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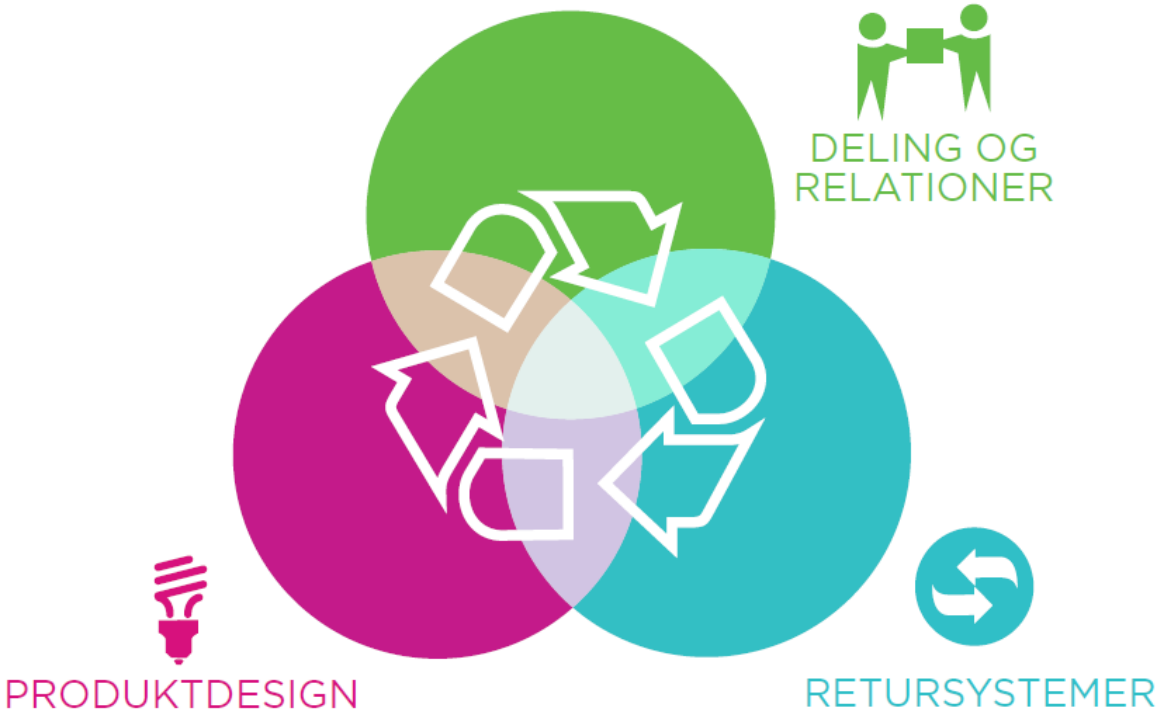

CITIES IN TRANSITION TOWARDS ZERO WASTE: A CASE STUDY OF AALBORG MUNICIPALITY

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Abstract

The World Population is growing in an enormous speed and the biggest part of this growth takes place in cities. Whereas in 2009 around 5 out of 10 people lived in a city, it will be 7 out of 10 by 2050. Cities are centers of resource consumption and follow a linear metabolism by consuming materials and resources and extracting waste and emissions. Facing the enormous growth that is forecasted for cities and the underlying patterns of consumption it becomes obvious that waste and emissions will proportionally increase with this development. Simultaneously to this development it becomes more and more profitable to extract resources from waste as non-renewable resources are facing scarcity.

Cities all over the world start initiatives to increase resource recovery, minimization and avoidance of waste, facing these two big developments. But how can a transition towards Zero Waste be done, as the waste system in our society is complex and also well-established which makes it more resistant to change.

The city of Aalborg in Denmark is approaching this challenge as Zero Waste developments are taking place in different domains in the city-area.

This thesis analyses how Aalborg moves its path towards Zero Waste and how such a transition can be made. To understand how this transition can be managed, transition theories are operationalized and applied to the case of Aalborg to further analyze potentials that could foster the development towards Zero Waste. The underlying research shows that Aalborg addresses mainly a technical approach and focuses very much on changing the structure in the waste system than concentrating more on the societal challenge that Zero Waste incorporates, however promising developments in Aalborg are on its way that can strengthen the transition towards Zero Waste.

