



What a Waste

Approaching Hamburg's Domestic Plastic Waste from a Circular Economy Perspective



Master Thesis



Written by:

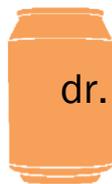
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Preface

This thesis is the final result of my studies of the double degree master program 'Water & Coastal Management' (university of Oldenburg) and 'Environmental and Infrastructure Planning' (university of Groningen). Looking back the path to finalizing this study from November 2016 to March 2018 was anything but straight, however, I am eventually very happy with choosing a topic, which is often overlooked, yet so ubiquitous in our daily life: plastic waste. Starting with an interest in marine plastic litter, I soon came to realise that it would be more fruitful to investigate a holistic approach focussing on plastic and plastic waste while it is still part of our daily life instead of only concentrating on the small part, which leaked as incorrectly disposed waste into the environment.

This thesis could have never been completed without the contribution of various people, who I would like to thank at this point. At first, I want to thank all interviewees for their time and effort to share their perspectives, experiences and insights with me and their outspokenness to my questions. Secondly, my grateful thanks also go to Ariane Rimmel, Anna Kuhlmann, Ulrike Brinkmann, and Niels van der Goot for their editing and feedback, which did not stop during any holidays. Lastly, I want to thank the one person, who arguably shaped this thesis more than anyone else, dr. Elen-Maarja Trelle. Thank you Elen for your constant feedback to bring this thesis to the desired academic level, listening to and answering all my questions, and for always being a voice of reason; also during times of frustration and disorientation.

I hope you enjoy reading this thesis!

Jana Brinkmann
Oldenburg, March 2018

Abstract

Germany's waste management is one of the world's leading waste management systems. Despite its high standards and numerous regulations, *plastic waste* is only marginally reintroduced into the economic system thereby contributing to several environmentally damaging impacts. A concept which is increasingly discussed as a solution to this and similar problems is the circular economy (CE) concept. CE envisions an economic model based on the principles of reducing, reusing, and recycling in which waste is not disposed, but reintroduced as resource for new products. Thereby, CE claims to eventually decouple economic growth and environmental consequences. Following the CE idea in terms of plastic waste means decreasing the general amount of plastic waste while increasing the reuse and recycling of the remaining amount of plastic waste. Combined with the transition management (TM) concept to steer the change from the status quo to one incorporating the CE idea, this thesis investigates how an approach of decreasing the general and increasing the remaining amount of waste can be fostered in the context of Hamburg, one of Germany's federal states, narrowed down to the domestic plastic waste fraction. As revealed the main change inhibiting factors in this specific context have numerous origins, most notably the lack of bans and regulations, the complicatedness of existing regulations, the throwaway society mentality, and a poor waste quality. However, also change favouring factors could be identified rooted in recent economic changes and developments, rising environmental awareness, and changed lifestyle choices. Based on these insights, advice to steer change are given according to the TM cycle, as specific tool derived from TM.

Keywords: circular economy, plastic waste management, transition theory, transition management, waste prevention, recycling

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List of Abbreviations

AWP	Abfallwirtschaftsplan (<i>waste management plan</i>)
CE	Circular Economy
EPR	Extended Producer Responsibility
EU	European Union
HWT	Hamburger Wertstofftonne (<i>Hamburg's recyclable material container</i>)
KrWG	Kreislaufwirtschaftsgesetz (<i>Germany's recent waste legislation</i>)
PSS	Product Service Systems
TM	Transition Management
UN	United Nations
WFD	Waste Framework Directive

1. Introduction

Waste is an issue that affects us all. We all produce waste [...]. All this waste has a huge impact on the environment, causing pollution and greenhouse gas emissions that contribute to climate change, as well as significant losses of materials [...] (EU, 2010, p. 2)

The above is a statement of the EU's approach to waste management highlighting the urgency to act and to improve the waste management system (EU, 2010), which holds particularly true for plastic waste (Huysman et al., 2017, ten Brink et al., 2017a; WEF, 2016). This thesis focuses on this need to improve domestic waste management of plastic waste generated in Hamburg, Germany.

1.1. Problem Description: Germany and its Waste Management

Germany has one of the technically best developed waste management infrastructures in the world (UBA, 2017a). Indicators for this are inter alia the high standards of incineration plants (Wilts, 2016), or the high recycling quotes in most waste streams, such as 66 % recycling of municipal waste in 2014 (UBA, 2017b). Moreover, Germany is also seen as an international role model regarding its waste legislation as it already introduced extended producer responsibility (EPR) via the Packaging Ordinance in the 1990s, which redirected the waste disposal costs to the producers (Friege, 2015; Patel et al., 2000; Wilts, 2016). Furthermore, Germany introduced Circular Economy (CE) as its guiding principle in its dominant waste management act, the "Kreislaufwirtschaftsgesetz" (KrWG) (UBA, 2014; Wilts, 2016). CE is a concept which envisions an economic production system whose resources are not disposed when turning into waste, but constantly reintroduced to serve as resource for new products. Thereby, the economic system is ideally decoupled from its associated environmental consequences (Ghisellini et al., 2015). This is particularly attractive for plastics, as plastics are produced from fossil fuels, a finite resource, and enforce an import dependency for countries without fossil fuel stocks (Huysman et al., 2017), such as Germany, which has EU-wide the highest demand for plastic material (PlasticsEurope, 2016). Considering all these described circumstances, Germany's waste management creates a very positive picture.

However, a different picture emerges when the real circulation of waste is examined. Estimations of the DGAW conclude that only 30-40 % of all waste is actually reintroduced into the economic production system (Obermeier et al., 2016); and for plastic waste Friege (2015) estimates a sobering 12 %. The underlying reason is rooted in the still prevalent, rather linear production system of 'take - make - dispose', which is combined with an overcapacity of incineration plants. As the prices for waste incineration are low, only few incentives exist to pursue waste avoidance or higher rates of material recycling (Wilts, 2016). Moreover, there is an overconfidence among many waste management actors into the technical waste management infrastructure boosted by Germany's high recycling rates leading to the prevalent perception that "waste is a problem that has been 'technically solved'" (Wilts, 2016, p 11).

This false feeling of a problem-free waste management transcends to the consumers and lulls them in the false feeling that there is no need for a change of their consumption behaviour, which is why (among other reasons) Germany can be characterised by very high levels of waste generation (Friege, 2015). According to Friege (2015), this issue of high waste generation is just as problematic as the lack of properly reintroducing waste as resource into the production system in Germany.

The high levels of waste generation and the lack of properly reintroducing the produced waste – particularly plastic waste – is connected to environmental consequences (ten Brink et al., 2017b). As aforementioned, the generation of new plastic material requires fossil fuels; and both the production process as well as the incineration process release high amounts of CO₂ emissions (Huysman et al., 2017). Moreover, the impacts of plastic waste are also strongly discussed in connection to the damage that is caused when plastic waste leaks into the environment and eventually enriches in the marine habitats (Bergmann et al., 2015). Due to the globally numerous leakages of plastic litter, this waste has become so ubiquitous in the oceans, that waste items are deposited at remote shores (Barnes, 2005), polar waters (Barnes et al., 2010) and even the deep sea – places far off any form of human settlement (Galgani et al., 2015). Estimations regarding the global average of marine plastic pollution vary between 10,000 pieces * km⁻² (Galgani et al., 2015) to 13,000 pieces * km⁻² (UNEP, 2005). These numbers are highly problematic; not because of aesthetics, but due to the multiple harmful, often lethal consequences for marine animals, like entanglement, digestion of plastics and other effects caused by the hundreds of hazardous chemicals that plastics contain (Kühn et al., 2015; Rochman, 2015). While the amount of plastic leakages is low in relative numbers in Germany, the absolute amount of leaked plastic waste is still significant simply due to the high amount of plastic waste generated in Germany (Friege, 2015; ten Brink et al., 2017b).

Germany's high demand for plastic material in light of the minimal amount of plastic waste, which is reintroduced, as well as the harmful environmental impacts connect to plastic consumption, emphasises a need to change Germany's plastic waste management, which is why such a change will be the focus of this thesis.

1.2. Presentation of the Research Question

As emphasised in the previous sub-chapter, there is a need for changing plastic waste management in Germany. Due to the German waste legislation, differences exist among the federal states (UBA, 2016). Among all 16 federal states, Hamburg – which is a federal city state – is a notably case: On the one hand, Hamburg is recognised for its role model position with regards to green public procurement, e.g. passing a ban on disposable tableware or coffee capsules and demonstrates a willingness of the public authorities to act sustainably (Stadt Hamburg, 2016; ten Brink et al., 2017b). On the other hand, Hamburg has the highest per capita domestic and bulky waste generation (DeStatis, 2016a) as well as the lowest amount of collected plastic packaging per capita (DeStatis, 2016b), and many newspaper articles report high levels of littering within the city (Hamburger Abendblatt, 2016a; Hamburger Abendblatt, 2016b). Thus, Hamburg's situation can be characterised by an incongruity between the

willingness to act from the public side and the actual status quo of waste generation of Hamburg's citizens, which is why the spatial focus of this thesis is set on Hamburg.

Another focus is chosen regarding the type of waste stream. In Germany, 20 different waste categories are distinguished according to their origins. Eight of these 20 categories comprise plastic waste (AVV, 2016). Out of these eight, municipal waste is the one category that comprises the majority of post-consumer waste, which "exceeds the amount of pre-consumer waste by a factor of 3.5-5" and offers more room for optimization (Patel et al., 2000, p. 66). Due to the limited scope of this thesis, the focus is narrowed down to *domestic waste*, which is a part of the municipal waste stream (BMUB, 2012). Moreover, domestic waste constitutes the biggest share within the municipal waste: In Hamburg, 49.5 % of the entire municipal waste stream originates from domestic waste and overall has the lowest recycling rate within the municipal waste (Stadt Hamburg, 2017). Considering that post-consumer waste, which includes domestic waste, contains most plastic waste as well as that the overall amount of waste and the low recycling quote of domestic waste, plastic waste within the domestic waste is also chosen as focus. To give a clear definition of this focus, the general UN definition of waste management acts as outline.

Waste management are:

... activities [that] include a) collection, transport, treatment and disposal of waste, b) control, monitoring and regulation of the production, collection, transport, treatment and disposal of waste and c) prevention of waste production through in-process modification, reuse and recycling." (UNSD, 1997, p. 76).

Thus, domestic waste management covers the categories a)-c), but only applied to waste originating from domestic sources. Moreover, as this thesis focuses on plastic waste within the domestic waste, domestic plastic waste management refers to all actions in a)-c) that concern plastic waste within the domestic waste.

Based on these foci, this thesis aims to examine the issue of high plastic waste generation and lack of sufficiently reintroducing the generated plastic waste within Hamburg's domestic waste management. Furthermore, the thesis aims to explore the possibility of how to improve Hamburg's current situation of high waste generation and waste management by fostering a change within the domestic plastic waste management by using the Transition Management (TM) concept. The TM concept is a concept to guide change within a society or a sub-system of society (van der Brugge et al., 2005). In the context of this thesis, TM is expected to strengthen CE within Hamburg's domestic plastic waste management. Thus, the main research question asks:

How can a change strengthening the circular economy (CE) principles be fostered in order to both decrease the overall amount of plastic waste generated as well as increase the reintroduction of plastic waste of Hamburg's domestic plastic waste management by using the principles of transition management (TM)?

This guiding research question is complemented by six sub-research questions, which allow further elaboration to fully answer the guiding research question. The first three sub-research questions have a theoretical nature.

1. *Why is there a need to change Hamburg's domestic waste management regarding plastic waste?*
2. *What is CE and how can it help to improve the plastic waste management of Hamburg's domestic waste?*
3. *What is TM and why is it suitable to guide a change in Hamburg's domestic waste management of plastic waste?*

The other three sub-research questions will be answered by consulting experts and actors, who are connected to domestic plastic waste in Hamburg in different ways. Further details regarding the data collection for these questions is presented in chapter 3.

4. *What are the main causes which inhibit a change in Hamburg's domestic plastic waste management?*
5. *What are the main aspects favouring a change in Hamburg's domestic plastic waste management?*
6. *Which advises based on TM are suitable to support a change in Hamburg's domestic waste management to strengthen CE in regards to plastic waste?*

Throughout this thesis, the theoretical basis of the questions will be presented, data for analysing them will be collected and finally discussed to derive a conclusion, which will answer the main research question.

1.3. Scientific and Societal Relevance

From a societal point of view, this thesis is relevant as it advises action on how to deal with the aforementioned environmental impacts associated to plastic waste: most notably high CO₂ emissions during production and incineration of plastic materials as well as multiple biodiversity threats due to plastic litter leaked into the environment. Even more, some studies suggest that such leaked plastic waste poses also a threat to human health (Galloway, 2015). The advices given in this thesis are responding to these threats by highlighting actions, which can be taken to (i) reduce CO₂ emissions as these actions would contribute to produce less virgin plastic material and incinerate less plastic waste through improved waste prevention and reuse and recycling of the remaining plastic waste, and (ii) reduce the amount of leaked plastic waste also through improving waste prevention. Moreover, these actions can be taken on the federal level, thereby enabling the federal states to take actions without needing to rely on previously taken action on the national level.

In addition, these advices can help to unlock several of subsequently explained benefits of CE in terms of human health and employment possibilities. The outcome can be potentially expanded to other

federal states - adjusted to the respective regulations and conditions there - as plastic waste management needs to be improved nation-wide (Wilts, 2016).

From a scientific point of view, this research is vital as it links the CE concept with the TM concept. Although connecting these two concepts has been already done before in at least one other case (Loorbach & Rotmans, 2010; Silva et al., 2017), it is novel in the German context. The particular scientific value in combining these two concepts is (i) unravelling problems, facilitators and similar aspects through the specific TM-perspective on the way towards more circularity and CE in Germany. As stressed by Wilts (2016; 2017) there are currently many hindrances – probably even some unidentified – on said way, which require a sound scientific base in order to overcome them. Moreover, this thesis investigates its research objectives in a comparatively narrow scope – namely the city of Hamburg – to also account for barriers and facilitators, which are particularly important on lower levels, which might not be revealed in spatially broader analyses as they would be too specific for them (Ghisellini et al., 2015; Silva et al., 2017). This research would respond to that need. In addition, (ii) gaining insights regarding weakness of the TM concept, which become visible in a practical context. Thereby it also follows up Loorbach & Rotmans' (2010) recommendation to examine how TM can be practically applied.

1.4. Thesis Outline

This thesis is structured as follow (figure 1): After the introduction chapter, the theoretical framework is presented in chapter 2 to provide an understanding of Hamburg and its contextual conditions as well as the concepts of CE and TM and how they relate to the research objective. In chapter 3, the methodology to examine and evaluate the research questions is presented, which is followed by chapter 4, the results and discussion chapter auf the empirical results. The reflection and conclusion in chapter 5 finalises this study.

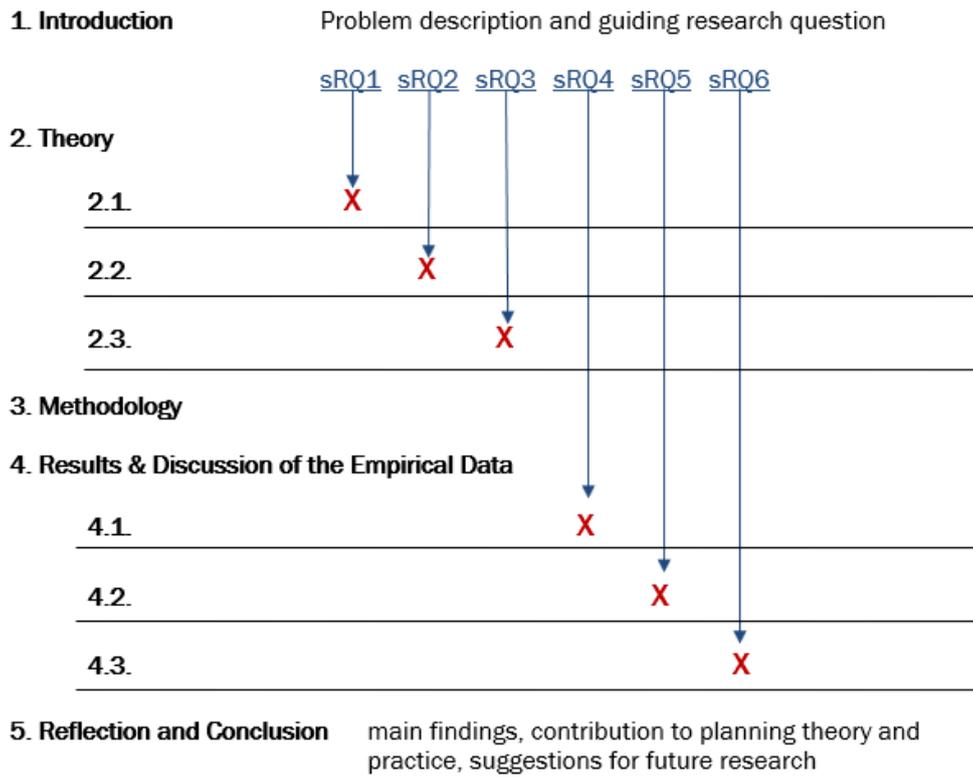


Figure 1: Thesis outline (source: author)

2. Theoretical Frame

This thesis' guiding research question asks how the CE principles can be strengthened in Hamburg's domestic plastic waste management by fostering a change using the principles of transition management (TM). To understand the theoretical foundation and how the two concepts of TM and CE interrelate in light of the research question, this chapter will explain in four parts why (i) Hamburg's waste management needs to be changed regarding its domestic plastic waste, (ii) what CE is and how it can help to improve the plastic waste management of Hamburg's domestic waste, (iii) what TM is and why this concept is suitable to guide a change in Hamburg's domestic plastic waste management, and (iv) a 'synthesis', which interlinks the three previous topics into a conceptual model.

2.1. Hamburg and its Waste

2.1.1. Waste Management in Hamburg

Hamburg is Germany's second largest city located in Northern Germany (figure 2) (Statista, 2017). Moreover, Hamburg is both a city and a federal state (Bundesrat, n.y.), which is why federal and local tasks are not separated within the public bodies (Stadt Hamburg, n.y.a). In regards to waste management, this means that Hamburg has to transpose and implement the general requirements, rules, and standards set by the national level through the KrWG, but has the main authority to determine the collection as well as the recovery of household waste and thus also domestic plastic waste. (Stadt Hamburg, 2017; UBA, 2016).



Figure 2: Hamburg's location and its size (source: Map of the World, n.y.)

The KrWG is the German transposition of the Waste Framework Directive (WFD) (2008/98/EC) (UBA, 2016) and uses CE as its guiding principle (UBA, 2014, Wilts, 2016). In the KrWG, CE is meant as waste prevention and the recovery of waste material. Waste prevention should be achieved by decreasing the amount of waste per product, increasing the reusability, as well as fostering a related consumer behaviour. Recovery of waste material comprises all processes of preparing for reuse, such as cleaning or repairing, as well as recycling of materials. Recycling in the KrWG explicitly refers to recovery of waste materials in the sense that the material is available for new manufacturing processes. Moreover, incinerating waste is explicitly excluded as recovery and is classified as disposal (§ 3, 19-25, BGBl, cited in Umweltrecht, 2012¹). This distinction between recycling and incineration (also often referred to as energy recovery) is opposing to other definitions, such as of Hopewell et al. (2009) and PlasticsEurope (2016), who declare energy recovery as form of recycling as this is in some cases the only possible way to use some waste products, since some are not recyclable in the sense of the KrWG. However, this thesis will use the KrWG definition of recycling since this is the legal definition. Nevertheless, it needs to be pointed out that - despite this explicit distinction in the KrWG between recycling and incinerating and the priority of recycling based on the WFD's waste hierarchy - there are several loopholes within the waste legislation giving rise to these high numbers of incinerated waste (Wilts, 2016).

As general information, it needs to be mentioned that if both recycling as well as reusing are meant, the term 'reintroducing' is used in this thesis to highlight that former waste material becomes available again for production or manufacturing.

The federal waste management measures are defined in the waste management plans (AWP; *from the German name Abfallwirtschaftsplan*) set by the federal government (Stadt Hamburg, n.y.b). Waste prevention regarding municipal waste in general, which includes domestic plastic waste, is pursued through fostering and financing of innovative projects, such as the introduction of reusable coffee to go cups, green public procurement, and initiatives to raise public awareness, especially among children. Regarding recycling of plastic waste within the municipal waste management, Hamburg uses the so-called Hamburger Wertstofftonne (HWT) since 2011 (*translated: Hamburg's recyclable material container*) (Stadt Hamburg, 2017). The HWT is a collective container for all kinds of plastic and metal waste (Stadt Hamburg, n.y.c). Therefore, it differs from the regular so-called 'Gelber Sack' or 'Gelbe Tonne' (*translated: yellow sack or yellow container*) as the Gelbe Sack/Tonne is solely meant for plastic and metal packaging waste. Other non-packaging waste items made of these two materials are collected in the residual waste, which is eventually incinerated. Hence, this represents a loss of valuable material, which could have been recovered in the sense of the KrWG (Patel et al., 2000). Thus, from a CE-angle, the HWT is preferable over the regular Gelbe Sack/Tonne. The main responsibility for executing the waste management of domestic waste is in the hands of the Stadtreinigung Hamburg which is the public agency for the communal task for the public waste management (Stadt Hamburg, 2017).

