to raise the sensitivity for certain topics. Introducing sustainability and circular economy topics as ideas for practical projects in schools can reach a significant number of pupils acting as multipliers of circularity ideas.

Public sector as a facilitator

The public sector in Hamburg exerts a serious role model function in terms of transitioning towards a circular economy. Introducing strong circularity criteria for public procurement would send out the message that circularity is an accepted and desired aspect in Hamburg. Public administration and public companies can be the good practices that others need for orientation. Moreover, the public buying power should not be underestimated. For instance, making the use of recycled material mandatory in public construction projects would not only be a good practice but also provide recycling and construction companies with planning certainty to scale up the availability of recycled materials which also benefits private companies.

Adapting legislation is another important topic to simplify the introduction of circular solutions. Since Hamburg as a federal state has a larger range of law-making possibilities, these should be used to pave the way towards a circular economy. Where federal or European law is concerned, initiatives to change the legislation in favour of circularity are to be initiated.

5. References

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- ¹ Ellen MacArthur Foundation (2020): Concept, [online], available at: <https://www.ellenmacarthurfoundation.org/circular-economy/concept> [accessed October 5th, 2020].
- ² Kirchherr, J., Reike, D.; Hekkert, M. (2017): Conceptualizing the Circular Economy: An Analysis of 114 Definitions, Resources, Conservation and Recycling, 127, pp.221–232.
- ³ Corvellec, H.; Böhm, S.; Stowell, A.; Valenzuela, F. (2020): Introduction to the special issue on the contested realities of the circular economy, *Culture and Organization*, 26:2, pp.97-102.
- ⁴ European Commission (2020): Knowledge Dossier Circular Economy – Leading City: Hamburg (DE), [online], available at: https://ec.europa.eu/jrc/communities/sites/jrccties/files/kd_circular_economy_0.pdf [accessed September 15th, 2020].
- ⁵ Free and Hanseatic City of Hamburg (2019a): Hamburg in Zahlen, [online], available at: <https://www.hamburg.de/info/3277402/hamburg-in-zahlen/> [accessed October 5th, 2020].
- ⁶ Hamburg Parliament (2019): Mitteilung des Senats an die Bürgerschaft – Erste Fortschreibung des Hamburger Klimaplans und Gesetz zur Änderung der Verfassung, zum Neuerlass des Hamburgischen Klimaschutzgesetzes sowie Anpassung weiterer Vorschriften, Drucksache 21/19200, Hamburg.
- ⁷ SPD Hamburg / Bündnis 90/Die Grünen Hamburg (2020): Zuversichtlich, solidarisch, nachhaltig – Hamburgs Zukunft kraftvoll gestalten. Koalitionsvertrag über die Zusammenarbeit in der 22. Legislaturperiode der Hamburgischen Bürgerschaft, Hamburg.
- ⁸ Silvestri, F.; Spigarelli, F.; Tassinari, M. (2020): Regional development of Circular Economy in the European Union: A multidimensional analysis, *Journal of Cleaner Production*, 255, 120218.
- ⁹ Albè, F.; Colledani, M.; Picone, N.; Chiara, C. (2017): Screen Mapping Tool: Scope and Guidelines, [online], available at: <http://www.screen-lab.eu/deliverables/SCREEN-D2.1.pdf> [accessed September 24th, 2020].
- ¹⁰ Albè, F.; Colledani, M.; Picone, N.; Chiara, C. (2017): Screen Mapping Tool: Scope and Guidelines, [online], available at: <http://www.screen-lab.eu/deliverables/SCREEN-D2.1.pdf> [accessed September 24th, 2020].
- ¹¹ Albè, F.; Colledani, M.; Picone, N.; Chiara, C. (2017): Screen Mapping Tool: Scope and Guidelines, [online], available at: <http://www.screen-lab.eu/deliverables/SCREEN-D2.1.pdf> [accessed September 24th, 2020].