Abbreviations

ZW – Zero Waste

TM – Transition Management

MSW – Municipal Solid Waste Management

NV9220 – Business Network in Aalborg-East

NBE – Network for Sustainable Business Development

1. Introduction

It is becoming increasingly difficult to ignore the fact that our linear system of producing products which end up as waste will not only lead to an increasing pollution of our planet but also to decreasing deposits of natural resources. We are producing tons of waste yearly and the rates are increasing. Simultaneously world population gains 1 billion people every 12-14 years, which means a population growth by 200,000 people each day. This enormous growth sets high pressure on resource security (Zaman & Lehmann, 2011). A study of McKinsey and the Ellen Mc Arthur Foundation pointed out that we are wasting every year a potential from material saving at nearly a 3 trillion US-Dollar. This amount of money ends up as waste into incineration or landfill.

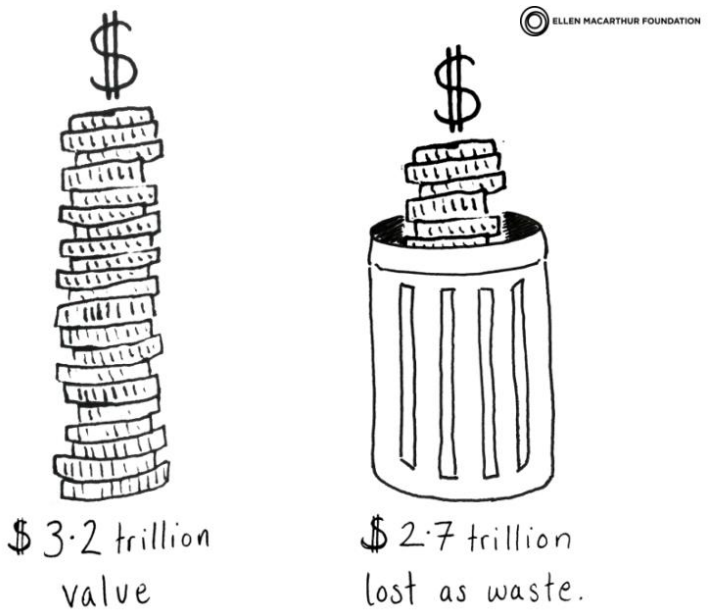

Figure 1 Worldwide yearly product value lost as waste (Source: Ellen MacArthur Foundation, 2014)

Recently, researchers have conducted a number of studies to get a better picture about global resources extraction trends, needs and future stocks (Zaman & Lehmann, 2011). One study by Chris Clugston analyzed non-renewable resources (NNRs) scarcity in the future (Clugston 2010). One essential outcome of the study shows that 88% of NNRs already experienced a worldwide scarcity during the period 2000-2008. A permanent global shortfall will likely be experienced by approximately 23 NNRs around 2030. NNRs like gold, tellurium, tungsten, mercury and cadmium will even have a high probability of a global supply shortfall by 2030 (Zaman & Lehmann, 2011).

"This trends strongly indicates that at the end of the day, we are not about to "run out" of any nonrenewable natural resources; we are about to run critically short of many. This reality will have a devastating impact on our industrial lifestyle paradigm" (Clugston 2010)

Cities will be especially affected by a global resource decline as their nature is not only an over-consuming and over-populated one but they also decline global finite natural resources in an incremental high rate. Poverty and urbanization show a positive relationship, which indicates that expanding cities that strive towards sustainability are an important factor for global sustainability.

If we could manage to shift our resource management towards more reusing, remanufacturing and recycling, we could create a significant job-range. Alone in Europe around 500.000 jobs have been created in the recycling sector (Ellen MacArthur Foundation, 2014). But it is still the question how change can be catalyzed on such a scale?

A sustainable improvement of Waste Management could be an incremental step, to save our resources and to improve the environmental impact of Waste Management systems that mainly rely on incineration and landfilling. A way to do this would be to take waste reuse, prevention, recycling and recovery, but also an improvement of the product design and consumer behavior into focus (EEA, 2013).

Recycling, Reuse and Prevention goals are already integrated in the Environmental policy of the European Union and incorporate a big part in the Europeans Commission's Roadmap on a resource efficient Europe and the EU's Waste Framework Directive. National efforts contribute to the shift up of the waste hierarchy for longer now, which are also driven by other EU legislations like the Landfill Directive.