¹ The KrWG belongs to the German Federal Law Gazette BGBl. It comprises 72 paragraphs, which are all listed in the environmental law book "Umweltrecht".

2.1.2. The Need for a Change

Hamburg has a population of over 1,860,000 inhabitants (Statistikamt Nord, 2017). Together, these inhabitants form 930,000 private households with an increasing trend to form single households. Already in 2015, 54 % lived in single households, which has important domestic waste management implications as small households produce comparably higher amounts of waste per capita (Stadt Hamburg, 2017). Simultaneously, the population has been constantly increasing over the last years (Statistikamt Nord, 2017), which intensifies the overall amount of waste generated. All these developments pose significant challenges on their own and demonstrate an urgency to reduce the amounts of waste generated.

However, two other contextual conditions exacerbate these challenges. Firstly, the waste separation varies greatly: While in residential areas with individual houses the HWT is widely established, the acceptance and establishment are far lower among housing associations, which is in most cases connected to either a lack of acceptance of the tenants (Stadtreinigung Hamburg, n.y.a), or a simple lack of space (Stadtreinigung Hamburg, n.y.b). Secondly, the amount of plastic waste, which could be recycled from the HWT, has been stagnating in the recent years (Stadt Hamburg, 2017). Thus, even in the official AWP for municipal waste emphasises the need for “development and implementation of new, completing measures” to achieve the self-set goals of the senate (translated from Stadt Hamburg, 2017, p. 14).

Considering the first sub-research question why Hamburg’s domestic plastic waste management needs to be changed in connection with the explained conditions in Hamburg of (i) increase of population structures favouring a high waste generation, (ii) a great variety how waste separation is executed across the city if even possible, (iii) the need for additional measures to achieve higher recycling rates, it can be summarised that Hamburg’s domestic waste management faces a multifaceted challenge that is further intensified by the general problem of only reintroducing a minor share of domestic plastic waste as explained. Moreover, the different aspects of this problem potentially influence each other, such as the growing share of single-households, which would increase the stress on reaching the desired recycling rates. By changing how much plastic waste is generated and how much of it is reintroduced within the Hamburg-specific conditions would address the core of the problem and is more desirable than alleviating or improving just some aspect of the problem. For this reason, this thesis argues to change the domestic plastic waste management in the context of Hamburg.

After explaining why there is a need for a change, the next sub-chapter will explain what CE is and why a change towards the CE principles is needed to improve the plastic waste management of Hamburg’s domestic waste.

2.2. Circular Economy – An Introduction to the Concept

CE is a concept which gains increasing global attention by offering a fundamental alternative to the prevailing neoclassical, linear economy (Ghisellini et al., 2015). Contrary to the neoclassical model in which resources are extracted, processed, distributed, consumed, and eventually disposed, CE advocates for a constant circulation of resources within the economic system (Preston, 2012, Wilts, 2016). Instead of disposing waste, it should be reintroduced as resource into the processing stage, thereby closing the loop. Thus, ideally CE would not generate any waste at all as the material remains in a circulating manner within the system (figure 3) (Ghisellini et al., 2015; Wilts, 2016).

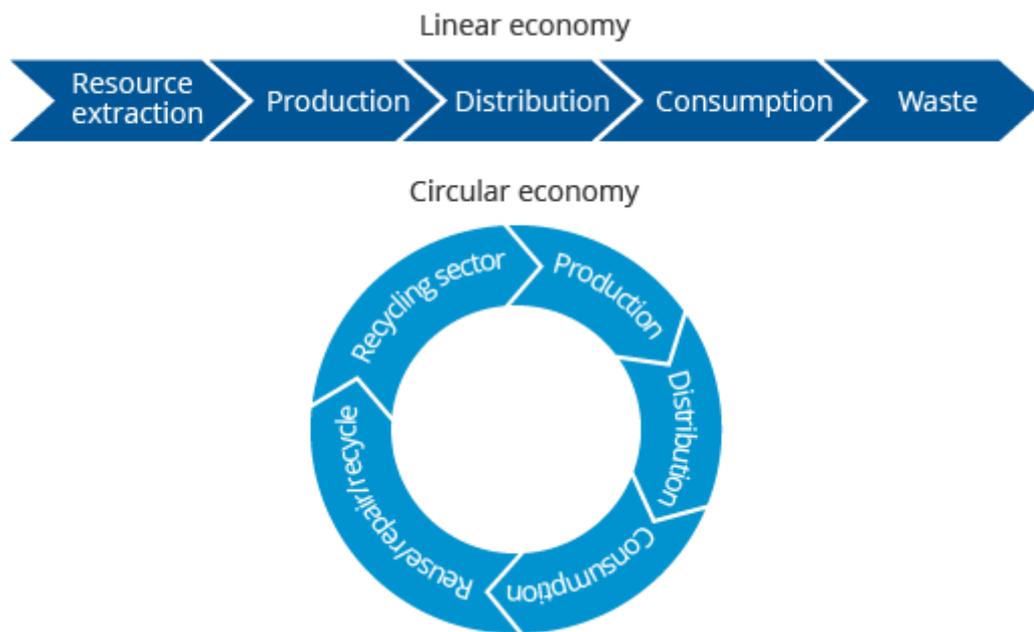


Figure 3: Linear vs. Circular economy (AkzoNobel, 2016)

Due to this circulating character, CE offers a more efficient resource use, which has economic, environmental, and social benefits. Economic benefits are the result of the decreased resource dependency on raw materials and thus less import dependency. Moreover, less resource extraction and disposal of waste also offers significant ecological benefits, since the environmental threats connected to extraction and disposal will be reduced if the cause is removed. Last but not least, this offers also social benefits as the threat for human health driven by environmental impacts of extraction and disposal is reduced and the need to reintroduce resources into the economic system instead of disposing them offers new employment possibilities (Feng & Yan, 2007; Ness, 2008; Stahel, 2014; Wilts, 2016). Thus, CE offers a way towards a more sustainable world, which eventually might be able to decouple economic growth from environmental impacts (Ghisellini et al., 2015).

It is important to acknowledge that the concept of CE is very nuanced and consists of different directions and interpretations. For instance, there is a discrepancy between the origins of the concept: The Ellen

MacArthur Foundation lists the cradle-to-cradle concept as well as the blue economy concept as origins that shaped CE (EMF, 2012), whereas Wilts (2016) describes them as concept that emerged out of CE. These discordances illustrate how dynamic and emerging the CE concept is. Moreover, specific guidelines on how to execute and operationalise the CE concept also vary between the different directions and interpretations (Ghisellini et al., 2015). This thesis will not analyse the nuances of CE in detail as this would be beyond the scope, which is why the theory is narrowed down to the aspects that are widely agreed upon.

CE is based on three overarching principles: reduce, reuse, and recycle (Feng & Yan, 2007; Ghisellini et al., 2015; Su et al., 2013; Wilts, 2016), which can also be identified in the KrWG presented in paragraph 2.1.1.. As the name implies, the *reduction principle* pursues the maximum reduction of raw material and energy demand, which are needed for production as well as waste that is generated during production and/or consumption. This can be achieved by improving both the production and consumption processes, e.g. by developing more efficient technology, downsizing the packaging material or changing consumers' demand (Feng & Yan, 2007; Su et al., 2013).

The *reuse principle* obliges that products or components of products, that are not waste, are reused again (Ghisellini et al., 2015). This offers especially environmental benefits as it decreases the resource and energy demand since the product is not newly manufactured (Castellani et al., 2015). The last principle, the *recycle principle*, refers to any process, in which waste is recovered through reprocessing the material or its chemical constituents thereby making it available for new manufacturing processes (Ghisellini et al., 2015, Hopewell et al., 2009).

CE is predominately associated with the recycle principle (Ghisellini et al., 2015). However, as explained by Stahel (2013), out of the three principles, recycling is the least preferred from the CE point of view. Recycling often faces several problems since it is in many cases not possible to recycle waste material into material of equal quality as before (Hopewell et al., 2009), making it at some point even unreasonable as the quality would be too low (Andersen, 2006), which holds particularly true for plastic waste (PlasticsEurope, 2016; ten Brink et al., 2017a). Furthermore, a lot of waste is not recyclable in the first place due to technical reasons, thus only leaving the option to incinerate or directly dispose it (Wilts, 2016). In any of these cases, new resources need to be extracted to process new material, which is why the other two principles are preferred regarding resource use and profitability (Stahel, 2013; Stahel, 2014). Moreover, CE is often narrowed down to its waste management function (Ghisellini et al., 2015), as it is also done in Germany's KrWG (Wilts, 2016). However, this ignores that CE "is not a 'more of the same' approach, [...] but instead requires a broader and much more comprehensive look at [...] alternative solutions, over the entire life cycle of any process as well as at the interaction between the process and the environment and the economy in which it is embedded" (Ghisellini et al., 2015, p. 12). Other limitations of CE are that the current demand of material products is constantly increasing, which renders it impossible to satisfy this demand without supplementing with newly extracted resources (Bringezu & Bleischwitz, 2009). Thus, even in a fully economic system, the increasing demand could not be satisfied with the resources that reside within the system. Moreover, as explained by Wilts (2016),

even in theory it is impossible to endlessly circulate resource without losses due to the entropy law. This means, that although CE is built on the premise to generate no waste at all in theory, this is simply not possible.

CE measures cover a broader field than just waste management measures and are operationalised at different scales (Ghisellini et al., 2015). Ideally, this should be done in a complementing manner. But as pointed out by the World Economic Forum (WEF, 2016), this is usually not the case and most initiatives, despite being often promising, remain fragmented and measures across scales are often not well aligned. To overcome this, a good coordination and collaboration between the actors of the various CE measures is vital. An important prerequisite for a good collaboration to align various measures is acknowledging the importance of actors outside the waste management and eventually broadening of the circle of the involved actors. Particularly actors from the industry are important to include as e.g. their product design strongly influences if a waste item can be reused or at least recycled (Silva et al., 2017; Wilts, 2016). Moreover, a stronger consideration of the consumers' influence on CE measures is also important as they ultimately determine if they buy a product, which can be reused or recycled, or not, as well as if and how well waste is separated, which also plays a critical role if reusing or recycling is even possible (Wilts, 2016). Thus, a well-executed CE benefits from including and cooperating with multiple actors outside the waste management. Figure 4 visualises this more sophisticated conceptualisation of CE.

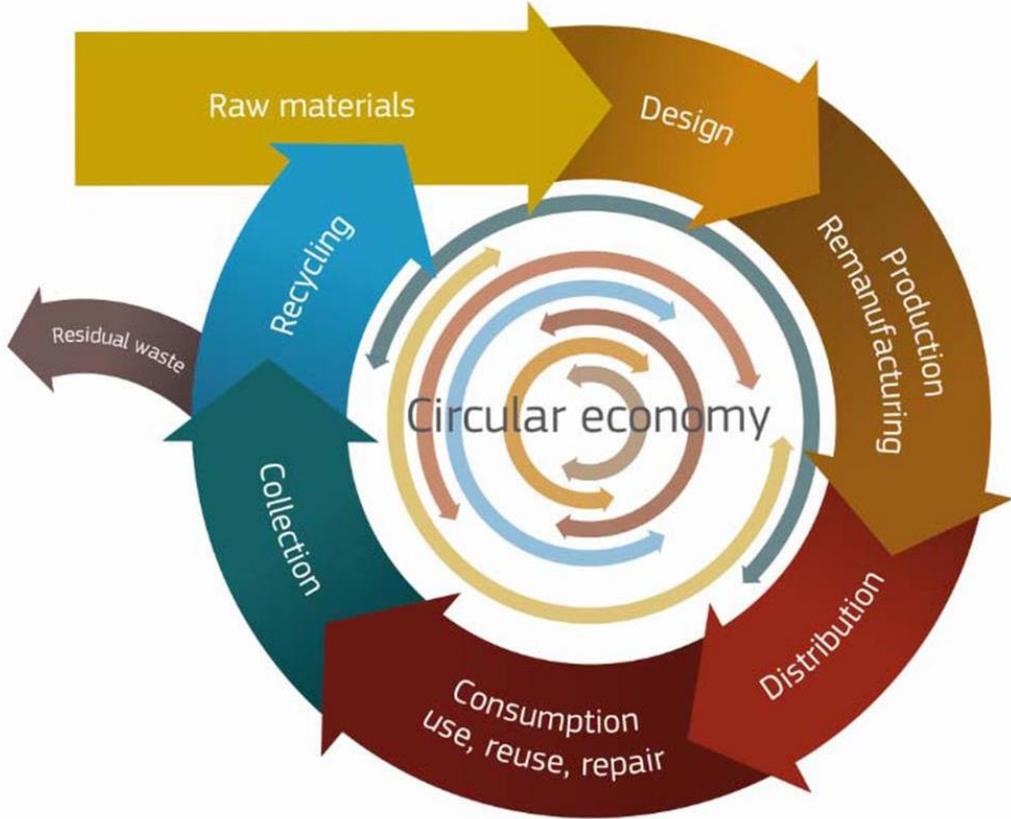


Figure 4: CE model taking the needed input of raw materials as well as the inevitable generation of waste into account. Moreover, the model also visualises various measures across various steps of the value chain, represented through the arrows in the inner circle (source: Green Growth, 2014)

Shifting the perspective to the German CE implementation, Wilts (2016, 2017) concludes that the status quo is narrowly focused on waste management complemented by inadequate market signals, which prevent an upscaling of CE measures outside the waste management realm, such as repairable and durable product design. Moreover, waste prevention - despite its highest priority in the KrWG - has currently a marginal role (Wilts et al., 2016). This problem is rooted in a lack of incentives: In Germany, producers are legally required to take back their products once they turned into waste. Therefore, producers contract waste disposal companies to do this in their behalf; the EPR (Friege, 2015; Fischer et al., 2015). For plastic packaging waste, these companies are referred to as 'Duale Systeme' (*translated to: dual systems*) (Friege, 2015). As the disposal companies are paid based on the waste volume, waste prevention and thus less volumes of waste is not economically attractive (Fischer et al., 2015).

This dilemma of waste prevention highlights the need to include actors over the entire value chain of a product - from the producer to the disposing companies - and align their interests to transform CE into an economically viable concept for all these actors (Fischer et al., 2015; Wilts, 2016, Wilts, 2017). Thus, it is important to also consider CE measures outside the realm of plastic waste management in order to strengthen the circularity of domestic plastic waste and decrease the overall quantities of domestic plastic waste. Furthermore, including various actors eventually allows implementing more holistic solutions, adapted to local conditions (Silva et al., 2017).

To answer the second sub-research question what CE is and how it can help to improve the plastic waste management of Hamburg's domestic waste, it can be summarised that CE is an economic model, which builds on reducing, reusing, and recycling to keep its resources in a circulating manner within the economic system. In a well-executed CE, operationalising these principles relies on a variety of measures not only taken in the field of waste management, but all along the entire value-chain of a product. As prerequisite, this requires that the circle of involved actors is broadened, and their interest are aligned. Thereby, domestic plastic waste could be reduced and the remaining waste better reintroduced. As Hamburg's domestic waste management is facing high levels of plastic waste generation while simultaneously reintroducing too few amounts of said waste, CE offers a solution to explicitly address these problems. However, the current execution of CE in Germany does not sufficiently use the CE concept, which is why this thesis' objectives targets a strengthened CE execution to overcome the shortcoming of the recent execution.

After having explained the need for a change and why CE is crucial for this change, the next sub-chapter will present how to direct such change.

2.3. Transition Management as Means to Guide Change

As illustrated in the previous sub-chapters, Hamburg's domestic waste management needs to be changed in the sense of reducing the overall amount of plastic waste generated as well as increasing the amount plastic waste, which is reintroduced. However, this would not require slight adjustments,

but would need a change leading to new structures and actor constellations as previously explained, thereby making this change a fundamental one (Wilts, 2016). This sub-chapter centres around the question how such a fundamental change can be directed. A concept, which explicitly claims to direct such change is TM shaped by the Dutch researchers Rotmans, Kemp and Loorbach (Kemp, 2007). TM is a concept which explains and governs transformational change processes in societal systems to derive at a higher order of sustainability (van der Brugge et al., 2005). Since changing Hamburg's domestic plastic waste management would be both a fundamental change as well as beneficial from a sustainability point of view, the TM concept was chosen. To understand how TM conceptualises steering of change, this sub-chapter firstly presents the two main conceptualizations of transitions to reveal the basic underlying patterns and dynamics, and secondly, the TM cycle, which draws upon these two conceptualisations complemented by complex system theory and governance insights. This is complemented by insights from practical TM implementations.

2.3.1. Conceptualizing Transitions

A transition is a “gradual, continuous process of change where the structural character of a society [...] transforms” (Rotmans et al., 2001, p. 16). This occurs when its dominant structures “are put under pressure by external changes in society, as well as endogenous innovation” (Loorbach, 2010, p. 166). It is important to stress that such described changes are multi-dimensional meaning that developments from multiple sectors, involving multiple actors and on multiple societal levels mutually reinforce each other leading to a fundamental transformation (Loorbach, 2010; Rotmans et al., 2001).

There are two basic concepts which are central in transition thinking (Rotmans et al., 2001; van der Brugge et al., 2005). The first one is the multi-phase concept, which divides a transition into four phases (figure 5). In the first phase, which is called the pre-development phase, no structural changes of the initial dynamic equilibrium are visible. Only in the second phase - “take-off phase” - first visible changes emerge as the change process is increasing as the threshold of the system is reached. However, the major changes occur in the third phase as a result of the cultural, institutional, economical, ecological and technological co-evolution, which is also referred to as acceleration phase (Rotmans et al., 2001, van der Brugge et al., 2005). The transition is completed by the “stabilization phase”, in which the “speed of social change decreases and a new dynamic equilibrium is reached” (Rotmans et al., 2001, p.17).

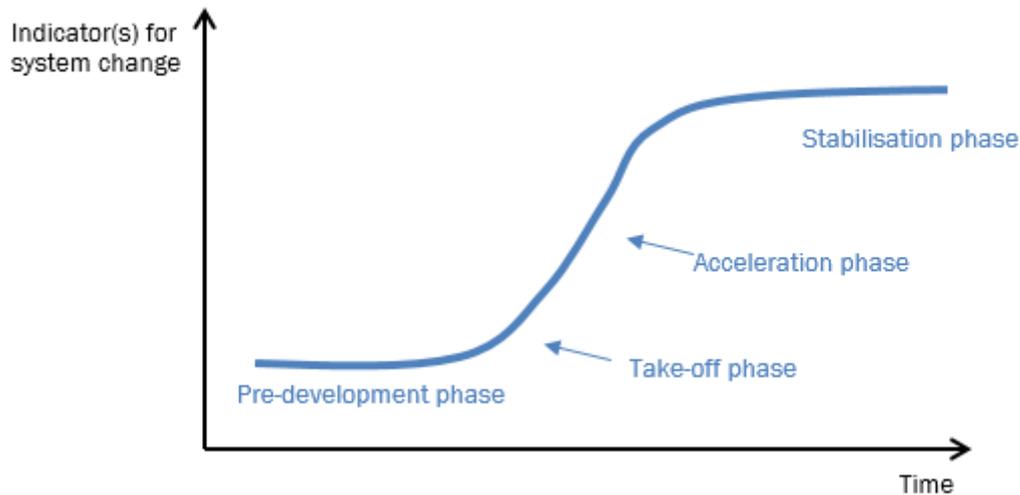


Figure 5: The four different phases of the multiphase model (modified after van der Brugge et al., 2005)

The second concept is the “multi-level” concept which focuses on the social organization of transitions, which can be categorized into three levels (figure 6). The highest level is the macro level; it embodies the socio-technological landscape which describes elements such as macro-economics, population development and politics. This level is responsive to slow trends and developments and can thereby either act in an accelerating or inhibiting way. The meso-level captures the dominant regimes, such as institutions, rules, and networks. As such, they operate primarily at aiming to conserve and enable stability instead of fostering innovation. Thus, the regime on the meso-level has an inhibiting role. However, as the transition is underway, this role transforms into an enabling one as change, pushed by developments on the two other levels, leads to major structural transformations, differing from the status quo so that new developments come into their own. In this thesis, the status quo is the current state of Hamburg’s domestic plastic waste management. In this stage of a transition, regimes (can) foster this new development due to their large resource base in terms of capital, knowledge, and organizational power. Finally, the micro-level - the niche level - forms level of individuals, alternative technologies, and local practices. New, innovative ideas, practices and/or technologies cause deviations from the status quo and act as catalysts for transitions if they are upscaled from their niche level into the dominant structures (Rotmans et al., 2001; van der Brugge et al., 2005).