-
- ¹² Free and Hanseatic City of Hamburg (2014): Regionale Innovationsstrategie 2020 der Freien und Hansestadt Hamburg. Dokumentation der Strategie zur intelligenten Spezialisierung (RIS3 Hamburg) zur Erfüllung der Ex-Ante-Konditionalität für das Operationelle Programm Hamburg für den Europäischen Fonds für regionale Entwicklung (EFRE) in der Strukturfondsperiode 2014 bis 2020, Hamburg.
- ¹³ Albè, F.; Colledani, M.; Picone, N.; Chiara, C. (2017): Screen Mapping Tool: Scope and Guidelines, [online], available at: <http://www.screen-lab.eu/deliverables/SCREEN-D2.1.pdf> [accessed September 24th, 2020].
- ¹⁴ Ministry of Environment, Climate, Energy and Agriculture (2020): Abfallstatistik Siedlungsabfälle, Stand 30.07.2020, Hamburg.
- ¹⁵ Ministry of Environment, Climate, Energy and Agriculture (2020): Abfallstatistik Siedlungsabfälle, Stand 30.07.2020, Hamburg.
- ¹⁶ Ministry of Environment, Climate, Energy and Agriculture (2020): Abfallstatistik Siedlungsabfälle, Stand 30.07.2020, Hamburg.
- ¹⁷ Ministry of Environment, Climate, Energy and Agriculture (2020): Abfallstatistik Siedlungsabfälle, Stand 30.07.2020, Hamburg.
- ¹⁸ Ministry of Environment, Climate, Energy and Agriculture (2020): Abfallstatistik Siedlungsabfälle, Stand 30.07.2020, Hamburg.
- ¹⁹ Ministry for Urban Development and Housing (2020): 10.000 Wohnungen pro Jahr – Wohnungsbau wird weiter gestärkt, [online], available at: <https://www.hamburg.de/bsw/wohnungsbau/4029174/wohnungspolitik> [accessed September 29th, 2020].
- ²⁰ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2014a): Abfallaufkommen und Anteile der Bau- und Abbruchabfälle, [online], available at: <https://www.bmu.de/themen/wasser-abfall-boden/abfallwirtschaft/statistiken/bauabfaelle-und-bodenaushub/abfallaufkommen-und-anteile-der-bau-und-abbruchabfaelle/> [accessed September 29th, 2020].
- ²¹ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2014b): Auszug aus der Abfallbilanz für Bau- und Abbruchabfälle 2014, [online], available at: <https://www.bmu.de/themen/wasser-abfall-boden/abfallwirtschaft/statistiken/bauabfaelle-und-bodenaushub/auszug-aus-der-abfallbilanz-fuer-bau-und-abbruchabfaelle-2014/> [accessed September 29th, 2020].
- ²² Free and Hanseatic City of Hamburg (2020b): Projektgalerie – Zentrum für Ressourcen und Energie, [online], available at: <https://www.hamburg.de/altona/klimaschutz-projekte-altona/10288274/zentrum-fuer-ressourcen-und-energie> [accessed September 22nd, 2020].
- ²³ EPEA Hamburg (2020): Über uns - Circular Economy, [online], available at: <https://epea-hamburg.com/ueber-uns/circular-economy> [accessed September 22nd, 2020].

-
- ²⁴ Cradle to Cradle NGO (2020): Regionalgruppe Hamburg – Über uns, [online], available at: <https://c2c.ngo/mitmachen/regionalgruppen/hamburg> [accessed September 29th, 2020].
- ²⁵ Free and Hanseatic City of Hamburg (2019b): Resourcify – Kostenlose Nutzung einer Abfall-App für aktive UmweltPartner, [online], available at: <https://www.hamburg.de/kreislaufwirtschaft/12643194/resourcify> [accessed September 22nd, 2020].
- ²⁶ Ministry of Environment, Climate, Energy and Agriculture (2019a): Die UmweltPartnerschaft – Wer wir sind, [online], available at: <https://www.hamburg.de/die-umweltpartnerschaft-hamburg> [accessed September 29th, 2020].
- ²⁷ Bundesverband Nachhaltige Wirtschaft (BNW) (2019): StartGreen Award 2019: Diese Start-ups sind ausgezeichnet, [online], available at: <https://www.bnw-bundesverband.de/blog/2019/11/27/startgreen-award-2019-diese-start-ups-sind-ausgezeichnet> [accessed October 1st, 2020].
- ²⁸ Cirplus (2020): Rezyklate und Kunststoffabfälle online handeln, [online], available at: <https://www.cirplus.com> [accessed September 22nd, 2020].
- ²⁹ Hamburg News (2020): Grüner Gründen: Die neue Lust die Welt zu retten, [online], available at: <https://www.hamburg-news.hamburg/unternehmen/gruener-gruenden-die-neue-lust-die-welt-zu-retten> [accessed October 5th, 2020].
- ³⁰ Albè, F.; Colledani, M.; Picone, N.; Chiara, C. (2017): Screen Mapping Tool: Scope and Guidelines, [online], available at: <http://www.screen-lab.eu/deliverables/SCREEN-D2.1.pdf> [accessed September 24th, 2020].
- ³¹ CORDIS (2020b): Development of 2nd Generation Biorefineries – Production of Dicarboxylic Acids and Bio-based Polymers Derived Thereof, [online], available at: <https://cordis.europa.eu/project/id/613771> [accessed October 1st, 2020].
- ³² CIRCuIT Project (2019): About CIRCuIT, [online], available at: <https://www.circuit-project.eu/about-circuit> [accessed October 1st, 2020].
- ³³ CORDIS (2020c): A DECentralized management Scheme for Innovative Valorization of urban biowaste, [online], available at: <https://cordis.europa.eu/project/id/689229> [accessed October 1st, 2020].
- ³⁴ Dibichain Project (2019): Our mission, [online], available at: <https://dibichain.com/> [accessed October 1st, 2020].
- ³⁵ Free and Hanseatic City of Hamburg (2018): FORCE – UmweltPartner stärken die Kreislaufwirtschaft, [online], available at: <https://www.hamburg.de/kreislaufwirtschaft/11854366/umweltpartner-staerken-die-kreislaufwirtschaft> [accessed September 22nd, 2020].
- ³⁶ LOOP Ports project (2018): Overview, [online], available at: <https://www.loop-ports.eu/about/overview/> [accessed October 1st, 2020].