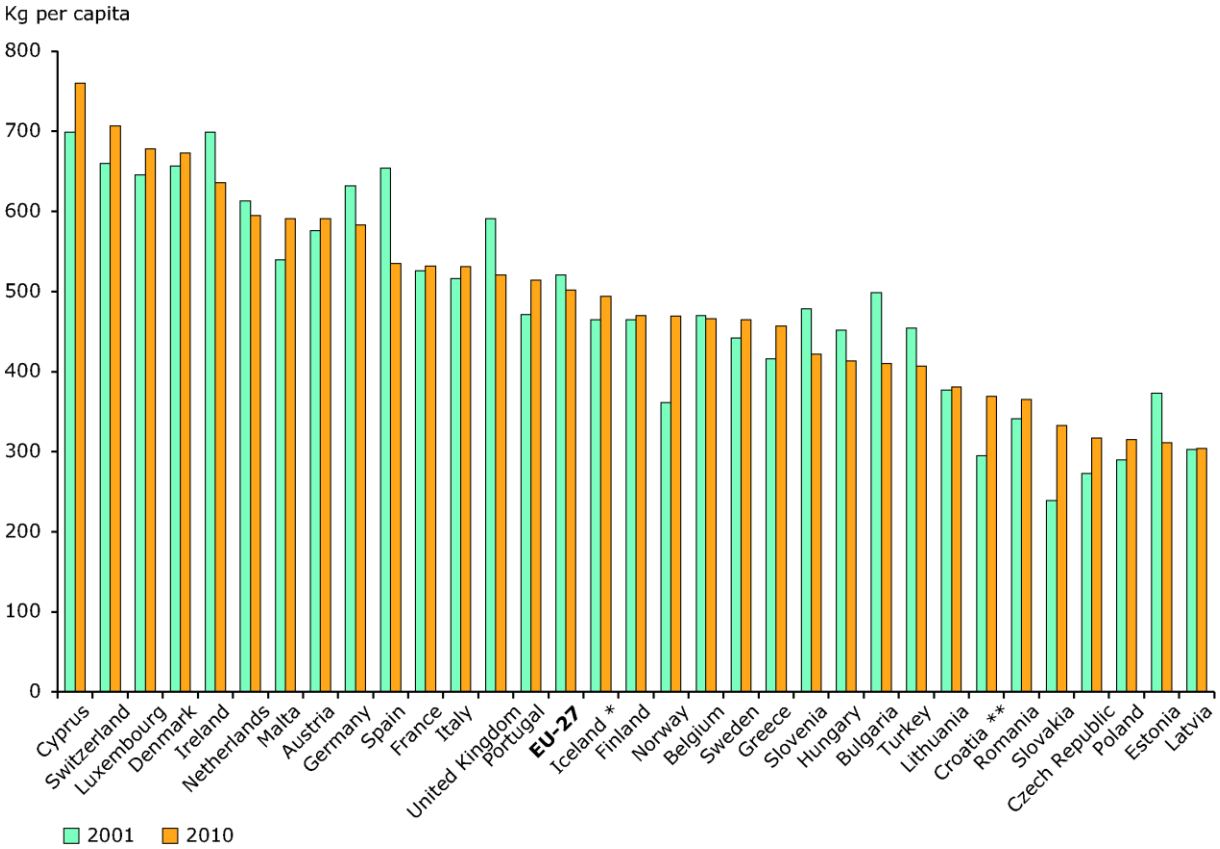

Figure 2 Municipal waste generated per capita in 2001 and 2010 (Source: EEA, 2013)

But even though that the EU launched policies to improve the Waste Management system, there are no trends detectable whether these policies had or have a real effect.

Figure 1 show the waste generated per capita for the 32 countries in the EU in a time span from 2001 to 2010. 21 countries were still increasing their waste amounts over that time and 11 show a decrease. If the figure would be compared for the years 2001 to 2008, only 6 countries decrease their waste generated per capita and 26 countries increased it. This brings up the suggestion that the economic

downturn in 2008 may have caused a reduction of the waste generation. Overall the figure shows a mixed picture and a clear evidence of improved waste prevention across countries between 2001 and 2010 is not detectable (EEA,2013).
An Improvement of our Waste Management combined with a shift in our thinking of how we are producing products will hence be necessary elements of our businesses, if we aim to develop in a sustainable manner. It will not be only the task to introduce and implement new technologies, it is also about changing the way we value resources and the way we are used to manage our resources. This shift faces a societal challenge which requires as well a transition on a societal but also on a technical level.