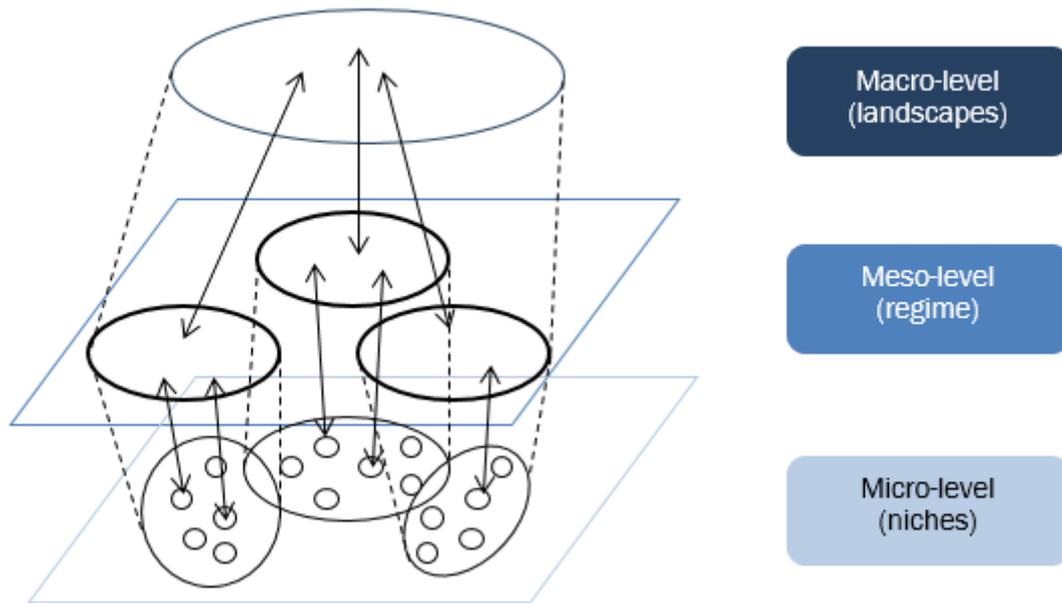


Figure 6: The three different levels of the multilevel model (modified after: van der Brugge et al., 2005)

As previously explained, institutions are part of the meso-level. Since the term ‘institution’ is used in a variety of different contexts with different meaning attached to it (Kim, 2011), this term is defined in this thesis as “a relatively enduring collection of rules and organized practices, embedded in structures of meaning and resources that are relatively invariant in the face of turnover of individuals and changing external circumstances” (Olsen, 2009, p. 9); often also referred to as “rules of the game” (Koppenjan & Groenewegen, 2005, p. 244). Institutions are firm components of today’s societies. However, they are not naturally occurring, but social constructs formed from values, beliefs, practices, and rules and can be of formal (formal laws and regulations) or informal (e.g. norms and attitudes within a sector) nature. At the same time, institutions prescribe beliefs, rules and practices and thereby enable organizing and structuring actors, resources and political patterns and eventually impact society (Alexander, 2005; Olsen, 2009), which also highlights their change resisting character (Koppenjan & Groenewegen, 2005). Thus, institutions, or more precisely institutional change, hold the potential to create long-term changes (Alexander, 2005), which makes institutional changes important in the context of transitions.

In short, two central concepts describe the patterns of change. One focuses on the sequence of phases from the beginning to the end of a transition and the other one focuses on the interplay of the three societal levels of a transition. Both concepts are valuable, analytical lenses of transition theory (Rotmans & Loorbach, 2009). However, both concepts give little to no advice on how to steer a transition process (Shove & Walker, 2007), which constitutes a sharp difference to TM, which explicitly aims to influence direction and pace of change. The next paragraph explains how TM is operationalised.

2.3.2. The Transition Management Cycle

The TM cycle operationalises the TM concept. It is an iterative process, which coordinates multi-actor processes across multiple domains to steer change towards an envisioned, more sustainable future (Loorbach, 2010). The cycle incorporates the insights of the two previous models regarding the sequence of phases as well as the interactions between the societal levels and complements them with complex system theory. Particularly systems, that learn from the experience of change (Rotmans & Loorbach, 2009). By combining these two parts, four steps in the TM cycle can be distinguished (figure 7) (Loorbach, 2010, Rotmans & Loorbach, 2009).

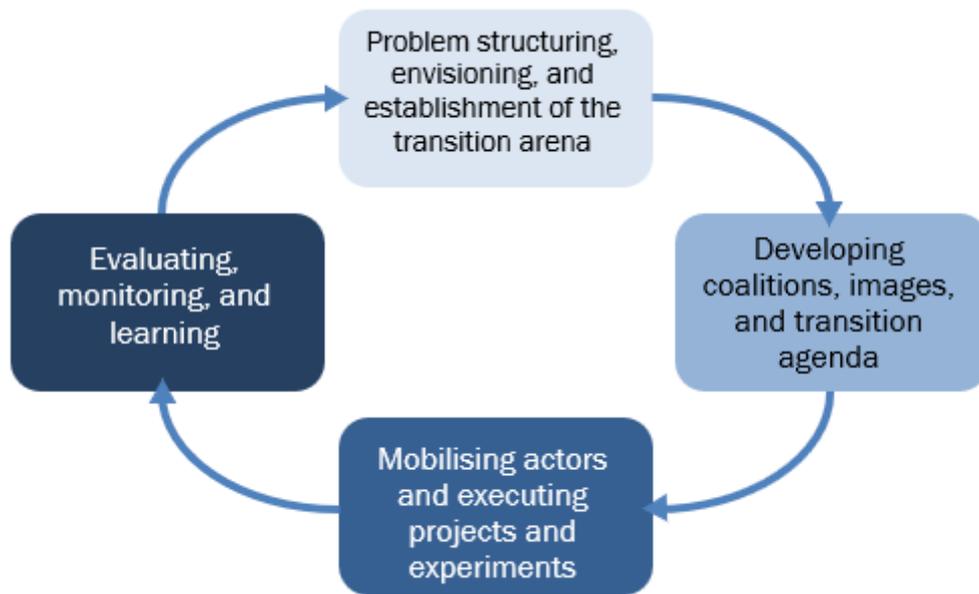


Figure 7: The transition management cycle (modified after Loorbach, 2010)

The first step of the TM cycle is the establishment of the so-called transition arena, which serves a strategic purpose and is a virtual innovation network of ten to fifteen frontrunners, who originate from different societal backgrounds. It is important to note that these frontrunners must not act as representatives of their organization or institution, but as individuals (Loorbach, 2010). As seen in practical implementation of the TM cycle, the transition arena has the pivotal role for a successful change (Loorbach & Rotmans, 2010). Moreover, frontrunners need some degree of political support, but must remain as free as possible from political influences to develop “space for their innovation activities”. (Loorbach & Rotmans, 2010, p. 243). Within the transition arena, the frontrunners develop a shared problem understanding and structuring as well as a long-term vision with respective transition images based on an envisaged sustainable future (Loorbach, 2010; Rotmans & Loorbach, 2009).

In the second step, the previously established images are translated into guiding principles for specific, intermediate objectives and routes leading towards the future vision; the so-called transition agenda and the subsequent transition pathways (Loorbach, 2010; Rotmans & Loorbach, 2009). Both agenda and pathways need to be tailored in order to remove barriers of the predominant regime. Such barriers

entail “regulatory, institutional, and economic conditions but could also include consumer routines, physical infrastructure, or specific technologies” (Loorbach, 2010, p. 175). Thus, special emphasis is put on designing the agenda and pathways in such a way that they inspire and gain a broad support of actors, particularly the ones, who are part of the dominant regime. These “regime actors” can push the implementation within the structures of the predominant regime (Loorbach, 2010). Another important aspect is creating new coalitions and networks around the transition agenda (Rotmans & Loorbach, 2009).

The third step focuses on fostering innovation and carrying out so-called transition experiments. This term comprises all experiments taken to increase the diversity of options by broadening, deepening or up-scaling action and initiatives that reinforce each other and thereby contribute to the overarching vision and transition pathways (Loorbach, 2010; Rotmans & Loorbach, 2009).

The cycle is complemented by the fourth step: monitoring and evaluating the transition process. An important distinction needs to be drawn between monitoring the transition process itself and transition management. Monitoring the transition management means monitoring the physical changes of system subjected to the transitional shift. This comprises e.g. monitoring niche developments or changes in macro-politics. Monitoring transition management focuses on the three previous steps, such as the processes within the stages and the associated activities, which is essential for social learning (Loorbach, 2010; Rotmans & Loorbach, 2009).

The four parts of the TM cycle are not limited to a fixed sequence but can be executed in a different order or in parallel depending on the context of the transition (Loorbach, 2010). Regarding the context it is also important to acknowledge that the “informal aspects [...] are just as important as the formal” ones (Loorbach & Rotmans, 2010, p. 243). Moreover, each step requires different actors, instruments, and competences (Kemp et al., 2007). The TM cycle will be used in sub-chapter 4.3. as foundation to match the advices from the empirical data to the four respective steps to incorporate the TM principles as demanded by the guiding research question.

To operationalize the TM cycle, both market forces as well as decentralized decision-making are needed. However, this does not neglect the importance of government in the TM process: The government is needed to safeguard the transition process by securing conditions, which foster continuous change and innovation (Kemp et al., 2007). Practical examples of guided transitions based on TM, like the ongoing Flemish transition from traditional end-of-pipe waste management to closed loops and high circularity, reveal that TM has indeed the potential to steer change if well synchronised between various governmental and non-governmental actors (Loorbach & Rotmans, 2010). Nevertheless, at the same time it is crucial to see TM critically, as “there is a politics to transition management, a playing out of power of when and how to decide and when and how to intervene, which cannot be hidden beneath the [...] common interest claims of sustainability” (Shove & Walker, 2007, p. 5).

To answer the originally asked question what TM is and why this concept is suitable to guide a change in Hamburg's domestic waste management of plastic waste, it can be concluded that TM is a multi-actor, multi-level, and multi-sector concept to guide fundamental change processes. A central aspect is the iterative TM cycle consisting of the four steps of (i) a transition arena, which consist of various frontrunners, (ii) transition agendas and pathways to translate the vision set in the transition arena, (iii) knowledge development and learning through experiments, (iv) and monitoring and evaluation of the whole process. As explained in the beginning of this sub-chapter, addressing the underlying problem in Hamburg of too much domestic plastic waste generation as well as too little introduction of this produced waste, requires such a fundamental change, which strengthens CE in relation to the domestic waste management and broadens the scope to give rise to new structures and actor constellations. Particularly the multi-actor, multi-level, and multi-sector nature of TM makes it suitable for this thesis for fostering such change: As described in the previous sub-chapter measures based on CE are operationalised at different levels (captured by the multi-level aspect) and require multiple actors from different backgrounds (captured by multi-sector and multi-actor aspects).

After explaining why Hamburg's domestic waste management of plastic waste needs to be changed, why CE is crucial for this change and how and why this change can be guided with TM, the next sub-chapter provides a description of how the three sub-chapters for the theoretical frame connect - the synthesis - and also presents the conceptual model.

2.4. Synthesis

The point of departure of this conceptual model (figure 8) are the two theoretical concepts applied in this thesis. The first concept is CE (upper blue circles) as an economic model building on the three principles of reducing, reusing, and recycling. A well-executed CE depends, however, also on two important prerequisites: (i) a broad actor involvement along the entire value chain complemented with (ii) an alignment of measures across various scales and sectors. As the objective of this thesis of decreasing the overall amount of domestic plastic waste while increasing the reintroduction of the remaining waste can be achieved through a strengthened CE (see sub-research question 2), one of the axis (left, blue arrow) indicating the change is based on a strengthened CE.

The second concept is TM (green circles) as means to steer the desired change. TM builds on transition thinking (multi-level and multi-phase model) and based on this conceptualisation of change TM steers the change in form of a transition through a cyclical four-step cycle. Thus, the second axis indicating the change is the progress of the transition (right, green arrow).

TM also reinforces a broad CE-approach, as TM requires multi-level, multi-actor, and multi-sector action which is reflected in the prerequisites of a well-operationalised CE: including a variety of actors with different backgrounds, to operationalise and align measures across sectors and levels. Together, these two concepts form the theoretical foundation of this thesis set in the spatial context of Hamburg.

The objective of this thesis pursues changing the current status of domestic plastic waste management characterised by high levels of waste generation and lower levels of reintroducing the remaining waste to a status of low levels of waste generation and higher reintroduction of the remaining waste (two purple circles). As previously stated, there are several hindrances hampering a potential change (Wilts, 2016) (red 'barrier' rectangle). Thus, the TM cycle, directly derived from the TM concept, is used to steer the desired change and overcome these barriers. In order to do so both theoretical concepts are applied: CE to give guidance on how the barriers impair the change towards CE either in regards to the principles or the two prerequisites; TM to connect the barriers to the different types of barriers in relation to change, like regime barriers. Due to this analysis, the barrier insights allow to tailor the TM cycle (green rhombus) to the specific conditions.

As second aspect relevant for the TM cycle are facilitators (orange 'facilitator' rectangle), which influence the status quo but do not steer the change, however, can give momentum to a transition (van der Brugge et al., 2005). The CE concept serves as anchor to unravel aspects enhancing the CE principles or prerequisites, while TM complements the analysis through connecting the facilitators with the transition dynamics, like reinforcing multi-level and multi-sector developments. Through this combined analysis, the facilitators can be potentially exploited in the TM cycle, which is why the facilitators are also examined in respect to the key actors.

As the TM cycle aims to give management and governance advices, revealing the key actors (dark grey rectangle) in light of the barriers is also pursued in this thesis.

Previous to analysing the empirical data based on this conceptual model, the underlying methodology of this thesis will be presented in the next chapter.

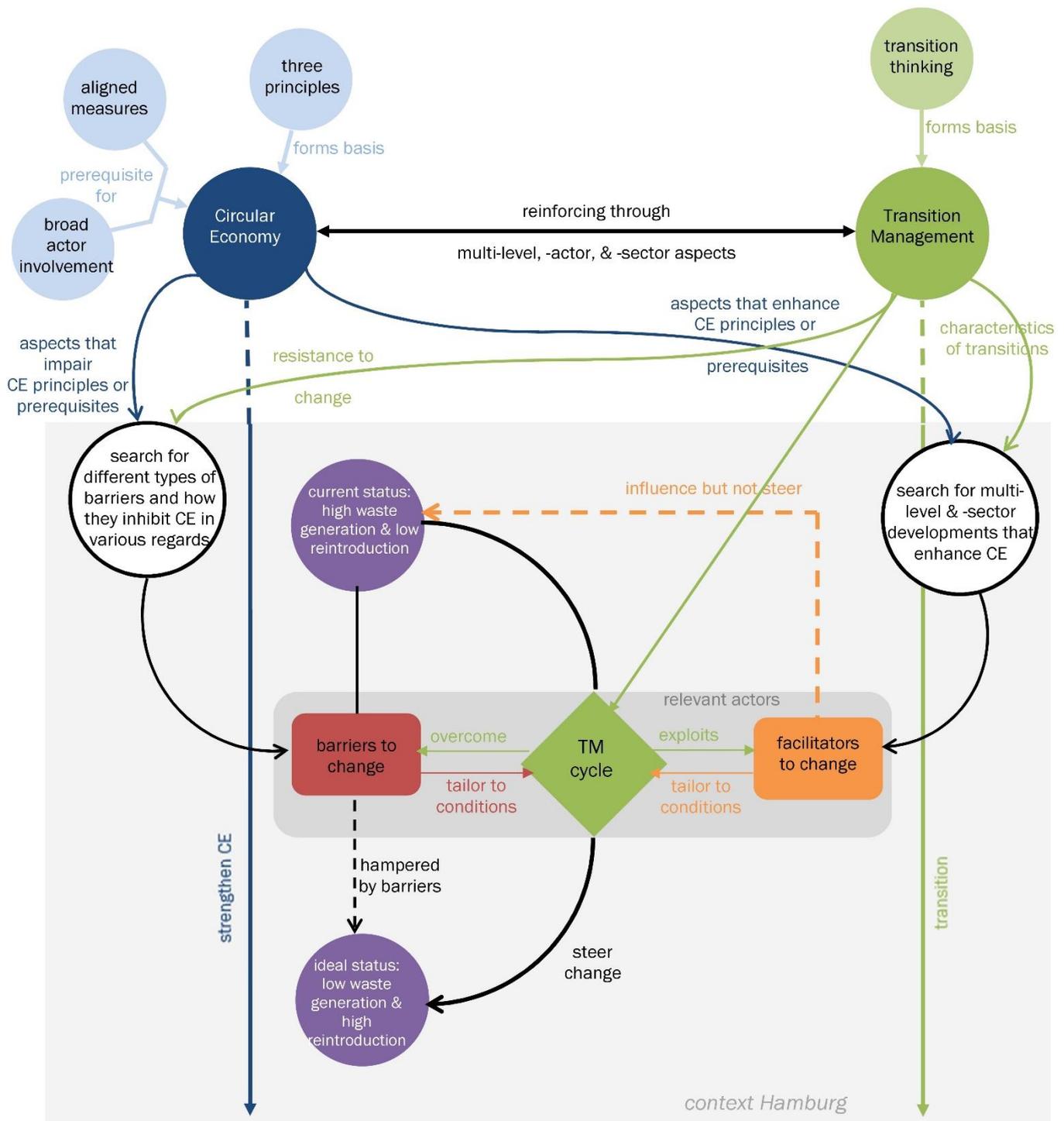


Figure 8: The conceptual model of this thesis (source: author)

3. Methodology

To give a thorough answer to the thesis' research objective, six sub-research questions are formulated as corner stones to analyse the various aspects of the guiding research question in more depth. After explaining the theoretical foundation on which this thesis is built, this chapter explains the methodology and respective methods to collect and analyse data for answering the sub-research questions.

3.1. Research Methodology and Research Design

To systemically address this research objective, a qualitative case study methodology is chosen as this “facilitates [the] exploration of a phenomenon within its context [...] through [...] a variety of lenses which allow for multiple facets of the phenomenon to be revealed and understood” (Baxter & Jack, 2008, p. 544). It allows to understand a case and its respective problems in their full individuality (de Vaus, 2001). Yin (2003) adds that a case study approach is particularly suitable when the study's focus is set on answering “how” and “why” questions regarding a phenomenon, which cannot be manipulated by the researcher, as well as when the contextual conditions need to be covered as they are relevant for the studied phenomenon. Both conditions hold true for this research indicated by the main research question which explicitly asks *how* a change based on TM to strengthen CE can be fostered to approach the plastic waste *in the context of Hamburg's* domestic waste management. A downside to choosing a case study methodology is that it diminishes the generalisability of findings (Sartori, 1991).

Further classification regarding the type of case study can be made based on the purpose and how many cases are considered in the analysis (Baxter & Jack, 2008). The purpose of this thesis centres around exploring how a change within Hamburg's domestic waste management can be fostered. However, several sub-research questions have an explanatory nature. Therefore, this thesis uses predominantly an explorative case study type with some explanatory elements. Since only Hamburg is studied as case, this thesis is a single case study (Yin, 2003).

Based on this methodology, the research design is selected. The research design is a “conceptual structure within which research is conducted; it constitutes the blueprint for the collection, measurement and analysis of data. As such the design includes an outline of what the researcher will do from writing the hypothesis and its operational implications to the final analysis of data” (Kothari, 2004, p. 31). It comprises the research questions, the theoretical foundation, defining what is studied, linking the research questions with appropriate data collection and how the data is interpreted (Yin, 2003; Kothari, 2004). In the previous two chapters the research questions and the theoretical foundation were presented. The remaining aspects will be presented in the following sub-chapter.

3.2. Data Collection and Analysis

Qualitative research, as it is pursued in this thesis, is based on words and language instead of numerical data (Taylor et al., 2015). Thus, literature research, and semi-structured interviews as methods and coding as analysis of these interviews are chosen to collect, analysis and interpret the data needed to answer the sub-research questions.

Literature research

Literature research expands the researcher's knowledge and understanding by building upon the work of other researchers (Neuman, 2007). It is the first method conducted in this thesis to create the problem description and the research objective, the theoretical framework, which is as aforementioned an essential part of the research design, and to answer the first three sub-research questions. Moreover, this method is also vital to answer the remaining three questions by discussing the empirical results with insights from other publications. Thus, literature research covers thematically a broad range from transition, TM and institutions to CE and waste management in Germany as well as Hamburg in specific to environmental governance.

Semi-structured interviews

Interviews collect primarily data by a verbal exchange between an interviewer and an interviewee. Generally, interviews can be categorized based on their level of structure into highly structured, semi-structured and unstructured interviews (Dunn, 2005). Semi-structured interviews are characterized by combining a clear-cut structure ensuring that relevant data is collected during the interview with flexibility as the interviewer can go into more detail if desired to explore interesting topics in more depth (Fylan, 2005). This possibility of exploring topics in detail allows for examining valuable aspects during the interview, which might not have been anticipated prior to the interview, but add sophisticated explanation to e.g. current change inhibiting and change favouring aspects in Hamburg as asked in the sub-research questions 4 and 5.

A guide (appendix I) has been developed for each interview tailored to the respective expertise with ten to twelve questions serving as cornerstones.

The interviews were either conducted as a telephone call or a Skype talk depending on the interviewee's preference. To ensure the interviewees' privacy (O'Leary, 2004) and prevent any negative consequence for them due to participating (Flick, 2009), the interviewees are anonymized. Thus, each interview is assigned to a code, which is used as reference. Moreover, the interviews are categorised based on the expertise of the interviewees: A (waste management), B (industry), C (NGOs), D (research). These four groups were chosen since the first two groups have a vital role in CE, as explained in sub-chapter 2.2, and the last two are added to complement with their expertise, as recommended in the TM concept (Loorbach, 2010). Consumers are excluded as their heterogeneity and the complexity of the topics CE and plastic waste management made them unsuitable for this method.

Table 1 presents an overview about the various interviews. All interviews are recorded and subsequently transcribed.