-
- ³⁷ REPAiR Project (2016): Objectives, [online], available at: <http://h2020repair.eu/about-repair/objectives/> [accessed October 1st, 2020].
- ³⁸ Interreg Europe (2019): REgional PoLicy Actions for Circular Economy – Project summary, [online], available at: <https://www.interregeurope.eu/replace/> [accessed September 29th, 2020].
- ³⁹ CORDIS (2020a): Risk-based management of chemicals and products in a circular economy at a global scale, [online], available at: <https://cordis.europa.eu/project/id/226552> [accessed October 1st, 2020].
- ⁴⁰ Hamburg University of Applied Sciences (HAW) (2020a): Smart Recycling, [online], available at: <https://www.haw-hamburg.de/forschung/projekte-a-z/forschungsprojekte-detail/project/project/show/smart-recycling> [accessed October 1st, 2020].
- ⁴¹ Hamburg University of Applied Sciences (HAW) (2020b): WASTE-EI, [online], available at: <https://www.haw-hamburg.de/en/research/projects-a-z/research-projects/project/project/show/waste-ei> [accessed October 1st, 2020].
- ⁴² Free and Hanseatic City of Hamburg (2020a): Hamburg-Flasche – Aus Hamburg für Hamburg: vollständig recycelte Flasche kommt, [online], available at: <https://www.hamburg.de/kreislaufwirtschaft/13590988/hamburg-flasche> [accessed September 22nd, 2020].
- ⁴³ Elbcampus (2020): Geprüfte/r Meister/in für Kreislauf- und Abfallwirtschaft und Städtereinigung, [online], available at: <https://www.elbcampus.de/weiterbildung/gepruefter-meisterin-fuer-kreislauf-und-abfallwirtschaft-und-staedtereinigung-inkl-ausbildung-der-ausbilder> [accessed September 22nd, 2020].
- ⁴⁴ HafenCity University (2020): Stadtplanung und Regionalentwicklung, [online], available at: <https://www.hcu-hamburg.de/bachelor/stadtplanung/arbeitsgebiete-professuren/joerg-knieling> [accessed October 1st, 2020].
- ⁴⁵ Hamburg University of Applied Sciences (HAW) (2020c): Department Design, [online], available at: <https://www.haw-hamburg.de/hochschule/design-medien-und-information/departments/design> [accessed October 1st, 2020].
- ⁴⁶ Hamburg University of Applied Sciences (HAW) (2020d): Fakultät Life Sciences, [online], available at: <https://www.haw-hamburg.de/hochschule/life-sciences> [accessed October 1st, 2020].
- ⁴⁷ Hamburg University of Technology (TUHH) (2020a): Recycling von Metallen aus WEEE, ELV, Industrieabfall, [online], available at: <https://www.tuhh.de/alt/iue/research/research-fields/wg-waste-resources-management/recycling-und-circular-economy/recycling-von-metallen-aus-weee-elv-industrieabfall.html> [accessed September 22nd, 2020].