1.1. The Link between Waste and Urbanization

With industrialization, mankind started to use massive resources of energy and materials which brought up serious problems in the past like material depletion, global warming and enormous waste generation. This topic is not anymore just in the interest of scientists, as it also attracts a high political attention. The interest in understanding the complexity of the relations and feedbacks between material consumption, depletion of resources and urbanization is growing. It has already been proved for some time that there is a positive link between increasing urbanization and waste generation, whereas it is still not fully clear how urban density and form have an impact on resource consumption (Lehmann, 2011).
Over the last hundred years human population on the planet has increased fourfold, while – in the same time period – energy and material use has increased tenfold (United Nations, 2010). The majority of the world's population lives in a city nowadays and the trend is increasing. In 1990, less than 40% lived in a city, but as of 2010, already more than half of all people lived in an urban area. Forecasts assume that by 2030, 6 out of 10 people will live in a city and this will increase to a proportion to 7 out of 10 by 2050. At this time the urban population will almost be doubled, from around 3.4 billon people in 2009 to 6.4 billion in 2050 (WHO, 2014). It is time to rethink our urbanization development patterns facing this enormous growth prognosis. To do this in an appropriate way it is necessary to be aware of the reasons and impacts of urbanization, which principally occur through: growing social disparities, growing demand of resources (water, energy, materials), loss of biodiversity, demographical changes, continuing urbanization processes with an increasing number of rapidly expanding cities and too material and energy intensive productions methods of industry and agriculture (Lehmann, 2011). Urbanization is increasing rapidly and cities already face the effects of our activities in urban life today. Climate change is one of the significant challenges, which is mainly caused by cities, where water, food, energy and materials are consumed to a significant extent and therewith connected to greenhouse gas emissions. But on top of the climate change discussion, urgent challenges about the supply of resources, food, water and materials have come up in the last decades (Lehmann, 2011). Cities will thus have to go through ambitious transitions, which will require a change in structure (physical: infrastructure, supply systems; institutional: new regulations, policies, etc.), culture (sum of shared norms, values, images, etc.) and practices (routines, behavior, implementation and ways of handling)(van Bosch-Ohlenschlager, 2010). This reorganization of new ways of thinking will challenge cities and transition path need to be found to find an appropriate way to manage sustainable urban development.
Industries and communities saw waste as a burden for a long time, which needed to be carried out of sight. However a better understanding of resource depletion and global warming have led to a shift in thinking, that values waste as resource which asks for responsible solutions for nurturing, separating,

collecting, managing and recovering. The concept of a zero-waste life-cycle emerged out of this new thinking and offers answers to the problem of waste and the economic fairytale of endless growth and consumption (Lehmann, 2011). We need to discuss resource recovery and resource effectiveness the same way as we are discussing energy efficiency right now. This also includes strategies of waste minimization and to design products and processes out of waste. Actions can be taken by every municipality or company, in identifying individual solutions. A focus on behavioral change and the need for a more sustainable living has increasingly been articulated over the last years. The current global Municipal Solid Waste production is at around 1.3 billion tons per year and expected to increase to around 2.2 billion tons per year by 2025 (World Bank, 2012). Waste Management emerged to a huge challenge all over the globe and it is time to rethink our common practices to find the most effective way in managing our waste and material streams of cities and urban development. The waste hierarchy diagram is used as a framework for European communities to direct their Waste Management. The pyramid shows on top the most preferable way to manage waste and the at least preferred on the bottom. This pyramid shows however not only a preferred direction of Waste Management, but also the current ways how waste is proportionally treated worldwide. The common way to treat waste is dumping which builds the fundament of the pyramid and the least practiced Waste Management option is reduction. So if this pyramid should be used as a guideline or vision of how a sustainable Waste Management should look like, then the options should be changed in a total opposite way, so that the most preferred option builds the fundament of the Waste Management and the least preferred the peak.