Table 1: Overview about the conducted interviews

Interviewee	Expertise	Date and form of interview	Code
A1	Staff member of the waste management section in Hamburg's environmental ministry	02.08.2017, telephone call	INT.A1
A2	Experts in waste stream management of Hamburg's city cleaning company Stadtreinigung Hamburg	23.08.2017, telephone call	INT.A2
B1	Advisor for energy and environmental topics in Hamburg's chamber of commerce	11.08.2017, telephone call	INT.B1
B2	Staff member of the <i>Umweltpartnerschaft</i> (<i>translated: environmental partnership</i>), which is a cooperation fostering voluntary measures taken by companies aiming at environmental protection; also include CE	18.08.2017, telephone call	INT.B2
B3	Founder of a package free store in Hamburg	23.08.2017, telephone call	INT.B3
C1	Speaker for environmental policy of a large environmental NGO in Germany	10.08.2017, telephone call	INT.C1
C2	Zero-waste activist in Hamburg	31.08.2017, Skype talk	INT.C2
D1	Waste management researcher; focus of research on recyclability and circular economy	06.09.2017, Skype talk	INT.D1
D2	Waste management researcher; focus on environmentally sound products and waste policy	06.09.2017, telephone call	INT.D2

Coding

Since qualitative research predominately builds upon words & language (Taylor et al., 2015), a major emphasis needs to be put on identifying the core ideas and meanings within the interviews (Drisko & Maschi, 2015). This can be done through the help of codes: A code is either “a word or a short phrase that symbolically assigns a summative, salient, essence-capturing and/or evocative attribute for a portion of language-based [...] data” (Saldaña, 2009, p. 3). By identifying such codes in the interviews, a prerequisite for an extensive data analysis is built as codes allow the identification of categories consisting of codes either sharing a similarity or that are related. Eventually, identification of categories leads to emergence of themes and concepts, which capture process at general, higher-level of abstraction (Saldaña, 2009).

Coding and analysing of the codes can be done either manually or with the help of specific computer programs (Saldaña, 2009). In this thesis, it is executed manually. The generation of codes is done in a “grounded” manner (Basis, 2003, p. 145) as the codes emerged after collecting all empirical interview data contrasting to approaches, in which researchers “create a provisional ‘start list’ of codes prior to fieldwork” (Basis, 2003, p. 145). Generating codes after collecting the data has been chosen to derive codes from the entirety of data and base them on the present units of meaning instead of potentially

risking overlooking important units of meaning while searching for other, which are not or only marginally presented. The various codes are based on units of meanings, so that relevant phenomena, patterns, similarities, and differences of said phenomena described by the interviewees, and example for these phenomena (Seidel & Kelle, 1995).

An overview of all codes is presented in appendix II.

Together the described methods for data collection and analysis are parts of a research strategy, which is presented in the next sub-chapter.

3.3. Research Strategy

To research the guiding research question in a systematic way, literature research is used to both gain a familiarity with the theoretical concepts as well as gaining familiarity with the contextually relevant conditions. Based on the insights from these two methods, the first three sub-research questions have been answered to accentuate how the theoretical concepts and contextual conditions relate to the guiding research question and how they help answering it. Moreover, the theoretical insights are connected in a theoretical framework, which serves as anchor for discussing the later sub-research questions.

The theoretical part is complemented with empirical insights from the conducted semi-structured interviews. In particular, the semi-structured interviews serve three purposes. Firstly, gain a holistic understanding of the situation by considering various perspectives, not just from the actors directly involved in the waste management of domestic plastic waste, but in a broader sense by considering actors that are indirectly involved. Moreover, this allows potentially uncovering conditions, which are not mentioned in the literature. Secondly, to use the interviews as basis to search for transitional elements: As the status quo, and particularly a transition, are constantly developing and changing, identifying such elements from literature is only limitedly possible as the literature will be probably not recent enough to identify such status once published. And thirdly to gain insights on for potential action actors that are in different ways involved with domestic plastic waste and its management in Hamburg.

The insights from the interviews are used to analyse and discuss the status quo in term of its inhibitors and drivers, but also use this as basis to identify the key actors, the institutions, which need to be changed, as well as the typical reinforcing developments from several societal levels and sectors. Last but not least, the advices named in the interviews regarding possible changes are linked to the TM cycle and compared how well they address the status quo and help to achieve a stronger CE for domestic plastic waste. To structure this analysis, the three practical sub-research questions serve as cornerstones and eventually enable – together with the first three sub-research questions – answering the guiding research question (figure 9).

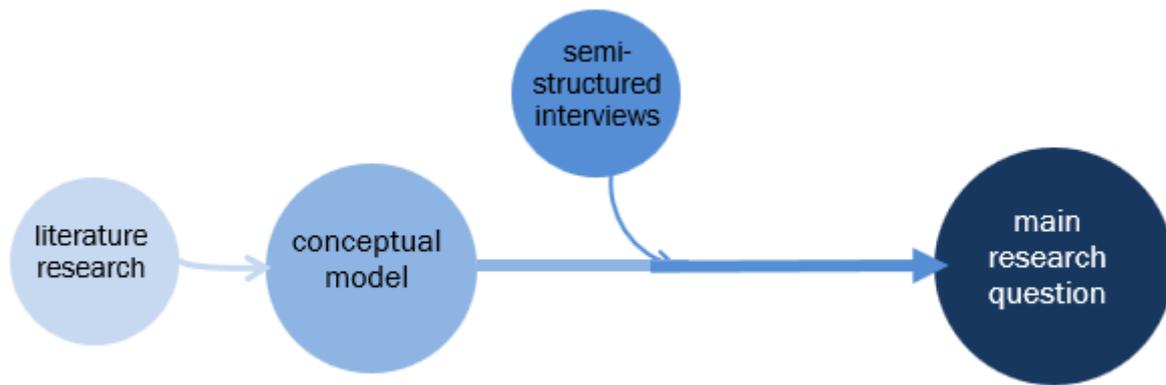


Figure 9: Research strategy of the thesis (source: author)

3.4. Reflection on Data Collection and Positionality

This last sub-chapter of the methodology elaborates possible influences on the results, particularly with regards to the data collection and the positionality of the researcher as no researcher can be purely objective and rational (Allmendiger & Tewdwr-Jones, 2002).

While there is a good access to suitable articles and documents for the literature research, the semi-structured interviews depend on the participation of the potential interviewees. Although invitations have been sent to multiple experts, there are particularly two sectors in which the potential experts declined the invitations: waste disposal companies as well as producers and conventional commerce. Thus, their perspectives could not be included in the empirical analysis. However, their lack could be balanced by experts who have an expertise covering a very broad field and thus partly compensated for it. Thereby an overall holistic description could be composed. Nevertheless, it needs to be admitted that the conclusions in these ‘missing fields’ are not as precise as potentially possible.

Another influence on the analysis of the empirical data emerges from the researcher themselves, and their position (e.g. their identities, values, beliefs) in relation to their research, also referred to as positionality (Bourke, 2014). Positionality accepts that no research can be done in a completely objective manner, which is why the researcher must be aware how their position might subjectively influence their research approach, process, and results (Bourke, 2014; England, 1994). In the case of this thesis, it needs to be acknowledged that I pursued my studies environmental science and environmental planning based on a strong normative motivation. I am aware of this motivation and bias, which might arise from this in relation to how I approach, analyse and interpret the various aspects of my research.

4. Results and Discussion of the Empirical Data

Complementing to the previously analysed theoretical sub-research questions, this chapter focuses on the three sub-research questions, whose analysis is primarily based on the empirical data from the interviews. This chapter is sub-divided into three parts analysing and discussing (i) the change inhibiting as well as (ii) changing favouring aspects, and (iii) the advices to guide the desired changes.

4.1. The Status Quo and its Change Resisting Elements

Since the guiding research question explores the possibility of changing Hamburg's domestic plastic waste management, this sub-chapter adds a necessary prerequisite by analysing and discussing the main causes inhibiting such a change in three parts. Moreover, this part is also important from a TM-angle to identify barriers, which need to be addressed in the TM cycle in sub-chapter 4.3..

4.1.1. Opposing Change: The Four Actor Groups, and Their Inhibitors

Analysing the causes inhibiting a change, referred to as inhibitors hereafter, which can be identified from the empirical data reveals that these causes can be matched to four key actor groups: the industry, the consumers, the waste management, and politics. It is important to note that these four key actor groups do not equal the groups used in the interviews as the four actor groups have been derived after analysing the empirical data. Since the key actor groups and the interview groups are not completely congruent, there is a lack of perspective for the actor groups consumers and politics as their respective inhibitors exclusively stem from people outside the actor groups meaning that the analysis might not be as sharp in some regards as it could have been if more perspectives from the groups had been included. Subsequently, these actor groups and their respective inhibitors will be briefly described. A more detailed description of each inhibitor is presented in appendix III.

The group industry (figure 10) comprises both the producers of plastic products and/or plastic packaging as well as the commerce (INT.B1, INT.B2). Generally, it needs to be acknowledged that this group is very heterogenous. It ranges from companies who only do the legally required minimum, to companies whose entire business models centre around providing environmentally friendly products or services, which also often includes strong and/or innovative CE-measures. However, the later example accounts only for a few companies often operating in niches (INT.B1, INT.C1, INT.D2). Most companies fall in between these two poles depending on how strong ecological interests are valued in comparison to economic aspects (INT.B1).

The inhibiting character of this group can be traced back to two main problems. Firstly, most product designs allow only for a poor recyclability of the plastic material or none at all (INT.A2, INT.D1), which is amplified by a lack of legal recyclability standards (INT.A1, INT.D1), an increasing short-term use design which is met by an increasing consumer demand for such products (also referred to as part of the

‘throwaway society’) (INT.A2, INT.D1), and an incompatible brand image (INT.A1, INT.D2) thereby contrasting both the ‘recycle’ as well as ‘reduce’ principle of CE (Ghisellini et al., 2015; Stahel, 2013).

This problem is accompanied by, secondly, a slow progress towards CE measures indicated through the predominant focus on innovative single products (INT.D1) and discussions that address “at most questions of detail. [These questions] are not wrong per se, but if we look at the outcome of the recycling processes, then we do talk about wrong topics” (INT.D2, p. 14). This slow progress originates (i) the complicated legal requirements companies are obliged to fulfil and document as “there has barely been a month without any changes of the legal requirements a company has to fulfil. [...] leading to a lot of insecurities. Just as the documentation obligations [...]. These are enormous administrative expenses and it is becoming bigger and bigger. Even for small businesses” (INT.B1, pp. 8-9). Moreover, (ii) previous, negative experiences and path dependencies (INT.D1, INT.D2), and (iii) too abstract advices (INT.B2) are obstacles that slow down significant progress. Last but not least, (iv) resource efficiency measures – contributing to the prevention pillar of CE (Feng & Yan, 2007) – are a complicated and time-intensive measure, which is why resource efficiency is rarely used to its full potential (INT.B1. INT.D2).

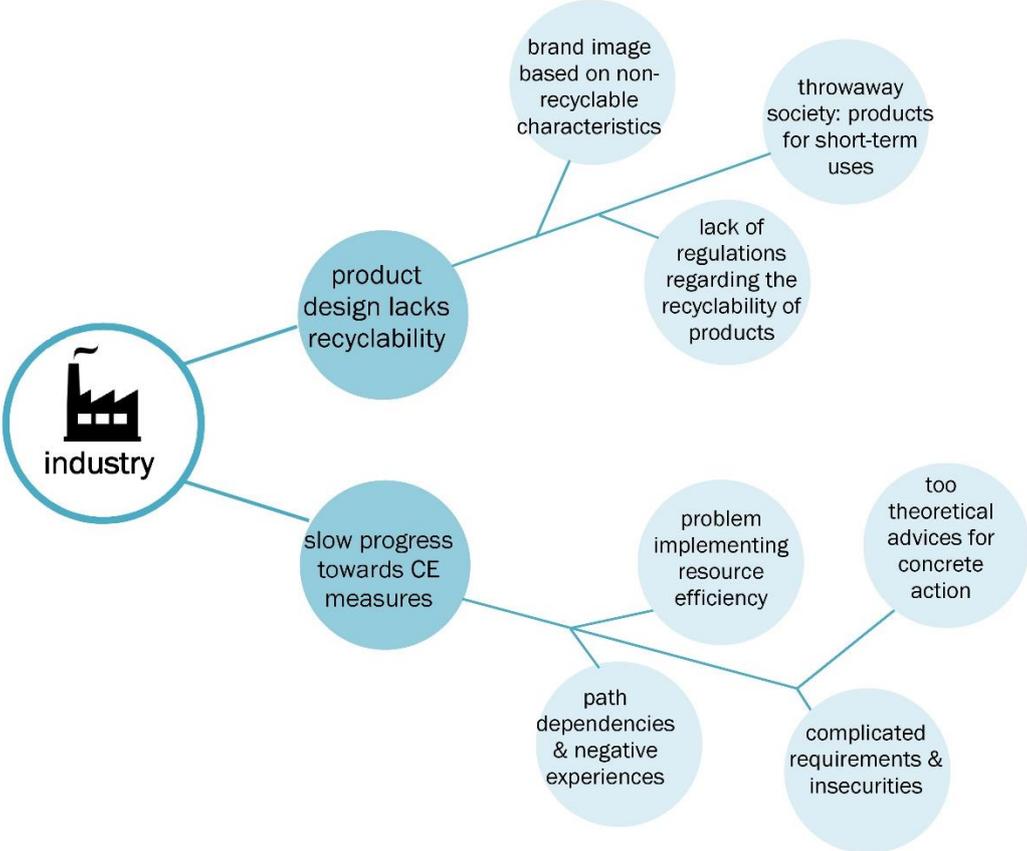


Figure 10: The group industry and the respective problems inhibiting a change (source: author).

The second group are the consumers (figure 11), who transform plastic products or packaging into waste. Domestic plastic waste is a diverse, fast changing in terms of its material composition and polluted mixture (INT.D1). These characteristics create a waste stream that can only be poorly recycled in most cases (INT.B3, INT.C2, INT.D1, INT.D2), which is why the poor waste quality of domestic plastic waste is a major problem for the CE principle of recycling (Hopewell et al., 2009). Other influences

shaping the waste quality and recyclability are the greatly varying level of waste separation (INT.A1, INT.A2, INT.C1, INT.D1), as well as a suboptimal waste collection (INT.D1), although the HWT has been assessed as a more progressive than the average collection form in Germany (INT.A1, INT.A2, INT.B1, INT.D1, INT.D2).

Other main problems can be found in the high plastic consumption, which is significantly fostered through advertisement and commercials promoting predominantly easy and convenient products of the so-called throwaway society. This phenomenon values rebuying over repairing (INT.A2, INT.C1) as *“everything needs to be fast and convenient. [...] As contrast, buying things unpackaged is laborious and time-consuming. You need to think in advance what exactly and how much you want to purchase. And also how you are going to transport it”* (INT.A2, p. 15). This quote also hints at another influence of the throwaway society on a consumer problem opposing the CE-principle of reducing: poor waste prevention. This influence is rooted in (i) a lack of time required for prevention measures like purchasing goods unpackaged (INT.A1, INT.A2, INT.B3), and (ii) rejection (INT.A1). Furthermore, the influence is amplified by the subordinate importance of waste and waste related issues for the majority of consumers: Most people *“are indeed aware [about waste connected issues]. However, there are simply things in their life that are more important”* (INT.D1, p. 12). Nevertheless, in the context of purchasing unpackaged goods it is also acknowledged that there is often a lack of possibilities to buy many goods without a plastic packaging in regular supermarkets (INT.C1)

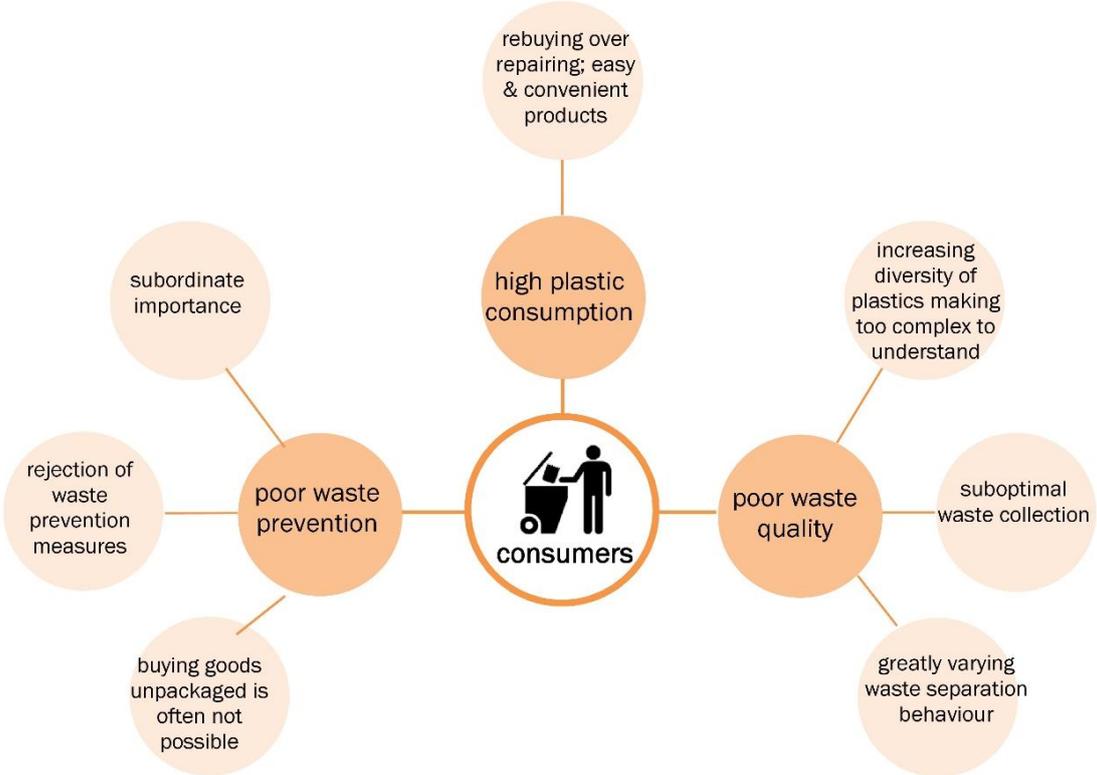


Figure 11: The group consumers and the respective problems inhibiting a change (source: author).

The third group consists of the public and private actors that are part of the waste management (figure 12) responsible for collecting of the domestic plastic waste, processing it, and eventually recycling the plastic waste (or burning in case recycling is not possible (INT.A2, INT.D1).

Most issues regarding CE measures mentioned for this group concern the lack of recyclability, which prevents closing the loop from the waste management to the industry (INT.A1, INT.C1, INT.C2, INT.D1), which is a central aspect of CE (Ghisellini et al., 2015). This gap is caused by multiple factors: (i) the previously described poor quality of the domestic plastic waste (INT.A1, INT.D1, INT.D2), (ii) technical problems causing an inevitable quality loss of the plastic material (INT.ID1), (iii) high prices of plastic recyclate, and (iv) a lack of bans and regulations regarding the product design (INT.A1, INT.D1), leading to a situation in which producers are allowed to produce goods without the need to consider criteria such as recyclability, and the waste management is obliged to be able to deal with the resulting waste (INT.D1).

Another main problem centres around the low levels of innovation within the waste management, as – putting it in drastic words - *“the transparency and information management within the waste management is somewhere at the early stages of the last century”* (INT.D2, p. 7). On the other hand, as coined in these subsequent quote *“there is an innovation barrier, since we pushed development in a certain direction for 20 years and now we do not really know how to proceed. [...] There is changing a lot on the lower levels [...], but to make them big, we need to change the society”* (INT.D1, pp. 9-10) highlighting a societal innovation barrier (INT.D1), which in light of the TM concept might be attributed to innovation barriers from the regime (van der Brugge et al., 2015).

As third main problem, the Duale Systeme responsible for plastic packaging waste according to the German EPR, prioritise quantity over quality of plastic recyclate, thereby favouring a low quality as side effect, which can only be used for a limited number of purposes (INT.A2).

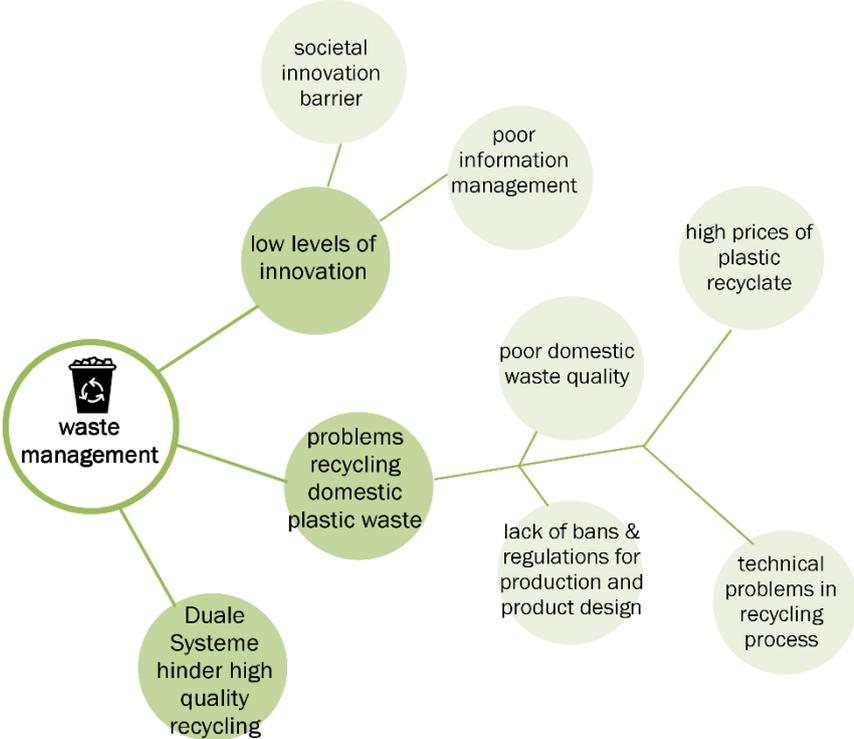


Figure 12: The group waste management and the respective problems inhibiting a change (source: author).