-
- ⁴⁸ Hamburg University of Technology (TUHH) (2020b): Biotechnologische Prozesse zur Rückgewinnung von Metallen, [online], available at: <https://www.tuhh.de/alt/iue/research/research-fields/wg-waste-resources-management/recycling-und-circular-economy/biotechnologische-prozesse-zur-rueckgewinnung-von-metallen.html> [accessed September 22nd, 2020].
- ⁴⁹ Hamburg University of Technology (TUHH) (2020c): PRELab – Polymer Recycling, [online], available at: <https://www.tuhh.de/alt/iue/research/research-fields/wg-waste-resources-management/recycling-und-circular-economy/polymer-recycling.html> [accessed September 22nd, 2020].
- ⁵⁰ Hamburg University of Technology (TUHH) (2020d): Kreislaufwirtschaft Phosphor: Phosphoranpassung in Tierfutter, [online], available at: <https://www.tuhh.de/iue/forschung/forschungsgebiete/ag-effiziente-energiesysteme-und-produktionsverfahren/bioraffinerie/kreislaufwirtschaft-phosphor.html> [accessed September 22nd, 2020].
- ⁵¹ Albè, F.; Colledani, M.; Picone, N.; Chiara, C. (2017): Screen Mapping Tool: Scope and Guidelines, [online], available at: <http://www.screen-lab.eu/deliverables/SCREEN-D2.1.pdf> [accessed September 24th, 2020].
- ⁵² Sustainable Design Center (2016): SDC Hamburg – Stammtisch Design und Business Innovation für die Circular Economy – Learning from the Netherlands, [online], available at: <https://sustainable-design-center.de/de/termine/nachrichtenanzeige/article/sdc-hamburg-stammtisch-design-und-business-innovation-fuer-die-circular-economy-learning-from-th> [accessed September 22nd, 2020].
- ⁵³ Beyer Schuch, A. (2018): Circular Economy Mapping Event in Hamburg, [online], available at: <https://cirklamodo.wordpress.com/2018/03/02/1117> [accessed September 22nd, 2020].
- ⁵⁴ REPAiR (2018): Conference “resource management and circular economy in city regions” in Hamburg on 10th of October 2018, [online], available at: <http://h2020repair.eu/conference-resource-management-and-circular-economy-in-city-regions-in-hamburg-on-10th-of-october-2018> [accessed September 22nd, 2020].
- ⁵⁵ Kommunalwirtschaft (2019): Hamburg setzt auf Kreislaufwirtschaft, [online], available at: <https://kommunalwirtschaft.eu/tagesanzeiger/detail/i31363> [accessed September 22nd, 2020].
- ⁵⁶ Northern Institute of Technology Management (NIT) (2019): Seminar: Circular Economy, Cradle2Cradle, Innovation, [online], available at: <https://www.nithh.de/de/nit/termine/veranstaltung/seminar-circular-economy-cradle2cradle-innovation-1> [accessed September 22nd, 2020].
- ⁵⁷ Business Club Hamburg (2019): Fachtagung Logistik: CIRCULAR ECONOMY – waren lineare Supply Chains gestern?“, [online], available at: <https://www.bch.de/veranstaltungen/fachtagung-logistik-circular-economy-waren-lineare-supply-chains-gestern> [accessed September 22nd, 2020].

⁵⁸ Kühne Logistic University (KLU) (2019): Sustainable ports and circular economy challenges, [online], available at: <https://www.the-klu.org/event/sustainable-ports-and-circular-economy-challenges> [accessed September 22nd, 2020].

⁵⁹ University of Hamburg (2019): Circular Economy: How to move away from linear thinking, [online], available at: <https://www.wiso.uni-hamburg.de/fachbereich-sozoek/professuren/geiger/mibas/mibas-debates-on-csr/2019/circular-economy-debate.html> [accessed September 15th, 2020].

⁶⁰ Stadtreinigung Hamburg (2020): Hamburg T.R.E.N.D. – Das Forum für Entwicklungsstrategien der Abfallressourcenwirtschaft, [online], available at: https://www.srh-events.hamburg/hamburg_trend [accessed September 23rd, 2020].

⁶¹ iPoint (2020): Hamburg: Koopetitive Geschäftsmodelle in der Circular Economy & Blockchains, [online], available at: <https://www.ipoint-systems.com/de/newsroom/news-detail-de/koopetitive-geschaeftsmodelle-in-der-circular-economy-blockchains-hamburg> [accessed September 22nd, 2020].