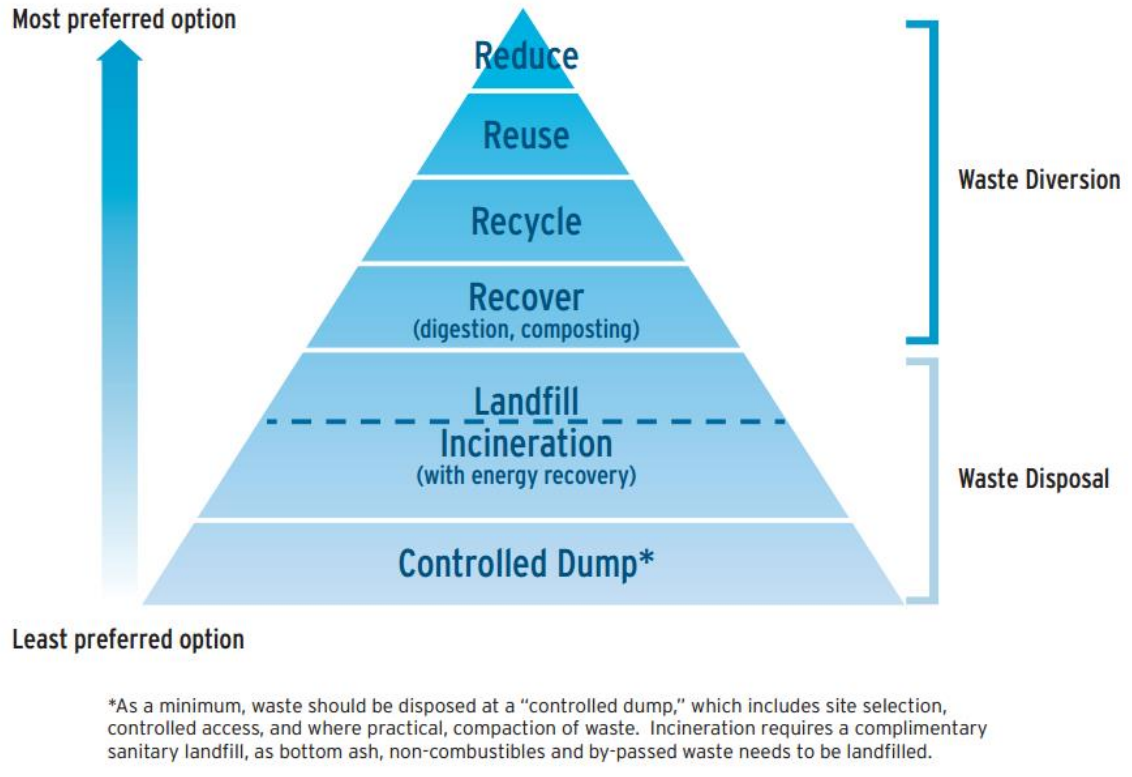

Figure 3 Waste hierarchy (World Bank, 2012)

1.2. Denmark without Waste

In 2014 the European Union published their 7th Environmental Action Plan (EAP) in which they formulated the environmental objectives for 2020. The key 2020 waste related objectives of the 7th Environmental Action Plan (EAP) of the European Union commit to following goals (European Comission, 2014):

- Full implementation of EU waste legislation based on waste hierarchy (prevention/reuse/recycling/energy recovery/disposal)
- Waste generated per capita and absolute waste generation in decline
- Energy recovery limited to non-recyclable materials
- Phasing out landfilling (limited to non-recyclable and non-recoverable) waste
- More systematic use of market based instruments including EPR (Extended Producer Responsibility)
- Strategy to combat food waste and increase composting/biomethanisation

However this action plan needs to be seen as recommendation of the European Environmental agency as it is not formalized in a legal text till now, which will take place by the mid of 2014 (European Comission, 2014).