The last group is politics (figure 13) who sets the overall legal framework for all other group (INT.A1, INT.A2, INT.C1, INT.D1). Two main problems hampering a change originate from this group. Firstly, there is a lack of missing bans and regulations to effectively implement recycling and waste prevention measures in relation to any of the three CE principles (INT.A1, INT.B3, INT.C1, INT.C2, INT.D1, INT.D2). This lack is a result of four circumstances: (i) Most bans and regulations could only be implemented by the national level or the EU-level, but not Hamburg (INT.A1), as well as (ii) the focus on voluntary measures taken at these two higher governmental levels (INT.A1, INT.D1), (iii) lobbying in favour of economic interests (INT.C2, INT.D2), and the connected (iv) weak profile of environmental interests in direct competition with economic interests (INT.A1, INT.C1, INT.D1), which are from a TM perspective inhibitors on the macro level (Rotmans et al., 2001).

Secondly, the extensive and suboptimal waste separation as defined in the current waste legislation does not allow for large-scale high-quality recycling plastic of domestic sources (INT.D1) and its separation is too complex for most consumers to understand (INT.A1, INT.A2, INT.B3, INT.D1). Moreover, current waste regulations and the associated administrative effort are very high for the industry leading to high levels of insecurity and reducing the interest of the individual actors to stronger participate in CE (INT.B1).

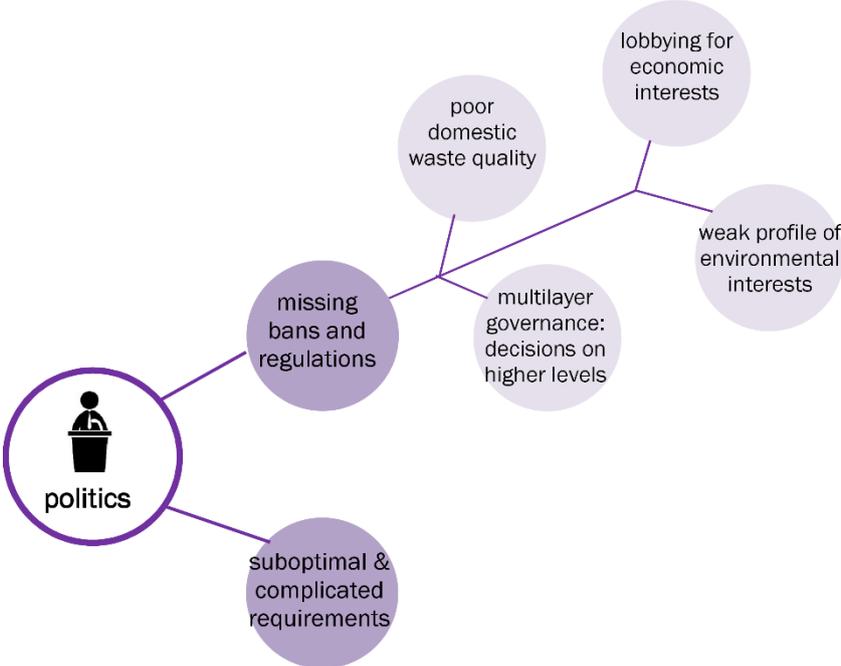


Figure 13: The group waste management and the respective problems inhibiting a change (source: author).

To complement the analysis of the inhibitors, they will be interlinked across the four groups to analyse how they are connected and potentially influence each other.

4.1.2. *Opposing Change: Interlinking the Groups and Inhibitors*

Examining the interconnection and influence across groups creates a picture (figure 14) reveals four major problems represented through arrows, whose influence reaches across groups: missing bans and

requirements and the inhibitors 'waste separation behaviour' and 'complicated requirements' is rooted in the complicatedness of the recent waste legislation. Although different legal requirements apply to the two groups industry and consumers, the complicatedness of these requirements constrain both in their actions and foster insecurities: Actors in the industry, on the one hand, often feel insecure about the existing regulations and their implications and are, thus, often intimidated to invest in innovations and reduces the interest in taking more innovative CE-measures, which is hindering in light of a well-operationalised CE as it lowers the number of effective and innovative measures taken in earlier stages of the value chain (Ghisellini et al., 2015). Consumer, on the other hand, are often flustered by the variety of plastic waste and the various, associated regulations on how to separate and dispose it, which has been identified as impairment for the waste quality and recyclability (INT.A2, INT.B1, INT.D1).

The blue arrows visualise the impact of the lack of effective bans and regulations originating from the group politics on all three other actor groups. This impact can be traced back to a lack of legal regulations regarding the materials which are allowed to be used for plastic product or plastic packaging and which design standards they must fulfil. Eventually, this lack steers the poor waste quality of domestic waste as well as the problem of recycling (INT.A1, INT.B3, INT.C2, INT.D1, INT.D2), which conflicts to one of the core ideas of CE of keeping its resources through recycling (together with reusing) circulating in its system. Moreover, this connection also highlights the need for aligned measures across the entire value chain of a product to implement the CE principles (Stahel, 2013).

The poor domestic waste quality itself shaped by multiple inhibitors, which are themselves affected by other groups. This poor waste quality strongly determines if recycling of the waste is possible and the quality of the resulting plastic recyclate. This connection – indicated through the yellow arrows – unravels how the product design, determined by the industry, and the consumers impact one of the main problems that the group waste management is facing: the lack of recyclability of domestic plastic waste (INT.A2, INT.D1, INT.D2), which – as stressed in the previous paragraph – conflicts with the CE-principle of recycling (Hopewell et al., 2009).

The green arrows represent the influence of the throwaway society, which manifests itself in various ways and influences the groups industry and consumers. As described in the interviews, the throwaway is connected to the fast pace of modern societies (INT.B3). It fosters a need for convenient (INT.A2, INT.C1, INT.D1) and easily available products (INT.A1, INT.A2, INT.B3). In turn, this demand is accompanied by a supply of predominately cheap and disposable plastic products and plastic packaging (INT.A2, INT.C1). Since plastic material is often cheaper than alternative materials *"it has a low very value, because it's not expensive, but cheap. And then you just throw it away. So, these [plastic] products never live long- [...] so, if you want to save money, you obviously go for plastics. But if we would not live in such a throwaway society and such fast pace, there would not be such masses of waste to begin with"* (INT.B3, p. 10). These elements describe how the throwaway society drives the consumers' high plastic consumption, hinder waste prevention methods as these are often time-intensive or simply

rejected and foster a demand product design for said products. Thus, the throwaway society conflicts with the reduce principle of CE.

The term throwaway society was coined as early as 1955 has been used ever since in an often blurry, superficial, and even populist manner; also within academia (Gregson et al., 2007). While being aware of and acknowledging the critical nature of the term throwaway nature, it is used nevertheless in the thesis due to a simple lack of alternative, more academic terms for the described phenomenon.

To summarise the results, the empirical analysis reveals that the status quo of Hamburg's domestic waste management is determined by four groups, and multitude of inhibitors, that are interconnected. Particular attention should be paid to the complicated legal requirements, lack of bans and regulations especially in regards to product design, poor waste quality as a main driver for the problem of recyclability, and throwaway society. In respect to a well-operationalised CE these inhibitors are conflicting with the concept as they oppose the reduce and recycle principle as well as hamper effective and innovative CE measures along the value chain. Moreover, this analysis also emphasises that in light of a potential change it is necessary to consider how this change might cascade to other actor groups, both positively and negatively, as the actor groups are connected. Shifting to the TM-angle of this analysis, most inhibitors classify as regime barriers (see sub-chapter 2.3.). The only exceptions are the four inhibitors 'focus on voluntary measures', 'multilayer governance', 'lobbying', and 'weak profile' of the group politics as they these barriers prevalent on the macro level.

Since there are other analyses of change inhibiting conditions in problems in Germany, it is also important to analyse and discuss how they correspond or differ with the identified inhibitors auf Hamburg's status quo.

4.1.3. Discussion of the Inhibitors

The majority of inhibitors correspond to those identified in other analyses (Fischer et al., 2015; Friege, 2015; Wilts, 2016, 2017; Wilts et al., 2016). However, there are also few deviating cases; either because inhibitors are named, which have not been identified in the empirical data or vice versa.

One of such unidentified inhibitors is the resistance against CE: Highlighting all the potential benefits of CE often obscures that there are also many actors who benefit well from the current system and as consequence oppose a change to more circularity, which also includes some waste management actors (Wilts, 2016). In particular waste prevention is rejected. Since waste disposal are paid based on the waste volume, a reduction of such volume – as envisioned in the CE-principle reduce – would result in less revenue (Fischer et al., 2015). More importantly, it also stresses the necessity to align the actors' interests along the value-chain and to expand the circle of involved actors – as explained in sub-chapter 2.2 – to e.g. establish business models where both producers and disposal companies have incentives to prevent waste (Fischer et al., 2015).

As second case, the lack of bans and regulations to implement more effective CE measures is discussed differently in some regards. Generally, there is a consensus of the inadequacy of the current political frame to establish more effective CE measures (Fischer et al., 2015, Wilts, 2016, 2017; Wilts et al., 2016). As explained in sub-chapter 2.2., the underlying reason can be traced back to Germany's CE approach predominately focused on waste management (Wilts, 2016, 2017). Therefore, a new regulatory framework is proposed extending far beyond the waste legislation (Wilts, 2016, 2017; Wilts et al., 2016). In particular, a mix consisting of both of amended regulations and stricter waste targets (Fischer et al., 2015; Wilts et al., 2016), as well as voluntary instruments to offer support for innovations outside the waste management and new business models is proposed (Fischer et al., 2015; Wilts & Palzkill, 2015, Wilts, 2017). Moreover, it is particularly important that these instruments and measures support the product design to "make products longer-lived or easier to repair, refurbish or upgrade" (Wilts, 2017, p. 5) as one important key to increase all three CE-principles (Friege, 2015; Wilts, 2016), which is also highlighted in the interviews. However, a contrasting element between the suggestions from other publications and the empirical data is that in the interviews solely stricter bans and regulations are advocated as means to support the product design while the focus on voluntary measures is regarded as constraining factor preventing the implementation of such effective bans and regulations. The difference between the other analyses and the empirical data is rooted in the purpose of the voluntary measures. The empirical data criticises that the focus both in the EU and on Germany's national level is set on achieving similar results with voluntary measures for traditional waste management targets, instead of implementing bans and regulations. However, the literature recommends targeting measures outside the waste management. This difference between the empirical data and the literature also highlights that there is a need to communicate that CE measures cover a broader field than just waste management measures (Ghisellini et al., 2015; Wilts, 2016, 2017).

There are also two inhibitors, which have been identified in the empirical data, but are not or only partially included in other analyses regarding hindrances to achieve a broader approach to CE in Germany.

The first one is the complicatedness of the current waste legislation, which constrains and intimidates consumers and actors in the industry and hinders the implementation of effective & innovative CE-measures as explained in the previous section (Ghisellini et al., 2015). Although this problem is not recognised in other analyses (e.g. Friege 2015; McKinsey, 2016; Wilts, 2016, 2017), it is acknowledged in other research fields that extensive and complicated regulations cause "local units [to] find themselves in a constant state of crisis management to try and navigate the complexity of policies and regulations. As a result [...], overstressed local authorities and stakeholders see their workloads increase, but are hardly, if at all, able to cope" (Zuidema, 2016, p. 56). As consumers and actors in the industry also need to fulfil and execute the waste regulations, this quote also encapsulates their situation. Moreover, as emphasised in the quote, the inhibiting character of an extensive and complicated regulations is having most effects on the local level, which would explain why it is not regarded in analyses focussing on CE and its barriers at the nation state level of Germany.

The second inhibitor, which differs in comparison to other analyses, is the throwaway society. The throwaway society has been subject to various research fields (Cooper, 2005), but has not been explicitly identified as hindrance in other analyses in connection to CE (e.g. Fischer et al., 2015; Frieg, 2015; Wilts, 2016, 2017). Nevertheless, several elements, described as parts of the throwaway society in the empirical data are also identified in other publication as obstacles for CE, such as the high resource consumption (Frieg, 2015; Wilts, 2017), and the poor waste prevention and reuse of products (Wilts et al., 2016), although this lack of waste prevention is also attributed to resistance from the waste management as previously explained. Since the individual aspects of the throwaway society seem to reinforce each other, e.g. through a demand-and-supply relationship of cheap, convenient products, this thesis proposes to consider these aspects not individually but as characteristics of a broader phenomenon; the throwaway society. Considering the aspects as a whole could (i) reveal new solutions – which might not be considered when looking for single solutions for the various aspects – to foster a change to a broader CE, (ii) reveal and account for interactions and potential cascading effects between the different characteristics, and (iii) unravel new connections to inter alia other identified problems, and rules connected to CE. However, this proposition would also need additional research specifically focussing on the throwaway society, and its relations to both domestic plastic waste management and CE.

One example for such a new relation might be one between the throwaway society and the waste management, which e.g. manifest in the way how waste prevention is executed. Although it has the highest priority according to both the WFD and the KrWG (UBA, 2016), it does not function well (Wilts et al., 2016). As coined in the following quote

“waste prevention is the one thing, which is extremely difficult and does not work out. [...] I think a lot is done, lots of educational initiatives, promising projects are supported, but we cannot reach all these 1.8 million people living here [in Hamburg]. The flow of life is somehow different... it's a cultural problem. Our life, work, and lean production is not optimised to prevent, but to dispose fast” (INT.D1, pp. 12-13),

it is highlighted that the current lifestyle, which is influenced by the throwaway society, is conflicting with effective waste prevention and thus a strong barrier to CE and its reduce principle (Fischer et al., 2015). Recycling on the contrast is not conflicting in the same way since recycling could be executed while having a high consumption (if the waste quality would be good enough), which is moreover amplified by the myth that

“many people think if they dispose this [plastic waste] in the yellow container, then it will be recycled. And maybe that recycled plastic might be used in the next product, which they will buy, which is simply not true, since [...] only a tiny fraction is ever reused for applications such as packaging” (INT.D2, pp.14-15).

This myth obscures the fact that most plastic waste will be burned (INT.D2; Wilts, 2016) or used for lower quality applications due to the low domestic plastic waste quality (INT.D2). The quote also corresponds with a study from PlasticsEurope (2017) revealing that more than 50 % of the German consumers believe that their domestic plastic waste can successfully be recycled into other plastic items.

Such a strong influence is possible if the throwaway society is regarded from an informal institution angle as in some cases informal institutions can substitute or compete with formal ones (Helmke & Levitsky, 2004). Following the definition of Helmke & Levitsky (2004) informal institutions are “socially shared rules, usually unwritten, that are created, communicated, and enforced outside officially sanctioned channels” (p. 727). The identified characteristics fit this definition in the following regards: the throwaway society influences consumption and production patterns and is advertised through e.g. large advertisement campaigns, which have the potential to influence consumption patterns (Norton et al., 1998). Admittedly, conceptualising the throwaway society and the associated practices as a potential informal institution requires more research as the empirical data only suggest that it might be one, but does not allow for any further conclusions. In particular, such research need to comprise (i) how this potential informal institution relates to other institutions, which shape domestic plastic waste and/or CE and (ii) the type of informal institution, and (iii) how it influences the four other groups.

The discussion about the throwaway society and (informal) institutions also bridges to a weakness of the inhibitor analysis in light of the TM concept: a missing identification of institutions. Although the inhibitors could be identified, it cannot be identified to which institutions of the regime they potentially belong. As introduced in sub-chapter 2.3., institutions have a far-reaching influence on societies. Thus, it is likely that several of the inhibitors belong to institutions. In turn, the identification of institutions and an institutional analysis would be a vital prerequisite for the institutional change, which is important as corner stone for a breakthrough in the TM cycle (Loorbach, 2010). Moreover, there is also a lack of research regarding the institutions, which interact with systems like waste management (Koppenjan & Groenewegen, 2005). Thus, it is recommended to generally invest in respective, further research; not just in connection to the throwaway society.

To answer the fourth sub-research question asking for the main change inhibiting factors in Hamburg's domestic plastic waste management, it can be said that the current status of the domestic plastic waste management is shaped by a multitude of factors. These factors can be assigned to four groups: the industry, the consumers, the waste management, and politics. Some of these inhibiting factors stand out as they do not only shape their respective group, but also exhibit a cross-group influence. Due to this far-reaching influence and the potential cascading effects across groups, these factors are considered as the main change inhibiting factors: The first one concerns the lack of bans and regulations to implement effective waste management CE measures complemented with a lack of voluntary measures to stimulate CE measures outside the waste management. This factor needs to be changed in order to push all three CE principles as well as to implement measures across the entire value chain. A second factor, the complicated legal requirements constrain consumers and individual actors in the

industry through insecurities. Therefore, this factor also hinders the implementation of CE measures along the entire value chain as well. Moreover, this problem is prevalent on lower levels and thus has a particular importance when considering implementing CE measures on this level. Thirdly, the phenomenon of the throwaway society with its high plastic consumption of cheap, convenient, and easily available products, which are in turn also fast disposed. There are signs that the throwaway society also impairs (amongst other factors) how waste prevention as part of the formal waste legislation is executed, which is why this inhibiting factor impairs the reduce principle of CE. This phenomenon seems to be so prevailing that it shows elements, which are characteristic for informal institutions. Fourthly, the poor waste quality of domestic plastic waste together with a not (well) recyclable product design strongly impair the recycling quality, which is also one CE principle. Lastly, it also needs to be remembered to not obscure the fact that multiple actors also reject a change to a broader and strengthened approach to CE as they simply benefit more from the current, rather linear system.

Another important factor to consider regarding a potential change are the circumstances favouring such a change, which will be analysed in the subsequent sub-chapter.

4.2. On the Way towards Change

4.2.1. Favouring Change: the Drivers of Change

The change favouring aspects, termed as drivers of change, can be matched to the same groups of key actors as the ones previously identified. Thus, it also needs to be acknowledged that this analysis might contain the previously explained lack of perspective from some actor groups onto their assigned drivers. Moreover, it needs to be mentioned that due to the high heterogeneity in the groups industry and consumers the drivers of change apply to the single actors in different degrees.

Identified drivers for the group industry (figure 15) can be found in the increasing number of companies diversifying through niche products and services (INT.B1). This development is driven by a partly saturated market (INT.B1, INT.D1) to which some companies respond to by searching for unique selling points (INT.B1), often based on more environmentally-friendly measures that go hand in hand with strengthened CE-measures (INT.B1, INT.D1).

Moreover, the number of companies taking voluntary CE measures is increasing both on a local scale (e.g. the cafés that teamed up to give discount when bringing own cup) as well as nation-wide (e.g. actions taken by big companies such as packaging producers) (INT.D2). Origins for this driver are rooted in a normative motivation based on intergenerational responsibility (INT.B2) or concerns associated to marine plastic waste (INT.D2). Moreover, Hamburg has a specific institution pushing such voluntary measures: the *Umweltpartnerschaft Hamburg* (INT.B1, INT.B2, INT.D2; explanation and translation in table 3.1).

The last driver in this group can be found in the increasing number of shops and selling goods unpackaged (INT.B3) contributing to the reduce pillar of CE (Stahel, 2013).

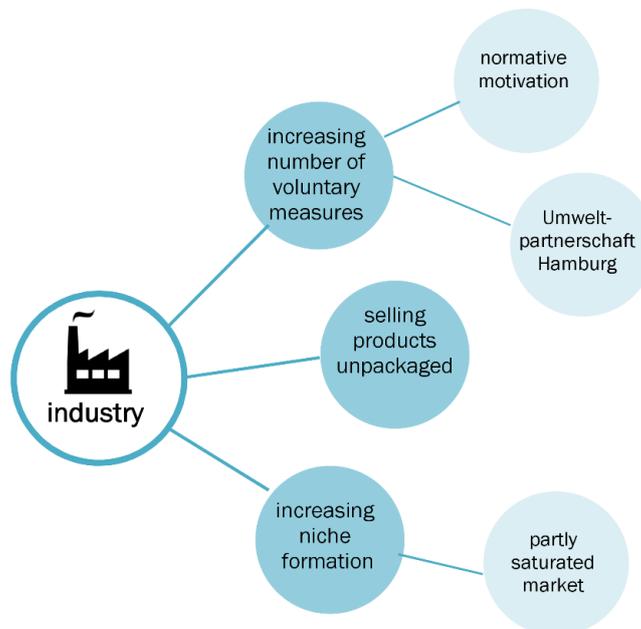


Figure 15: The group industry and the respective drivers favouring a change (source: author).

Regarding the consumer group (figure 16), the development of selling goods unpackaged is met by an increasing interest and number of people buying such unpackaged goods (INT.B3, INT.D2). However, it also needs to be mentioned that being interested in buying goods unpackaged does not consequently equal the act of doing so, as there is a mismatch between people who are interested, and people who are consciously becoming active (INT.A2, INT.C2, INT.D1).