⁶² Albè, F.; Colledani, M.; Picone, N.; Chiara, C. (2017): Screen Mapping Tool: Scope and Guidelines, [online], available at: <http://www.screen-lab.eu/deliverables/SCREEN-D2.1.pdf> [accessed September 24th, 2020].

⁶³ Free and Hanseatic City of Hamburg (2017): Gewerbeabfallverordnung – „Recycling-Offensive“ für das Gewerbe, [online], available at: <https://www.hamburg.de/kreislaufwirtschaft/9827598/gewerbeabfallvo> [accessed September 22nd, 2020].

⁶⁴ Free and Hanseatic City of Hamburg (2005): Hamburgisches Abfallwirtschaftsgesetz (HmbAbfG) vom 21. März 2005, [online], available at: <http://www.landesrecht-hamburg.de/jportal/portal/page/bshaprod.psml?showdoccase=1&doc.id=jlr-AbfWGHA2005rahmen> [accessed October 2nd, 2020].

⁶⁵ Umwelt Online (2020): KrWG – Kreislaufwirtschaftsgesetz. Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Bewirtschaftung von Abfällen, [online], available at: https://www.umwelt-online.de/recht/abfall/krwabfg/krwg_ges.htm [accessed October 2nd, 2020].

⁶⁶ Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (2012): Eckpunkte des neuen Kreislaufwirtschaftsgesetzes, [online], available at: <https://www.bmu.de/themen/wasser-abfall-boden/abfallwirtschaft/abfallpolitik/kreislaufwirtschaft/eckpunkte-des-neuen-kreislaufwirtschaftsgesetzes> [accessed October 2nd, 2020].

⁶⁷ SPD Hamburg / Bündnis 90/Die Grünen Hamburg (2020): Zuversichtlich, solidarisch, nachhaltig – Hamburgs Zukunft kraftvoll gestalten. Koalitionsvertrag über die Zusammenarbeit in der 22. Legislaturperiode der Hamburgischen Bürgerschaft, Hamburg.

⁶⁸ Albè, F.; Colledani, M.; Picone, N.; Chiara, C. (2017): Screen Mapping Tool: Scope and Guidelines, [online], available at: <http://www.screen-lab.eu/deliverables/SCREEN-D2.1.pdf> [accessed September 24th, 2020].

⁶⁹ Ministry of Environment, Climate, Energy and Agriculture (2019b): Holzbauförderung – Hamburg unterstützt Bauen mit nachwachsendem Rohstoff, [online], available at: <https://www.hamburg.de/waermewende/12643028/holzbaufoerderung/> [accessed October 2nd, 2020].

⁷⁰ Ministry for Urban Development and Environment (2011): Mehr Durchblick für Bessere Produkte. Integrierte Produktpolitik für Hamburg, [online], available at: <https://www.hamburg.de/contentblob/4401954/074dbb5776e170daac58bfcffefce7e2/data/broschuere-umweltfreundl-produktentw-.pdf> [accessed March 4th, 2021].

⁷¹ Free and Hanseatic City of Hamburg (2020c): Unternehmen für Ressourcenschutz, [online], available at: <https://www.hamburg.de/ressourcenschutz/> [accessed January 27th, 2021].

⁷² IFB Hamburg (2020): PROFI Umwelt und PROFI Umwelt Transfer, [online], available at: <https://www.ifbhh.de/programme/gruender-and-unternehmen/innovationen-realisieren/forschen-und-entwickeln/profi-umwelt-und-profi-umwelt-transfer> [accessed January 27th, 2021].

⁷³ KfW (2018): Zehn Milliarden Euro für eine nachhaltige Kreislaufwirtschaft in der EU, [online], available at: https://www.kfw.de/KfW-Konzern/Newsroom/Aktuelles/Pressemitteilungen-Details_531840.html [accessed October 2nd, 2020].

⁷⁴ Ministry of Education and Research (2020): Bekanntmachung der Richtlinien zur Förderung von Forschungs- und Entwicklungsvorhaben zum Thema „Ressourceneffiziente Kreislaufwirtschaft – Kunststoffrecyclingtechnologien (KuRT)“ im Rahmenprogramm „Forschung für Nachhaltige Entwicklung – FONAS3“, Bundesanzeiger vom 09.07.2020, [online], available at: <https://www.bmbf.de/foerderungen/bekanntmachung-3080.html> [accessed October 2nd, 2020].

⁷⁵ Sachsen Anhalt (2017): Förderung, [online], available at: <https://mule.sachsen-anhalt.de/umwelt/abfall/foerderung/> [accessed October 2nd, 2020].