The Danish government published according to the European policies a new waste strategy in 2013 with the title 'Denmark without waste, Recycle more – Incinerate less', which contains strategies about improvements in waste-treatment efficiencies (The Danish Government, 2013). The new strategy sets the ambitious goal that Denmark wants to recycle 50 % of its household waste by 2022. Till now around 80 % of Denmark's Municipal Solid Waste is incinerated to produce green energy in Combined-heat and power plants. However also a huge amount of resources get lost by incineration, which is why Denmark aims to improve their resource recovery and recycling performance to strive towards a more sustainable Waste Management (The Danish Government, 2013). The strategy focuses to a large extent on household waste and points out the importance of cost-effectiveness and socio-economic adequacy of the new waste separation systems in Danish municipalities. This strategy accompanies 6 initiatives which deal with the following topics:

- *More recycling of materials from households and the service sector*
- *More recycling of materials from waste electronic equipment and shredder waste*
- *From waste incineration to bio gasification and recycling*
- *Better exploitation of important nutrients such as phosphorus*
- *Improved quality in recycling construction and demolition waste*
- *Green conversion – new commercial opportunities*

(The Danish Government, 2013)

More recycling of materials from households and the service sector

The overall aim of a 50% recycling rate of Danish household waste by 2022 is emphasized by this initiative. The government plans to decrease the amount which is incinerated of the household waste, to save valuable resources that can be put back into the economic cycle. A main incentive to achieve this

goal will be to extend the sorting-system by supplying households with bins for plastic and organic waste. The concrete implementation will be carried out by the municipalities and an evaluation of their strategies and achievements will be done in 2016. In general they broach the issue of fee-exemptions to foster incentives for recycling, subsidies for the development of recycling technologies and the establishment of public-private partnerships.

More recycling of materials from waste electronic equipment and shredder waste

Specifically due to rising prices for rare-metals that can be found in several electronic devices, this initiative focuses on an increased recycling rate of these. The greatest recycling potentials lie nowadays in the recycling of electronic waste and energy saving light bulbs. This type of waste has to prevented from incineration as this releases hazardous substances. Denmark aims to to collect 65 % of the electrical and electronic equipment placed on the market by 2018 including 75 % from households. Initiatives focus on partnerships between municipalities and private companies to seek for possible solutions that could increase a waste collection.

From waste incineration to bio gasification and recycling

Denmark has the goal to achieve a fossil-fuel free energy supply by 2050 and sees energy from waste as one important pillar of their energy-mix. It is therefore a goal to achieve a greater efficiency in the incineration sector and to exploit recyclable waste which is incinerated today. The collection of organic waste will be increased and used for bio gasification.

Better exploitation of important nutrients such as phosphorus

80 % of phosphorus from sewage sludge shall be recycled by 2018. Till now 50-55 % of phosphorus in sludge is recycled, which is mostly done by exploitation of phosphorus out of ash from incinerated sludge. Initiatives will be launched that seek for possible ways to recover phosphorus from sewage sludge.

Improved quality in recycling construction and demolition waste

The quality of construction and demolition waste recycling shall be improved by recovering waste in finding new purposed for it. This goal includes initiatives that demand more strict requirements for the demolition of buildings, to get a better overview of the waste contents. Furthermore this goal comprises actions that investigate how different building materials could be treated better and which advantages and disadvantages this would bring with it.

Green conversion – new commercial opportunities

The last goal in Denmarks Waste strategy focuses on the promotion of business opportunities for closed resource cycle innovations and better solutions for Waste Management. This goals include the establishment of knowledge centre for resources which will generate and collect knowledge and experiences about closed resource cycles. Investigations shall take place that analyse how changing consumer behaviour could offer chances for new business models that contribute to a lower resource consumption. Industrial Symbiosis shall further gain more attention among businesses and be promoted around them.

1.3. The Transition Challenge

Approaching ZW is a challenging task. It is not only challenging because of a physical infrastructure change, but also because of the societal challenge which lies on the one hand in established user practices and behavior-patterns that are adapted to the current system and on the other hand on the common assumption that waste is a 'misallocated resource', which is unavoidable and has no value (Hodson & Marvin, 2010). To get a better picture of how such a socio-technical system can be changed it can be one way to look in the past to learn how similar systems had been changed. By looking at some examples it becomes obvious that such a change will take a very long time-span (covering at least one generation) (van Bosch-Ohlenschlager, 2010).

Good examples for this are the change to a railway-system in the USA from the water-channel system or the change from horse-carriages to engine-driven vehicles. In both cases it was mainly the societal challenge like policies and also the willingness of the people, which hindered and pro-longed a change for long time. Convincing power was needed to move this change forward. So the challenge in transitions lies in the development of a new thinking which influences common practices and structures. We often have images and visions in mind how a desirable future should look like, but the real challenge lies in implementing actions and to achieve short-term goals to make this visions become reality. Waste is part of a complex system, which can be seen by figure 4, which only distributes a simplified system of the socio-technical system of solid waste management.