Moreover, an increasing public awareness related to plastic waste in general (INT.D1) as well as of problems associated to plastics has been growing in the recent years (INT.D2). This awareness is generally pushed through environmental education and particularly by the topic of marine plastic waste which creates a high dismay among the consumers: *“It is the oceans, which get the most attention. For some reason, litter in the ocean is perceived worse than litter elsewhere. This statement [...] ‘2050 there will be more waste than fish in the oceans’ is what people remember”* (INT.D2, pp. 8-9). However, while the broad public attitude tends to be concerned about the issues of marine plastic litter, it does not equal taking effective action (INT.A2, INT.D2): *Marine litter “makes it [the amount of waste] visible. And then the public dismay is high [...]. However, the basic conclusion to take action oneself [...] is a different story”* (INT.A2, p. 3)

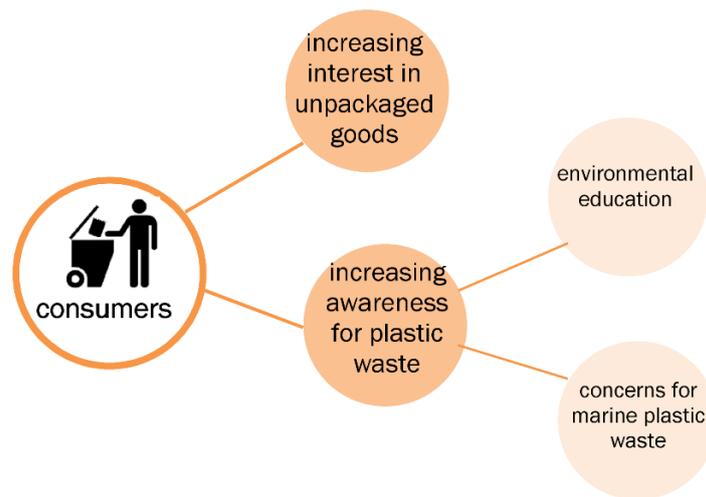


Figure 16: The group consumers and the respective drivers favouring a change (source: author).

Change within the waste management group, pictured in figure 17, is driven by a growing number of niche innovations, which are pushed both by companies as well as public agencies (INT.D1). Just as for the group industry, the partly saturated market fosters such niche innovation as an increasing number of companies invest in unique selling points (INT.B1), which also creates a demand for specific waste management-based CE innovations (INT.D1). Additionally, trends like 'Big data' (umbrella term for a large variety of techniques to collect, store and analyse large quantities of data and associated economic importance; Horvath, 2013) or 'Industry 4.0' (industrial transformation from using computers and automatization to establishing cyber physical systems, Rische et al., 2015) also push the usage of innovative waste management measure to be able to adapt and stay competitive (INT.D1).

Moreover, a Hamburg-specific driver is the Stadtreinigung Hamburg, which is acknowledged as a very active organisation in multiple aspects related to enabling a better CE for domestic plastic waste (INT.A2, INT.B3, INT.C2, INT.D1, INT.D2), such as investing in and implementing niche innovations (INT.A2, INT.D1) thereby deviating from waste management inhibitor 'low levels of innovation'.

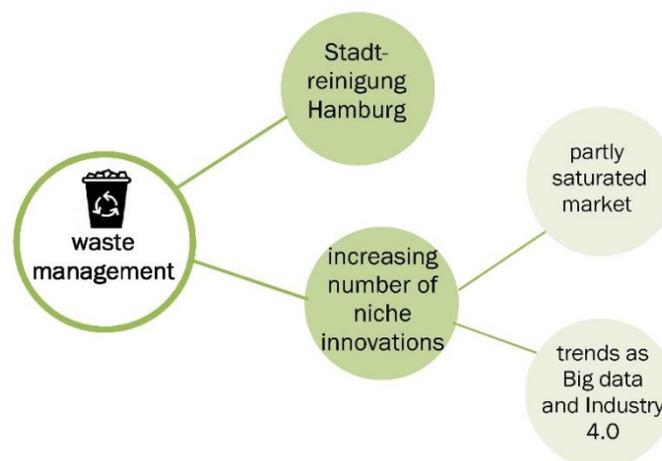


Figure 17: The group waste management and the respective drivers favouring a change (source: author).

For the group politics no clear drivers could be identified from the empirical data as the interviewees mentioned opposing statements regarding the aspect if there are drivers for a change or not (e.g. INT.A1 & INT.C1 vs. INT.D1).

To complement individual analysis of the groups' drivers, the components will be linked together to provide a full picture reflecting the change favouring elements.

4.2.2. Favouring Change: Interlinking the Actor Groups, Direct and Indirect Drivers

Figure 18 presents a visual overview illustrating the individual drivers and how they influence each other.

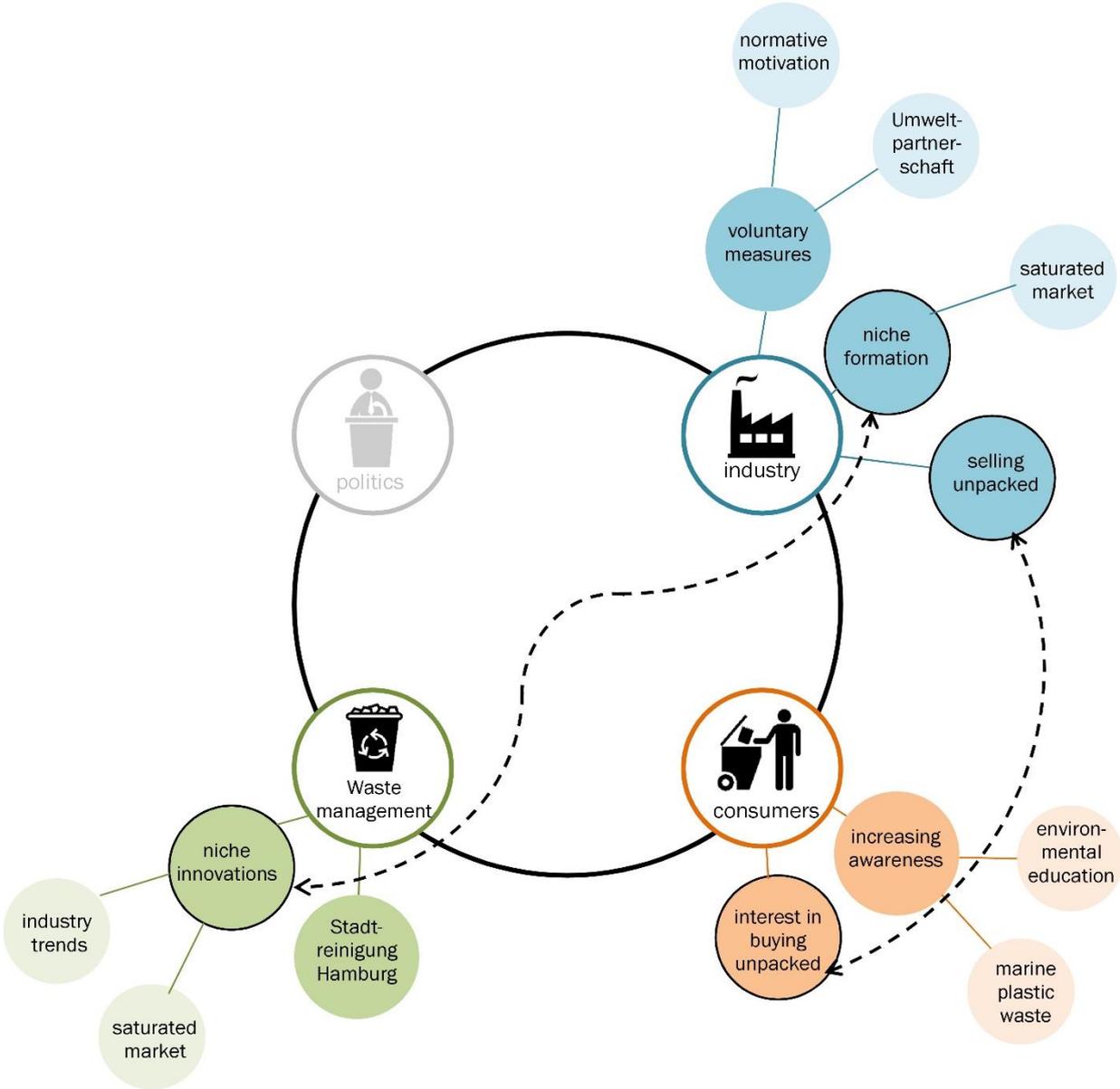


Figure 18: Favouring a change: actor groups with their respective direct and indirect drivers as well as their connection across groups visualised through arrows (source: author)

The figure visualises two mutually reinforcing connections among the actor groups: selling and buying goods unpackaged (right arrow) and the niche formation as well as niche innovations fostered through a partly saturated market (left arrow). This market situation pushes the niche formation of companies;

including the niche formation based on CE-measures (INT.B1). Simultaneously, this situation also creates a demand for respective niche innovations from the waste management (INT.D1). Last but not least, it needs to be mentioned that trends like Big data or Industry 4.0 also strongly affect the actor group industry with its companies across all sectors (Rische et al., 2015). However, the empirical data does not show if these industrial trends affect companies in such a way that it leads to an increase in CE-measures. Thus, these trends are not listed as drivers.

This situation of cross-group influence contrasts to the findings in the previous sub-chapter, where the inhibitors are shaped by a significantly higher degree of interconnectivity. However, this observation could also be influenced by the admitted lack of perspective. It is also striking that the actor group politics, which has two main inhibitors influencing several inhibitors of other actor groups, does not have any clearly recognisable drivers of change based on the empirical analysis, which is why the politics icon and circle is muted in grey. Nevertheless, it also needs to be pointed out once again that this lack can be caused by the described lack of perspective and subsequent insufficiency of the data quality in that regards.

In general, all drivers can be assigned to three categories: The first group are the economic changes and developments, which comprise the niche formation and innovation favouring CE-measures, as well as the industry trends and the partly saturated market. This category is based on a reinforcing connection between the groups industry and waste management. The second group are the environmental concerns and awareness, which encompasses the drivers of marine plastic waste, environmental education, and normative motivation. The last group reflects the changed lifestyle choices through the slowly growing interest and offer of unpackaged goods, which pushes the reduce aspect of CE and has a reinforcing connection between the groups industry and consumers.

Even more, marine plastic waste is listed twice as it influences both the industry (INT.D2) as well as the consumers (INT.A2, INT.D2). While the concern for marine plastic litter seems to be high from both groups, it does, however, not imply that effective measures and actions are taken in both cases (INT.A2, INT.D2).

In sum, the empirical analysis provides insights into the status quo of Hamburg's domestic plastic waste being a result of multiple inhibitors hindering a potential change, as well as drivers of change, which might facilitate a change. These drivers could only be assigned to three of the actor groups. Overall, the drivers can be matched to three categories: economic changes and developments, environmental concerns and awareness, most notably related to marine plastic waste, and changed lifestyle choices. Another interesting feature is that Hamburg stands out for some of its institutions positively deviate from standard practices, such as most noticeably the Stadtreinigung Hamburg.

How these insights relate to change, will be discussed in the next part.

4.2.3. Discussion of the Change Favouring Elements

There is significantly less literature on CE favouring factors in general, as most analyses in the field of CE favouring factors rather focus on the potential of a specific solution. Only two general statements of favouring factors are made in respects to (i) the Industry 4.0 (Stahel, 2016), and (ii) innovative business models (Wilts, 2017) comprising business models from a broad range of sectors, approaches, and products (Fischer et al., 2015; Wilts, 2017; Wilts & Palzkill, 2015). One of the most effective business models are Product Service Systems (PSS) (Tukker, 2015). PSS are based on costumers no longer purchasing a product but paying for using its asset. Generally, PSS comprise a broad spectrum of activities ranging “between pure products and pure services unfolding different sub-categories” contributing thereby to the reduce and reuse principle of CE (Fischer et al., 2015, p.2). Moreover, PSS are pushed by the Industry 4.0, which is why the Industry 4.0 can also be listed as driver for CE in the group industry (Rische et al., 2015)

This change favouring aspect is also named in the empirical data when referring to the niche formation and niche innovations in the groups industry and waste management. Aside the innovative business model example, most analyses regarding CE (e.g. McKinsey, 2016; Wilts, 2016, 2017; Wilts & Palzkill, 2015) do not name other driving factors.

However, in light of the guiding research question, which is proposing TM as guiding concept for a change, it is interesting to consider how the drivers of change identified from the empirical data relate to the TM concept. As explained in sub-chapter 2.3., change in form of a transition exhibits specific characteristics, namely (i) reinforcing developments that originate from different societal levels (macro and micro pressurising the meso level) and (ii) developments form different sectors (van der Brugge et al., 2005). Considering the identified drivers, these characteristics seem to be at least partially fulfilled as subsequently discussed.

Regarding the multi-level aspect, marine plastic waste and the emerging awareness of its threat as first development both influences macro-politics as well as motivates individual actors, even though the topic of marine plastic waste is not directly related to the issues of domestic plastic waste management and CE (INT.D2). For many people it is often marine plastic waste which triggers dismay and influences the willingness to act, although action may be incremental such as signing petitions (ten Brink et al., 2017b). As macro developments it can be observed that marine plastic waste has been declared as an important issue by the EU. In their action plan to combat marine plastic waste increasing CE is explicitly named as solution (EC, 2017). Nevertheless, there is so far no research focussing how marine plastic waste exactly influences the investigated issue of plastic waste in connection to CE.

Secondly, the economic changes and developments both appear on the macro level – indicated through the partially saturated market and trends such as Big Data and Industry 4.0 – as well as on the micro in form of niche innovations and niche formation as response to developments on the macro level. Knahl & Ruschmann (2016) confirm such favouring conditions in Hamburg through the recent growth of so-called green technologies to support environmental protection and/or reducing resource use as

means to decouple economic growth with resource use and the associated environmental consequence.

Thirdly, the changed lifestyle choices seem to be a development, which is so far limited to the micro level (ten Brink et al., 2017b). Thus, it is not a multi-level development.

Shifting to the multi-sector development of transitions, it can be said that marine plastic waste as environmental concern as well as the economic changes and developments are indeed stemming from different sectors, thereby fulfilling the multi-sector aspect.

Responding to the fifth sub-research question asking for the main aspects favouring a change, it can be concluded that there are three main categories of change favouring aspects. Firstly, the economic changes and developments pushed through larger developments complemented by niche formation and innovation from actors both within the waste management and the industry. Secondly, environmental concerns and awareness, with marine plastic waste as the most prominent one, influences the willingness to act – not particularly doing so, but at least the willingness to do so – among the consumers and the industry. And thirdly, changed lifestyle choices reflected in the slowly increasing interest and offer of unpackaged goods. Particularly, the first two categories are interesting in respect to how change is conceptualised in TM: Both categories fulfil together the characteristics of change resulting from a reinforcing multi-level and multi-sector development. Nevertheless, it remains unsure if these change favouring developments can reach enough momentum to achieve a breakthrough in a potential transition.

These insights are also important for the next sub-chapter, which analyses the advices regarding how to steer the envisioned change, as the advices could exploit the change favouring elements for their purpose.

4.3. Steering the Desired Change : Linking the Advices with the TM Cycle

This sub-chapter examines the advices and incentives derived from the empirical data complemented with insights from the previous sub-chapters and other publications to support the potential change pursued by this thesis' guiding research question. Therefore, the TM cycle, which has been explained in sub-chapter 2.3., will be used as basis for the advices proposed by the interviewees and insights from the two previous sub-chapters will be linked to the respective TM steps and discussed.

4.3.1. The Shared Vision

The first step of the cycle is about developing a shared vision (Loorbach, 2010, Rotmans & Loorbach, 2009). This vision entails strategic and abstract elements focussing on the culture of a system, which

should be transformed through long-term goals (Loorbach, 2010). The empirical data emphasises that four aspects should be integrated in such a vision in Hamburg.

Firstly, the role of waste prevention should be increased and strengthened (INT.A2, INT.B1, INT.B2), as it currently has – despite being ranked as highest priority in WFD (EC, 2008) – a marginal role (INT.D1). As previously explained, the problem of waste prevention has more than one origin, which needs to be considered when translating this vision aspect into action. Secondly, the recyclability and thus also the circulation potential of domestic plastic waste should be increased (INT.C2, INT.D1), to overcome the problem that the majority of plastic waste currently cannot or can only poorly be recycled (INT.A1, INT.D1, INT.D2). Moreover, it should be prevented that waste prevention comes on the expense of recyclability or vice versa, as e.g. some resource efficiency measures result in a loss of recyclability (INT.D1). Thirdly, it should be pursued to increase the value of plastic as a material (INT.A2, INT.B3), however, not just financially (INT.A2), but also the mindfulness of how plastic products are treated (INT.B3). Such a shift has not only implications for the consumers to change their perception and approach to plastics (INT.B3, INT.C2); it also demands the industry to produce and sell more long-lasting and repairable plastic products (INT.B1). The fourth vision aspect has pointed out that it is vital to cause a shift in the consumers' perception to a perception of collective awareness and more importantly, responsibility for the waste that is produced (INT.B3).

Based on the previous results and discussions, a fifth element can be recommended to add to the vision: Establishing a broader and more holistic understanding of the CE concept as a mean to overcome the narrow focus predominantly set on waste management and simultaneously help fostering an alignment of the actors. As explained in sub-chapter 2.2., CE and its respective measures can be found in various sectors and are operationalised by various actors and at various scales. Through broadening the CE understanding, their potential for decreasing the amount of domestic plastic waste or increasing the reintroduction can be unlocked which is the goal pursued through the change. Thus, successfully communicating CE as a broader concept is a crucial prerequisite for actors to “work together on optimised solutions, rather than continuing to concentrate solely on ‘their’ elements of the chain” (Wilts, 2017, p. 4).

Translating these five vision constituents into steering activities tailored to the current regime is part of the next step.

4.3.2. Steering Activities through Tactical Objectives

As second step of the TM cycle, tactical objectives such as intermediate goals of the strategic vision and respective routes to work towards them are developed. Moreover, these objectives and routes must focus on removing critical barriers of the regime (Loorbach, 2010, Rotmans & Loorbach, 2009).

Most advices, especially those for the first two aspects of the vision, propose to pass stricter regulations and more bans as means to achieve the objectives (INT.A1, INT.B3, INT.C1, INT.C2, INT.D1, INT.D2). However, Hamburg as a federal state does not have the scope of authorisation to pass most of them (INT.A1). Thus, amending, or implementing new bans and regulations as tactical objectives is not

discussed in this thesis. Moreover, it also shifts the predominant focus onto voluntary measures as alternative.

For the group industry, voluntary measures are recommended; mostly those that incentivise waste prevention as this is currently not strongly pursued (INT.A2, INT.B1, INT.B2). In particular, these incentives need to target a more durable, longer-lived and better recyclable product design (for plastic products) and alternative materials (for plastic packaging) (INT.A2, INT.B2, INT.D2). Moreover, resource efficiency measures should be facilitated as they are currently not used to their full potential (INT.B1, INT.B2). This could be amplified by thinking in product cycles (INT.B1) and trying to shift the attitude to a more proactive one (INT.D2) through (i) highlighting potential cost savings and marketing effects as results of innovative CE-measures (INT.B2), (ii) guarantee a stronger legal security when undergoing innovations (INT.B1), and (iii) investing into CE measures beyond waste management related CE measures, such as sharing economy (INT.B2). Furthermore, investing in such measures reflecting a broader CE approach also responds to the criticism that “only few German companies or regions use the CE principles as differentiating feature [in an EU-wide comparison]” (translated from McKinsey, 2016, p. 10).

In addition, it can be recommended to focus on simplifying the current legislation based on insights from sub-chapter 4.1. as its complicatedness causes insecurities for many companies and hinders establishing innovations. However, innovations are important to support the various objectives, such as a more durable product design. Please note, that simplifying does not equal jeopardising the minimum level of standards. Rather it is crucial to find a way, which allows for both: requirements that are easy to follow and implement, while providing at the same time provide the necessary level of minimum standards (Zuidema, 2016).

These tactical objectives correspond with four of the vision elements: increase of waste prevention, increase of recyclability, broader CE approach, and increasing the value of plastics material. Particular potential can be unlocked, if the measures based on these objectives exploit the identified driver of ‘economic developments and changes’, as described in sub-chapter 4.2, e.g. through fostering new business models triggered by the Industry 4.0 operating at the intersection of cycles (Wilts, 2017).

Despite the necessity for voluntary measures, it must be emphasised the term ‘voluntary measure’ covers a multitude of possible measures and respective instruments (Jordan et al., 2005). Further specifications regarding the voluntary measures cannot be given in this thesis as these measures need to – speaking in TM-terminology - target and remove the regime barriers for which institutional changes are critical (see sub-chapter 2.3.). However, as admitted in sub-chapter 4.2., the institutions shaping Hamburg’s status quo of domestic plastic waste could not be identified based on the empirical data. In turn, no insights regarding the needed institutional changes could be revealed, which is why no specifications can be given.

As objectives for the consumers, it is emphasized to make the topics waste prevention and reusing more tangible for them (INT.A2, INT.B3) and foster an awareness regarding the current limits of recycling (INT.B3, INT.C2). These two overarching objectives reflect the vision elements of waste prevention and

collective awareness. In addition, an objective based on the envisioned increased value of plastics material should be created to change the consumers' perception of plastics.