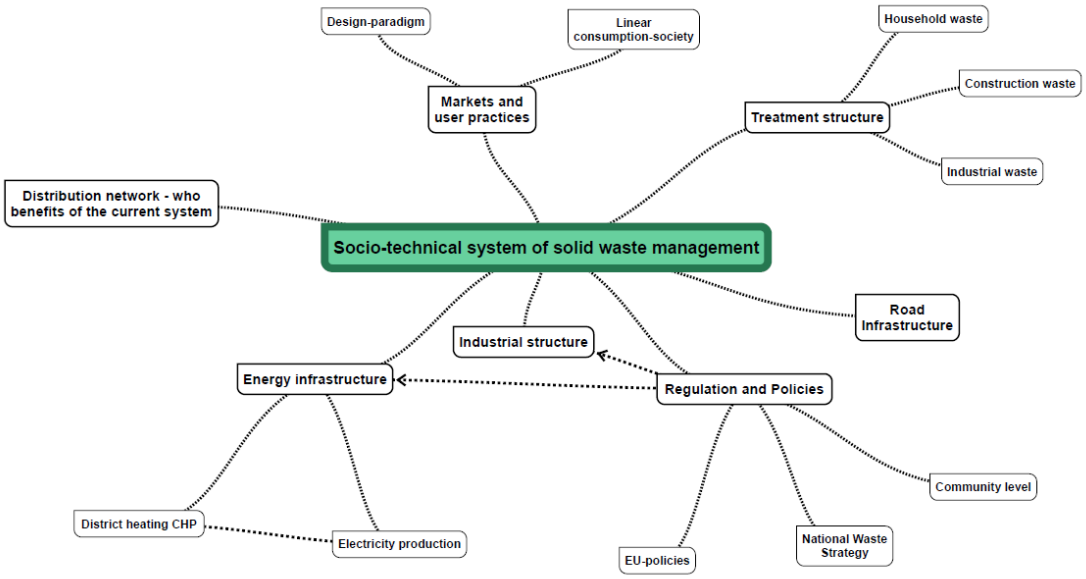

Figure 4 Socio-technical system of solid waste management (inspired by Elzen et al. 2004)

The transition of a city towards a ZW City is a socio-technical change which will necessitate changes in the structure, culture and practices of how waste is managed in a city. Municipalities already address the issue of ZW and first alliances and networks about ZW are established where communities can share ideas and collaborate. As ZW is something unknown and 'new territory', it is also necessary to change the ways how planning and management of a cities' development is approached. Different kinds of experiments have to be carried out that take learning as a central aspect. ZW doesn't need to be started by a certain stakeholder like the municipality or politicians. It can gain momentum on several different

levels. Citizen movements or new business models are as well important for ZW as policies that aim to hinder an incineration and landfilling of waste. However the transition of current waste systems in cities towards ZW will be more successful, when they are also managed and supported in a way that they can exchange common practices and establish a more sustainable system.

2. Focus of the Thesis

To change a waste system in the perspective of ZW lacks a systemic way of understanding which role different stakeholders and global changes play in such a socio-technical transition (Guy et al., 2012). How consumption patterns behavior and waste treatment structures can be changed shall be a focus of this thesis.

The application of Transition Theories provides tools to analyze how a transition towards sustainable development can be achieved and which features it needs to consider. Based on this theory and the concept of Zero Waste it will be possible to identify drivers and barriers of the Zero Waste development in the case and to see points that need to be considered to promote Zero Waste development.

The thesis focuses on the case of Aalborg Municipality, which is a city in Northern Denmark and highly interesting for the topic of ZW, as the Waste Management in Aalborg is like in the rest of Denmark dependent on incineration, which is traditionally considered as a sustainable solution in the municipality as it delivers heat and electricity to the community which highly relies on this supply. With the established district heating system, the incineration of waste constitutes an important pillar for Aalborg's Energy supply (see Appendix 4). Aalborg has to follow the new waste strategy of Denmark and increase its recycling rate for households. Furthermore there are first developments on a business level that aims to achieve Industrial Symbiosis in-between the industries.