As means for achieving these objectives, the empirical data suggests to (i) give easy advices as well as facilitating the participation in waste management measures (INT.C2, INT.D1) and (ii) invest into consumer education, especially in education of children (INT.A2, INT.B1, INT.B3). Education is also needed to prevent a rebound effect as "simple, usually technically dominated strategies [...] can lead to increased consumption, which again exhausts a part of the achieved savings" (Wilts & Palzkill, 2015, p. 1) conflicting with the reduce principle of CE (Feng & Yan, 2007). Other complementing suggestions are (iii) creating a 'positive branding' of waste prevention and reusing (INT.A2, INT.C2), while (iv) exploiting new information channels and platforms, like social media (INT.A2, INT.C1, INT.C2), since "it should be fashion magazines, not science journals, that bang the drum about jewellery sharing, leased jeans and rental designer handbags" (Stahel, 2016, p. 438). Last but not least, (v) more incentives to act should be provided (INT.A2, INT.B2, INT.C1, INT.C2). Nevertheless, it remains unclear what should be entailed in such incentives except for financial ones (INT.A2, INT.B2, INT.D1). Furthermore, there is a broad agreement that consumers are the most difficult group to provoke a change in (INT.A1, INT.A2, INT.B3, INT.D1, INT.D2).

Interestingly, none of the empirical recommendations is broadly discussed in other publications (e.g. Friege, 2015; Wilts, 2016, 2017; Wilts & Palzkill, 2015). Rather, most focus is set on collaborative consumption models which are characterised by a change in ownership: either it is shared among multiple consumers or no ownership (Ghisellini et al., 2015). Moreover, there seems to be a lack of insights on how to reduce the gap between the current consumer behaviour and the envisioned one of the various collaborative consumption models: As criticised owning products is highly valued; often not based on necessity, but due to the simple emotional desire to own it (Fischer et al., 2015; Tukker, 2015), which is why the desire to own is the strongest barrier on the way to collaborative consumption (Tukker, 2015). Without changed consumer habits many new CE business models which build on collaborative consumption, will remain niche projects (Wilts, 2016). A question, which should be raised in the context of this thesis, is if collaborative consumption models are useful for all forms of domestic plastic waste, especially for plastic packaging for food: Is it possible (i) regulation-wise as it must be ensured that contamination threats are excluded (INT.A2), and (ii) to what extent it would be economically viable?

In sum, it is recommended to use the advices given in the empirical data to improve education and awareness among consumers by using a variety of information channels and platforms complemented with a facilitated participation for the consumers in the CE by making central issues like waste prevention and limits of recycling more tangible. This facilitated participation can also support collaborative consumption; however only for those plastic products for which it is possible and economically viable. Just as for the objectives targeting the industry, no further specifications regarding what specific measures for action should be taken can be given.

Interestingly, no advice was given for the group waste management. However, based on the previous analysis of change inhibiting factors, it is important to pursue transforming waste prevention into viable economic model as objective for waste management actors (Wilts, 2017). As some companies already

offer such services in Hamburg (Wilts & Palzkill, 2015), it is important to establish measures for (i) incentivising more business centring around turning minimising waste, and (ii) supporting upscaling of already established models, e.g. through experience exchange outside the traditional organisational structure (INT.D2). Also for these measures, more success could be achieved if these measures would exploit the identified driver of 'economic changes and developments'.

No other recommendations for objectives derived from other vision elements could be identified in other publications. This does not insinuate that there are no additional ones: Since the institutions shaping Hamburg's domestic plastic waste as core element of the regime and its barriers could not be identified, no objectives based on them are discussed in this thesis.

4.3.3. Transition Experiments

The third step of the TM cycle focuses on niche experiments and innovations, which support the vision and objectives by exploring and diversifying niche activities, which might be potentially upscaled (Loorbach, 2010, Rotmans & Loorbach, 2009). There is only one specific recommendation voiced in the interviews for an experiment with focus on waste prevention: Scientifically guided waste prevention experiments targeting an almost zero-waste output conducted at Hamburg's public agencies, thereby creating a niche experiment, which – if successful - can be expanded to other organisation such as larger companies or schools and universities (INT.D1). The explicitly named scientific guidance is needed to create a bridge based on academic insights between the throwaway society mentality and the zero-waste lifestyle (INT.D1). As this experiment targets an increase of waste prevention, which is part of the vision. It also makes waste prevention easier and more tangible for the people working in the public agencies, which is advised in the tactical consumer objectives and supports the reduce-principle of CE. Moreover, public agencies "represent significant investment pools which can create economies of scale" for a demand for products suitable for waste prevention (ten Brink et al., 2017b, p. 7). There are also already some experiments underway pushed by the Stadtreinigung Hamburg and external research institutes on how to adapt and potentially change the waste collection and eventually increase the waste quality (INT.A2, INT.D1).

As a general facilitator for innovations both within the group waste management as well as industry is experience exchange outside of traditional organisational structures. It facilitates the emergence of new ideas, expanding innovative ideas and eventually up-scaling them (INT.A2, INT.D2) and publishing positive examples (INT.B2) to inspire for taking more actions (INT.B2, INT.D2).

Since most tactical objectives remain vague as previously explained, it is recommended to invest in a variety of experiments as means to gain more insights regarding the regime and its institutions and other barriers in a real-life context (Loorbach & Rotmans, 2010). Particularly valuable are experiments which are so-called area-based niches: Experiments and initiatives that are local deviations to the standard practices – thus the transition term 'niche' – which are well embedded in their regional context. Due to this integration, such experiments and initiatives have higher chances of acceptance by the citizens and are less prone to failure (de Boer & Zuidema, 2013). These effects are amplified, if the

experiments are well connected to the drivers of change ‘marine plastic waste’ and ‘economic changes and development’.

4.3.4. Monitoring and Evaluating the Transition

As fourth and last step, monitoring and evaluating are needed to keep track of the changes, prevent lock-ins of a transition, and act as basis for potential adjustments of the other three steps (Loorbach, 2010, Rotmans & Loorbach, 2009). No advices regarding monitoring and evaluating are mentioned in the empirical data, which indicates that the interviewees do not seem to value additional monitoring measures besides the one, which are already established as necessary to achieve progress. Based on the previous recommendations for executing more experiment to gain insights regarding the institutions and barriers of the regime, a throughout monitoring and evaluating of these experiments is a crucial prerequisite, which is why more monitoring and evaluation should be carried out. However, monitoring is an integrated part of the entire TM process and must not be carried out afterwards or detached from the process (Loorbach, 2010).

4.3.5. Putting the Steps together

As final aspect, it should be examined in which order the described steps of the TM should be executed. As emphasised by Loorbach (2010), the steps do not need to be taken in the specific sequence but can be taken in a different one or in parallel. As revealed through practical insights, it is not even necessary to start with the strategic vision as there is also a successful example of transitions (guided explicitly by TM), which started with experiments to develop and innovation network. In this specific case, this approach has been chosen to gain insights into how particularly the regime worked, what the barriers are, and possible alternatives to the status quo. Based on these insights from the experiments, the transition arena and the vision have been developed and then served as basis for the transition agenda (Loorbach & Rotmans, 2010).

Considering the vagueness of the tactical objectives originating the missing insights in respect to the regime and its barriers, steering the desired change of the research objective seems most suitable with transition experiments as start. Moreover, the experiments and monitoring should be accompanied by research focussing on an institutional perspective of the regime as it has been stressed throughout this chapter multiple times. The insights from both the experiments and the research can form a basis to refine both the vision as well as the tactical objectives to address the regime and its institutions and other barriers more tailored as the current recommendations allow for. Thereby, more of the identified inhibitors from the previous chapters can be addressed and the potential of achieving a significant success on the road towards a change of Hamburg’s domestic plastic waste management.

Bringing all the previously described steps (figure 19) together into a cycle also gives an answer to the sixth sub-research question asking which advices based on TM would be suitable to support a change in Hamburg’s domestic plastic waste management to strengthen CE in regards to plastic waste.

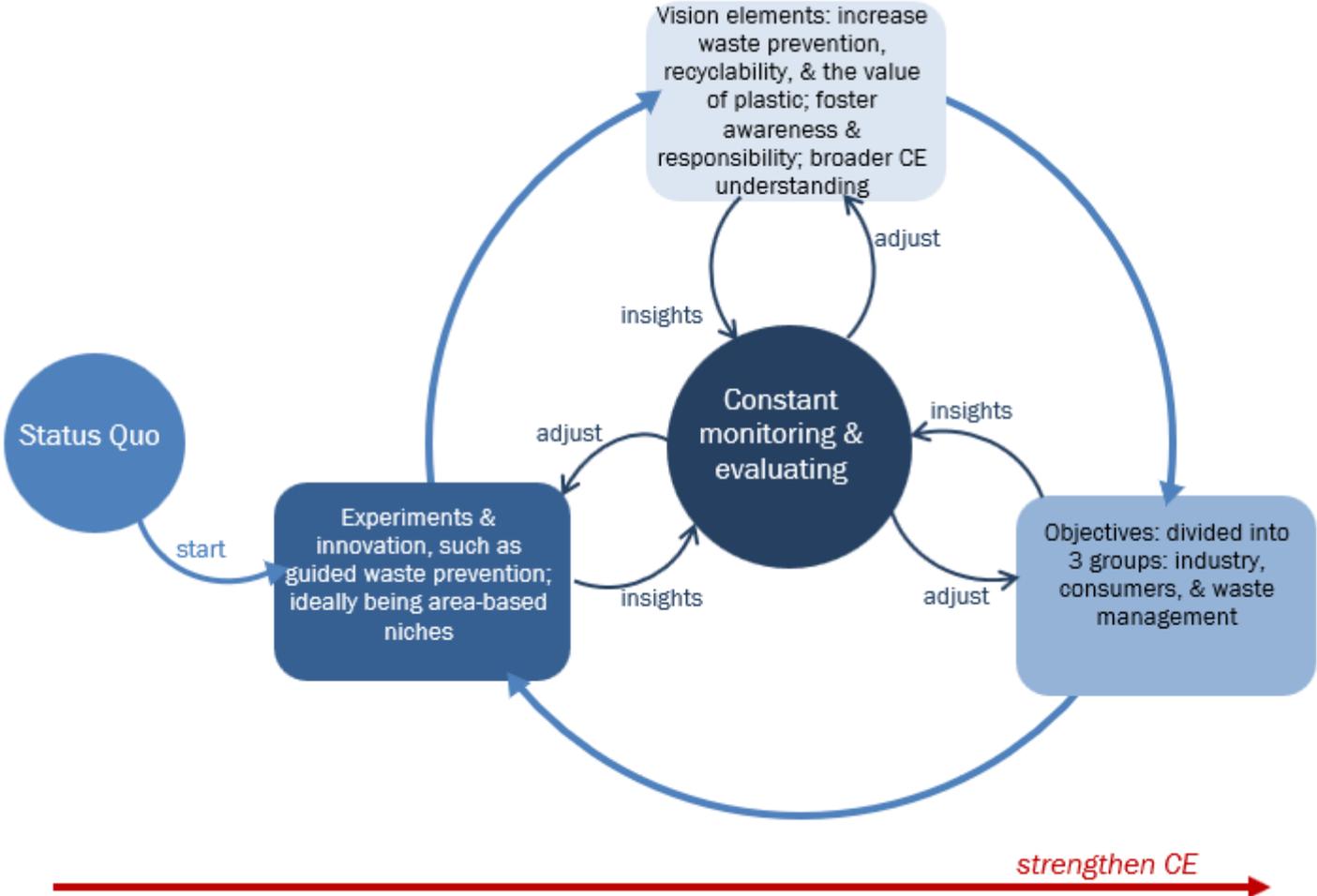


Figure 19: The TM cycle tailored to change Hamburg’s domestic plastic waste management; based on figure 7 (source: author)

As argued above, the cycle should start with transition experiments and innovation to diversify the niche activities while simultaneously gaining more insights about the regime and its barriers. So far, it is explicitly recommended to establish a scientifically guided waste prevention experiment at the public agencies with the potential to expand it to other institutions and organisations. As one experiment is not enough, more experiments should be initiated ideally being area-based niches. e.g. through experience exchange outside traditional organisational structures to stimulate the emergence and expanding of new ideas.

This step is followed by the development of a joint vision. Crucial elements which should be entailed in this vision are (i) increasing and strengthening waste prevention, (ii) increasing the recyclability of domestic plastic waste and thereby pushing the circularity of plastic material, (iii) increase the value of plastic as a material, (iv) create a collective feeling of awareness and responsibility, and (v) establish a broader and more holistic understanding of the CE concept. However, as this is not the finite vision, more elements might be added to it, e.g. through insights from the experiments.

As third step, the vision paired with the insights from the experiments regarding the regime and its barriers is translated into objectives and respective measures to remove the regime barriers and enable a shift towards the vision. Recommendation for such objectives and measures are divided into three groups: the industry, the consumers, and the waste management. For the group industry, it is recommended to incentivise waste prevention of domestic plastic waste through an improved product design, alternative materials, and resource efficiency. Moreover, thinking in product cycles and measures beyond the waste management realm should be fostered. Complementing, a general shift to a more proactive attitude is recommended. For the group consumers, recommended objectives are making waste prevention more tangible, increasing the awareness regarding the limits of recycling, and supporting collaborative consumption. So far, an objective reflecting the increased value of plastic is missing but should be added. These objectives can be achieved through more education and exploitation of new information channels as well as easier advises and more incentives to facilitate participation. For the group waste management, it is so far only recommended to make waste prevention for the actors within that group more profitable. However, in all three groups concrete recommendations for action are currently missing due to an admitted lack of insights regarding the regime and its barriers, particularly in regards to the institutions, which is why further improvement is needed in this step.

As last, monitoring and evaluation should be carried throughout the entire three steps.

After analysing and discussing the advices on how to support the desired change demanded in the guiding research question based on the TM concept, the next chapter will finalise this thesis through a reflection and conclusion in light of the main research question and research process.

5. Reflection and Conclusion

To provide a comprehensive reflection and conclusion, this chapter is divided into (i) answering the main research question, (ii) critical reflection of this study, (iii) contributions to planning theory and planning practice, and (iv) recommendations for future research.

5.1. Answering and Reflecting on the Main Research Questions

The guiding research question of this thesis was founded on how a change strengthening the CE principles can be fostered to both decrease the amount of waste generated and increase the amount of waste which is reintroduced to Hamburg's domestic plastic waste management by using the TM principles.

As a prerequisite for any change fostered through the TM principles, it is crucial to regard the multi-level, multi-sector, and multi-actor nature of a fundamental change (Rotmans et al., 2001; van der Brugge et al., 2005). In context of this thesis this means (i) establishing measures not just within the waste management realm but also beyond (multi sector), (ii) operationalising measures at various scales (multi-level), and (iii) including a broader circle of involved actors (multi-actor) (Ghisellini et al., 2015; Wilts, 2016). Thereby the overall amount of domestic plastic generated can be decreased – reflected in the CE principle of reducing – while increasing the reintroduction if the remaining amount of domestic plastic waste; as encapsulated in the 'reuse' and 'recycle' principle. Based on this interconnection of the two principles, both change inhibiting elements, relevant for the barriers TM must address, and change favouring elements pushing the desired change form the basis of the iterative TM cycle tailored to the specific conditions in Hamburg. As unravelled from the empirical insights, there are four major inhibitors acting as barriers, which are complemented by three favouring developments. Since a transition reaches momentum through reinforcing multi-level and multi-sector developments (van der Brugge et al., 2005), it is useful to exploit these change favouring developments in the TM cycle. Despite having identified these inhibitors and drivers, more insights regarding the regime barriers – particularly in regards to the institutions – are needed. Therefore, it is recommended to start the TM cycle with the step of 'niche innovations and experiments' to derive at more sophisticated advises for action to eventually achieve the desired status demanded in the guiding research question.

Linking the insights gained from this research with the broader realm of CE this research can confirm that the current focus of existing CE measures is primarily placed on waste management related measures while the implementation of non-waste management related measures is just slowly emerging. Thus, this research corresponds with Wilts' (2016) quote that Germany's CE approach "concentrates too strongly on the topic of waste management. [...] One central challenge will consist in communicating that circular economy means much more than better waste separation and technically optimised waste management" (p. 19). While the insights of this thesis support the need to communicate the broader CE approach to establish and align effective CE measures along the entire value chain, it seems – based on the experiences of this research – that this awareness of CE being a

broader concept is slowly increasing as all interviewees also suggested measures reflecting elements of the broader approach. Thus, this research suggests that the understanding of CE is in the process of changing at least among people familiar with the concept.

However, another central challenge on the way towards a broader CE approach, which can be emphasised based on this research, consists in increasing the awareness and implementation of waste prevention and similar measures based on the reduce and reuse principles of CE. As already criticised, recycling is the principle most strongly associated to CE (Ghisellini et al., 2015), while the reuse principle and waste prevention are rather marginally used (Fischer et al., 2015). This research confirms this as the number of suggested measures encapsulating the recycle principle has been higher and significantly more concrete than the number of measures for waste prevention or even reuse. Indeed, measures related to reuse seem to be almost absent in this research, which, however, might also be owed to the specific waste stream which has been subject to this research as it is unclear whether reusing is possible for all forms of domestic plastic waste.

Reflecting upon CE from a TM-angle highlights the value to regard CE in a more integrated manner with other developments and issues: In the analysis of barriers, this research has emphasised the need to include the influence of formal and informal institutions and how they affect CE, which so far seems to not have been explicitly done. Also the analysis of facilitating factors also revealed developments, which are not directly related to CE and domestic plastic waste but still favour a change, which have not yet been included in other publications.

On the downside, it also needs to be admitted that using the TM concept in connection to CE and/or (plastic) waste management cannot be recommended in all cases. TM is a concept which requires a sound knowledge base regarding multiple issues, which is not an easy requirement (i) in connection to the dynamic CE concept and its emerging research body (Ghisellini et al., 2015), and (ii) (plastic) waste management in Germany with its strongly technical focus, often on the expense of an approach integrating also insights from social sciences (Koppenjan & Groenewegen, 2005). If this base is missing or insufficient, the advices derived from TM might become vague or even inadequate to steer the desired change.

To derive at these answers, there have been choices that – knowingly or unknowingly – affected the outcome of the thesis, which be evaluated in regards to the research process and the scientific and societal relevance which motivated this study.

5.2. Critical Reflection of this Study

The scientific relevance has been grounded in pursuing a research revealing barriers, inhibiting factors and drivers arising from a shift to more circularity from a TM perspective; also looking for barriers and facilitators which might be specifically relevant for the federal level. The societal relevance has aimed at improving waste prevention, reuse, and recycling of plastic waste to reduce the associated

environmental impacts of plastic waste as well as harvesting the social CE benefits through investigating actions which can be taken at the federal level without relying on action from the national level.

First of all, the theoretical framework has been built upon two concepts that have a reinforcing connection as it has been shown making these concepts suitable to investigate the desired change. However, the scope of possible actions, which Hamburg could take, is rather limited, which is why most actions are based on voluntary measures thereby making it questionable if that is enough to achieve a truly fundamental change, which is the underlying rationale of TM. Moreover, it might be possible that other concepts in light of the contextual limitations would have led to better results regarding how to steer the desired towards a strengthened CE.

As the research objective pursued a broader CE approach, interviewees covering a wide spectrum of backgrounds and professions have been included. Unfortunately, the timing of the period in which the interviews have been conducted coincided with the summer vacation period in Hamburg, which is why a lot of potential interviewees did not respond or declined the interview invitations. Furthermore, several confirmed interviews have been withdrawn from interviewees returning to their work after their holiday, which is unfortunate as their expertise could have added more depth to the analysis.

It needs to be admitted that the empirical data does not allow for clearly identifying differences within the four key actor groups; also due to the lack of interviewees from some groups. From a retrospect perspective, it would have been valuable to include interviewees from the key actor groups, which have not been included in the four interview groups. However, this was not possible due to practical limitations. Thus, differentiations, e.g. between the B2B and B2C business in the group industry are not regarded in the results, although it is generally acknowledged that establishing CE is easier in the B2C business (INT.B1; Wilts, 2017). Due to this general lack of perspective, it is likely that (i) the named inhibitors constrain the actors within one group in different degrees, and (ii) that there are more inhibitors, which have not been revealed in the analysis but are important for the desired change. A similar statement can be made for the drivers of change, as this analysis is also based on a generalisation of the groups. Since some insights regarding the barriers and facilitators from the TM perspective, also one particularly relevant on the federal level, could have been unravelled nevertheless, this aspect of the scientific relevance is at least partly fulfilled.

Speaking from a hindsight-perspective, more questions targeting the institutional perspective, especially the informal ones should have been included in the interview questionnaires to unravel more specific barriers from a TM perspective. However, the insufficient research body on the matter of institutions in connection to domestic plastic waste, waste management, and CE became visible after analysing the empirical data, which is why the need to do more research on this topic is stressed throughout this thesis. Then again, this lack of institutional insights sheds light on an important weakness of the TM concept in a practical context, which is also part of the scientific relevance: The good operationalisation of the TM concept is dependent on a sound knowledge base regarding

institutions since they are important constituents of the regime and its barriers. However, as shown in this research, this is not always the case.

As previously admitted, the advises to steer action through the TM cycle are rather vague; partly because further specialisation would rely on insights which yet need to be uncovered. Nevertheless, the given advises inspire for action grounded on a broad variety of backgrounds. If these actions will be enough to steer a significant change, cannot be predicted. However, as the trajectory of any transition is arguably never fully predictable, it remains questionable whether more specific advises would lead to a definite success. Thus, it can be concluded that the societal relevance aiming at enabling actions that harvest the social benefits of CE and lower the environmental impacts of plastic waste (CO₂ emission, biodiversity threat), which can be taken independently from the national level by the federal level is also at least partly fulfilled.

Lastly, due to the case study methodology, the possibilities for generalisation of findings are limited meaning that these advises cannot be applied one to one to other German federal states. However, as most advises named in the TM cycle remain rather vague they could be used as inspirations for measures tailored to the respective contextual conditions and desired goals, which is also one of the aspects pursued in the societal relevance.

5.3. Contributions to Planning Theory and Planning Practice

This research unravelled several insights which, in a planning context, have important implications both for practice and theory. From a planning practice perspective, particularly the barriers of (i) complicated legal requirements, and (ii) throwaway society are important as they are novel to the planning field related to waste management and CE. Based on these two barriers it is, firstly, recommended for planners to anticipate the influence of informal institutions in projects related to CE and waste management. As shown in this study, there might be at least one (the throwaway society), which possibly influences how waste prevention is executed. Assuming “that actors' incentives and expectations are shaped primarily [...] by formal rules” would risk “missing much of what drives [...] behavior “(Helmke & Levitsky, 2004, pp. 725-726). Anticipating potential barriers driven through informal institutions is an important prerequisite to react and eventually overcome barriers from informal institutions in planning projects. Secondly, it can be recommended to planners to consider that involved stakeholders might be intimidated by the complicatedness of the existing regulations, which could hamper their willingness to implement innovative measures in the projects. Just as in the previous case, anticipating constraints from the complicatedness is an important prerequisite to react for planners and eventually overcome this, e.g. through taking an educational role to lower the insecurities.

Moreover, as derived from the facilitators, it can be recommended to connect projects in the field of waste management and CE with other favouring developments; for example the economic changes and developments to exploit facilitators. As shown in this thesis, TM offers a suitable perspective to identify other potential facilitating developments thereby offering the possibility to look for other facilitating developments related to the project in question.

Lastly, it can be recommended for planners to actively communicate in CE-related projects to the involved stakeholders that CE is more than just an improved waste management concept to push the rising awareness of the broader CE approach.

Shifting to a planning theory-angle, this thesis has shown that planning issues related to plastic waste management need a broader view including insights from social sciences and other external research fields as most barriers and facilitators would have not been revealed otherwise. Nonetheless, most planning theory related publication regarding (domestic) plastic waste management tend to solely focus on the associated, technical implications. However, considering the impact that the various barriers and facilitators have, as shown in this specific issue, it is important to sufficiently account for them also in planning theory, which holds particularly true for institutions as they are “important for planners because institutions are a critical aspect of everything planners do” (Alexander, 2005, p. 210). Thus, it is recommended to overcome the overly technical focus in planning theory regarding plastic waste management and open up to insights from social sciences, like institutional research, to establish a sound research body and give (theoretical) guidance for planning practice.

Based the insights from this sub-chapter, the guiding research question, and the critical reflection this chapter will be finalised with recommendations for future research

5.4. Recommendations for Future Research

One aspect stressed multiple times throughout this thesis is the need to research more on institutions in relation to domestic plastic waste, waste management, and CE. In particular, such research should contribute to not only identifying the institutions, but also how they relate to each other and the various actors, how these institutions are reinforced, and through which means they could be changed. One potential institution that has been highlighted is the so-called throwaway society, a possible informal institution driving the high consumption especially of cheap, convenient and easily available plastic products and products with a plastic packaging.

Considering the reflection of this study and its criticised aspects, more research should be invested in (i) analysing the differences within the four actor groups, and (ii) investigating the potential of other concepts as alternative to steering change. This recommendation is grounded in the described limitation of this research that no bans or regulations could be considered as the federal level simply lacks the needed authorisation to establish them. Since TM is not the sole concept to guide change and might not be suitable in all cases, it should be examined if other concept might lead to better outcomes, especially in light of the comparably narrow scope of authorisation of the federal or lower levels. Lastly, (iii) doing similar research to this one in other federal German states to overcome the shortcomings of a single case study and derive at a higher degree of generalisation of findings.

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Appendix

Appendix I: Interview Guide

Thema	Fragen	Follow-up Fragen
Warm-up	Wie würden Sie Ihr Aufgabenfeld beschreiben?	-
	Wie erleben Sie - aus Ihrer Erfahrung als [...] - die Wahrnehmung von Plastikmüll und Plastik in Hamburg?	-
Status quo	Was wären aus Ihrer Sicht geeignete Maßnahmen zur Müllvermeidung in Hamburg? Und inwieweit haben Sie das Gefühl, dass diese Maßnahmen in Hamburg existieren?	Falls Probleme: Was sind die Ursachen für diese Probleme? Und welche Hindernisse gibt es, um das Problem zu lösen?
	Wie schätzen Sie die aktuellen Recyclingmaßnahmen ein? Was sollten die Maßnahmen erfüllen, um Erfolg zu haben?	
	Haben Sie das Gefühl, dass die Bevölkerung gut erreicht werden kann bzgl. Abfallvermeidung, Wiederverwendung, etc., dass die bereit sind da mitzuarbeiten oder ist das eher eine träge Rückmeldung?	-
	Inwiefern denken Sie, dass die aktuellen Abfallvermeidungsmaßnahmen, die in Hamburg ergriffen werden oder teilweise schon etabliert sind, das volle Potential abdecken was Hersteller und Händler leisten können in Bezug auf Abfallvermeidung?	-
	Kooperieren Sie in Ihrer Tätigkeit für/als [...] mit anderen Firmen/Organisationen/etc.?	Was sind ihre Erfahrungen mit den Kooperationen?
Change	In einigen Artikeln bzgl. des deutschen Abfallmanagements wird kritisiert, dass es verhältnismäßig nicht genug Innovationen im Abfallmanagement gibt. Ich würde Sie gerne fragen, was Ihre Meinung zu dieser Aussage ist?	Was sind die Ursachen? Und welche Hindernisse verhindern eine Veränderung? Welche Eigenschaften sollten Innovationen oder innovative Projekte haben, um sich etablieren zu können?
	Wie bewerten Sie den Umgang der Politik mit dem Thema Plastik und Plastikmüll ein?	Was sollte sich Ihrer Meinung nach ändern?
	In der Literatur wird hingewiesen, dass wir ein technisch wunderbares Abfallsystem haben, aber das der Plastikkonsum in Deutschland wahnsinnig hoch und dass das ganze Optimieren hier und Optimieren da auf Dauer nicht genug sein wird; Und wenn nur ein bisschen recycelt und den Rest dann thermisch verwertet wird, das wird nicht hinkommen, denn unser „Plastikhunger“ steigt, d.h. wir brauchen immer und immer mehr Plastik. Und wenn dir davon nur ein kleines bisschen recyceln, dann ist das nicht genug und die Kritik ist dann dahingehend, dass die sagen, man sollte das System einfach mal komplett ändern. Und ich würde Sie gern fragen, was Ihre Meinung dazu ist?	Wenn Sie könnten – rein hypothetisch – was würden Sie am System ändern; nicht nur hinsichtlich der technischen Aspekte? Gibt es irgendetwas, wo Sie sagen das ist eigentlich immer ein zentrales Hindernis und das müsste anders werden? Wenn diese Veränderungen, die Sie grade beschrieben haben, umgesetzt werden würden, wie würde sich das auf Ihre Arbeit auswirken?

Appendix II: Lists of Codes

Status Quo	General measures	Recent changes	Frontrunner
	Hamburg-specific measures		Niche activities & experiments
	Attitude towards plastic & internalisation		Normative motivation
	Myth & misinformation		Cooperation
	Throwaway society		Up-scaling
Problems & barriers	Problems related to industry & commerce	Need to act	Window of opportunity
	Problems related to consumers & consumption		Progress in steps
	Problems related to waste management		Political action
	Problems related to politics		Education & awareness
	Path-dependencies & lock-ins		Consumer responsibility
	Hamburg-specific problems		Producer action
Related topics	Marine plastic waste		Inspiration
	Resource efficiency & resource protection		True circulation
	Energy & energy efficiency		
	Sustainability		
	Health		

Appendix III: Full result tables

Table All.1: The various direct inhibitors, which constrain the four identified actor groups

Actor group	Direct inhibitor	Description
Industry	Product design	Most products can only be poorly or not at all be recycled (INT.A2, INT.D1); recyclability or reparability often are less important criteria in decisions regarding product design in comparison to other, economic criteria (INT.A2, INT.D1); many plastic products and particularly plastic packaging are designed for short-term uses (INT.A2, INT.B3)
	Slow Progress	Innovative products in terms of recyclability are often limited to a single product or a single product line (INT.D1), discussions often centre around questions of detail instead of main problems (INT.D2)
Consumers	Poor waste quality	Incorrect waste separation and high levels of pollution (INT.D1)
	High plastic consumption	Extremely high plastic consumption per capita in Germany (INT.D2), focus on re-buying instead of repairing (INT.A2)
	Poor waste prevention	Many consumers do not care about waste prevention and thus do not put much effort into waste prevention measures (INT.A1, INT.B3, INT.C2); many waste prevention measurements are niche activities (INT.D1); plastic products and plastic packaging are often treated as low-value products, whose prevention is due to their lack of appreciation not considered as important (INT.B3)
Waste management	Problem recycling	Only a minor part of the domestic plastic waste can be recycled (INT.D1, INT.D2); recycled plastic is often of significantly lower quality (INT.B3, INT.C2, INT.D1, INT.D2)
	Low levels of innovation	Waste management as a whole is a very inert sector (INT.D2), major innovations are constrained by a large societal innovation barrier; only niche innovations exist (INT.D1)
	Duale Systeme	Are very economically oriented, which leads to low-quality recycled plastic (INT.A2)
Politics	Missing bans and regulations	Lack of appropriate bans and regulations to effectively implement recycling and waste prevention measures (INT.A1, INT.B3, INT.C1, INT.C2, INT.D1, INT.D2)
	Suboptimal and/or complicated legal requirements	Extensive and suboptimal waste separation due to the current waste system, which does not allow for large-scale high-quality recycling plastic of domestic sources (INT.D1), current waste separation and the associated administrative effort is very high for producers leading to high levels of insecurity (INT.B1), current waste separation is too

complex for most consumers to understand (INT.A1, INT.A2, INT.B3, INT.D1)

Table AIII.2: The indirect inhibitors as origins for the direct inhibitors of the actor group industry

Direct inhibitor	Indirect inhibitor	Description
Product design	No recyclability standards	Lack of legal standards and regulations regarding the recyclability of products (INT.A1, INT.D1), which is largely determined by their product design (INT.D1)
	Brand message	Certain effects, colours, etc. are part of the brand message, even though this often leads to products, which are poorly or not at all recyclable (INT.A1, INT.D2)
	Throwaway society	Demand for products, which are designed for short-term uses and are meant to be thrown away instead of repaired (INT.A2, INT.D1), lean production is optimised to quickly dispose waste instead of preventing it (INT.D1)
Slow Progress	Problem resource efficiency	The majority of CE measures taken by the industry are voluntary resource efficiency measures (INT.B1, INT.B2), however, resource efficiency is more complicated and time intensive to implement, which is why it is not often used to its full potential (INT.B1. INT.D2)
	Previous decision and experiences	Producers shy away from developing CE-innovative products if they already made previously negative experiences with such products (INT.D1); other previous, constraining decisions comprise those that lead to technical path dependencies, e.g. buying specific machines that are long-time investments and prevent upgrading to more resource efficient machines if the investment period has not been reached (INT.D2)
	Complicated legal requirements	The constantly increasing documentation obligations as well as frequent changes of these requirements foster insecurities, a lack of information and lead to high administrative expenses (INT.B1)
	Too theoretical advices	Many advices and guidance offered to producers remain at a too theoretical level and thus are often not well translatable into concrete action for many companies (INT.B2)

Table All.3: The indirect inhibitors as origins for the direct inhibitors of the actor group consumers

Direct inhibitor	Indirect inhibitor	Description
Poor waste quality	Suboptimal waste collection	Although the HWT is assessed as a more progressive CE-measure for domestic plastic waste than the average collection form in Germany (INT.A1, INT.A2, INT.B1, INT.D1, INT.D2), the current waste collection system focuses on collecting all forms of plastic waste, which leads to a highly diverse mix of different plastic types and high levels of pollution, which eventually enables predominantly only a poor quality of recycled plastic (INT.D1)
	Waste separation behaviour	High heterogeneity regarding how well waste is separated (INT.A1, INT.A2, INT.C1, INT.D1), which is determined by factors such as education (INT.A2), interest and awareness (INT.C1), and the household structure, such as families with children (INT.A2) or single households (INT.A1); lack of space in certain areas -such as neighbourhoods with a lot of old apartments or the inner city – which restricts the separation of waste (INT.A1, INT.A2, INT.D2); another great influence for insufficient waste separation is the high complexity of plastic waste: the diversity of plastic waste is too complicated for most consumers to comprehend (INT.A2, INT.D1); consumer can only sperate easy things well, such as glass or paper (INT.D1)
	Increasing diversity of plastic waste	Due to the increasing use of multi-layer plastic material (INT.A1, INT.D1, INT.D2) and new material (INT.A1, INT.D1), which are in many cases not recyclable (INT.A1, INT.D1, INT.D2), the composition of waste material is fast changing and impairs the recyclability of domestic waste (INT.D1)
High plastic consumption	Throwaway society	Advertisement and commercials promote predominantly products that should be preferable easy, convenient and favour rebuying over repairing (INT.A2, INT.C1); this is complemented with a supply of such products (INT.A2, INT.C1, INT.C2)
Poor waste prevention	Problem unpackaged	Buying things completely without any plastic packaging takes a lot of effort and time, which is why it is often cumbersome for most consumers (INT.A2, INT.B3, INT.D1); In most regular supermarkets the goods cannot be bought without a plastic packaging (INT.C1)
	Throwaway society	Many waste prevention measures, such as buying things unpackaged or reusable coffee to go cup require planning, which is often rejected by consumers for reasons such as not wanting to be restricted in their spontaneity or lack of time to do so (INT.A1, INT.A2, INT.B3)

Subordinate importance	A lot of consumers are at least partially aware of problematic aspects connected to plastic waste, however, this awareness easily becomes of subordinate priority, when competing with other, subjectively more important issues (INT.D1); no change without other incentives, most noticeably financial incentives (INT.A2, INT.B2)
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Table AIII.4: The indirect inhibitors as origins for the direct inhibitors of the actor group waste management

Direct inhibitor	Indirect inhibitor	Description
Problem Recycling	Problem domestic waste	Domestic plastic waste is highly diverse and polluted, which strongly impair the recyclability (INT.A1, INT.D1, INT.D2); domestic is also often incorrectly separated either due to a lack of understanding as plastic waste is too complex for most consumers (INT.D1) or because consumers refuse to separate waste (INT.A1)
	Technical problems	Inevitable loss of quality in the process of fusing plastic waste into plastic recyclate (INT.D1); multi-layer plastic material or black plastic material cannot be recycled (INT.D1, INT.D2)
	Problem plastic recyclate	Producing plastic recyclate is very expensive and laborious process, which is why plastic recyclate is just as expensive as virgin plastic material; virgin material is favoured by most producers, which eventually leads to many recycling companies becoming insolvent; recycling companies can only recover a few amounts of plastic waste (INT.D1)
	Lack of bans and regulations for production and product design	Currently, there are no bans or regulations regarding what is allowed to produce (INT.A1, INT.D1), which leads to a situation where producers are allowed to produce almost everything, and it's the waste management's responsibility to make sure to be able to deal with all that waste in the most appropriate way (INT.D1); many producers do not well include reparability and/or recyclability in the design process (INT.C1)
Low levels of innovation	Poor information management	Low exchange of information and poor networking within the waste management; amplified by a low transparency (INT.D2)
	Societal innovation barrier	The current waste system has been internalised by the society, which blocks any major changes, although these changes potentially could mean great improvements from a CE-angle (INT.D1)
Duale Systeme	[nothing identified from the interviews]	-

Table AIII.5: The indirect inhibitors as origins for the direct inhibitors of the actor group politics

Direct inhibitor	Indirect inhibitor	Description
Missing bans and regulations	Multilayer governance	Bans and regulations can only be implemented by the national level or the EU-level, but not by Hamburg as a federal state (INT.A1)
	Lobbying	Lobbying in favour for economic interests often prevent stricter regulations or bans (INT.C2, INT.D2)
	Focus on voluntary measures	The national and the EU-level prefer voluntary measures for the industry, such as market based instruments (INT.A1, INT.D1)
	Weak profile of environmental interests	Waste Management, as part of environmental governance, mostly loses when competing with economic interests (INT.A1, INT.C1, INT.D1)
Suboptimal and/or complicated legal requirements	[nothing identified from the interviews]	-

Table AIII.6: The various direct drivers of change and their respective actor groups

Actor Group	Direct Drivers	Description
Industry	Selling goods unpackaged	Within the last 1.5 years, the number of shops selling their goods completely unpackaged has risen from zero to over 50 shops across Germany (INT.B3); furthermore, supermarkets of large supermarket chain are planning to implement an unpackaged section (INT.B3)
	Increasing niche formation	Increasing number of companies are searching for and creating niches to stand out by providing more eco-friendly products, often connected to better CE-measures, such as preparing products, that turned into waste, for reuse (INT.B1)
	Increase in voluntary measures	Increasing number of companies taking voluntary measures related to waste prevention or recyclability both on a local scale (e.g. the cafés that teamed up to give discount when bringing own cup) as well as big companies such as packaging producers
Consumers	Increasing interest in buying unpackaged	The interest by consumers to buy things unpackaged is increasing (INT.B3); increasing number of consumers using the possibility to buy their groceries unpackaged (INT.D2)
	Increasing awareness	The public interest into topics related to plastic waste in general (INT.D1) as well as the public awareness of problems associated to plastics has been increasing in the recent years (INT.D2)
Waste management	Niche innovations	A lot of niche innovations, which are pushed both by the companies as well as the cities, as they are

		the ones responsible for organising the communal waste collection (INT.D1)
	Pet ban in China	Due to China's ban on importing PET flakes in July 2017, PET flakes need to be processed and recycled elsewhere: if recycled in Germany, it might act as a push for plastic recyclate, however, there is also the possibility of exporting the PET flakes to other countries (INT.D1)
	Stadtreinigung Hamburg	The Stadtreinigung Hamburg is regarded as outstanding in many regards, such as investing and implementing in innovations (INT.A2, INT.D1), public relation works (INT.B3, INT.C2), and their general engagement and motivation to address problems in multiple waste streams (INT.D2); moreover, they are also trying to push other niche innovations (INT.D1)

Table AIII.7: The indirect drivers pushing the direct drivers of the actor group industry

Direct driver	Indirect driver	Description
Selling things unpackaged	[nothing identified from the interviews]	-
Increasing niche formation	Partly saturated market	The market is at least partly saturated (INT.B1, INT.D1) to which some companies respond by searching for and investing in niche formation to have unique selling points (INT.B1), often based on more environmentally-friendly measures that go hand in hand with strengthened CE-measures (INT.B1, INT.D1)
Increase in voluntary measures	Umweltpartnerschaft	The Umweltpartnerschaft is a Hamburg-specific platform for a cooperative environmental protection organised by the environmental agency in Hamburg as well as the four large trade associations to support voluntary measures taken by companies that are beneficial from an environmental angle (INT.B1, INT.B2, INT.D2); the initial focus was centred around energy efficiency, but they started to expand and invest into CE and resource efficiency measures also with an explicit focus to address the issues of plastic waste (INT.B2)
	Normative motivation	Topics like marine plastic waste (INT.D2) or intergenerational responsibility (INT.B2) motivate an increasing number of people in companies to take voluntary actions (INT.B2, INT.D2)

Table AIII.8: The indirect drivers pushing the direct drivers of the actor group consumers

Direct driver	Indirect driver	Description
Increasing interest in buying unpackaged	[nothing identified from the interviews]	-
Increasing awareness	Environmental education	Hamburg has strongly invested into environmental education in the recent years to raise awareness in general regarding environmental topics (INT.B1); also pushed by events to Hamburg's EU Green Capital Award in 2011 (INT.D2)
	Marine plastic waste	Plastic litter in the oceans is a topic, which creates a dismay among the consumers (INT.A2, INT.D2); pushed by a wide media coverage in the last years, this topic lead to discussions and fostered awareness surrounding plastic as an environmental threat (INT.D2)

Table AIII.9: The indirect drivers pushing the direct drivers of the actor group waste management

Direct driver	Indirect driver	Description
Niche innovations	Partly saturated market	The market is partly saturated to which some companies respond by searching for and investing in niche formation to have unique selling points (INT.B1), which also creates a demand by companies for specific innovations from the waste management to be able to have such a unique selling point (INT.D1)
	Industry trends	Trends like 'Big data' (umbrella term for a large variety of techniques to collect, store and analyse large quantities of data and associated economic importance; Horvath, 2013) or 'Industry 4.0' (industrial transformation from using computers and automatization to establishing cyber physical systems, Rische et al., 2015) push the usage of innovative waste management measure to be able to adapt and stay competitive (INT.D1)
Stadtreinigung Hamburg	[nothing identified from the interviews]	-