The city of Aalborg will be used to analyze how the technological but as well the societal challenge of a waste system transition can be approached. By use of Transition theories it will be elaborated whether existing knowledge could support the journey towards Zero Waste as well as vis-versa.

Taking these points into consideration this thesis focus on the following research question:

How can transition theoretical concepts contribute to the Zero Waste development in Aalborg?

To answer this research question, following sub-questions are formulized:

What are plans and initiatives in Aalborg in terms of "Zero Waste"?
What are the barriers and drivers of "Zero Waste"-initiatives in Aalborg?
Which features of Transition theory can be supportive for the Zero Waste – development in Aalborg?

To analyze the Research and Sub-questions the concept of ZW and the Framework of Transition Management and Experiments will be used to determine the stage of change of the transition in Aalborg and to discuss which features could be supportive for Aalborg's ZW path. The discussion should also give a broader picture about how ZW can be applied in a city and which implications this could have in general for the concept of ZW.

3. Methodological Framework

To answer the research question a methodological framework has been developed. This framework can be seen as a technical approach of the research questions. To analyze how ZW can be approached, a case study has been chosen to become detailed information about actions, barriers, motivations and driving forces of ZW approaches. Within this case study Theories of TM will be used to define the specific changes in the system. The theories function therefore as a template to filter the significant information out of the case study to detect the important facts that are decisive for ZW approaches. Information will be gathered by Literature review of local reports and scientific journals. To get more insight knowledge into the initiatives that are going on in the case study, interviews were conducted with different key stakeholders of the current Waste Management system and the business initiative.

3.1. Theoretical perspective

Theories are used in this research as a methodological tool, to build up a funded construct which will further help to build up the analysis framework and to answer the research question. Three major theories will be used to give a concise picture of the dynamics that are taking place in the case study. The first theoretical stream is a Multi-Level-Perspective (MLP) Analysis. This theory is used to analyze the current Waste Management system in the case, by identifying obstacles, limitations, opportunities and challenges which can be supporting but also hindering for a transition towards ZW. To analyze how the transition towards ZW can be made more effective and goal-oriented, the theory of TM is used. Using this theory it is possible to identify, who should be involved more into the actions that a transition can be made and which steps it has to take in the case study to scale up initiatives so that they can become integrated into common practices. To analyze this more in detail, the concept of Transition Experiments will be introduced, which especially focuses on the approach of societal challenges.

3.2. Case Study

A case-study approach was used to allow a deeper insight into one single incident instead of the creation of a broad and statistical examination. This research conducts an illustrative case-study as the focus of the research question lies on the understanding of what is done and planned in the case. Theories will further be used to analyze how the described processes can be evaluated and what would be supportive that processes in the case could be organized in a different way (Booth et al. 2009).

A case study deals with studies of present phenomena that are embedded in their natural surroundings and offers thus many sources of data collection. By the analysis of real-life contexts it is necessary to take human behavior and opinions into account, which will help to understand why people act as they do (Booth et al. 2009). Therefore data has mainly been generated by interviews, to gain a picture about different opinions and motivations behind the ZW approaches.

As a case study the City of Aalborg in Northern Denmark has been chosen. With the established district heating system, the incineration of waste constitutes an important pillar for Aalborg's Energy supply. The initiatives which are planned by the municipality are therefore very interesting as they give an insight about how a municipality which is highly dependent on one technology tries to move towards ZW and to establish new technologies even though that the existing one seems to be sufficient and satisfying.

3.3. Research Design

The Research-Design helps to get an overview how the research question will be analysed and what will be the expected outcome of the thesis. In the Introduction the problem analysis demonstrated that waste is a problem and that Nations like Denmark plan to direct their development towards Zero Waste. A transition towards Zero Waste is a challenging task and it is the focus of this study to analyze how knowledge on transition management can contribute to the challenging task to move towards Zero Waste. To analyze this question, this thesis focuses on one case to analyze and to discuss the limitations, barriers, opportunities and challenges of ZW. Interviews and a theoretical framework of transition theories are used to answer the research- and sub-questions. The in-deep analysis of this single case will be used to refer in the Discussion part to the question, whether the ZW concept could be a promising concept and how socio-technical systems can be changed.

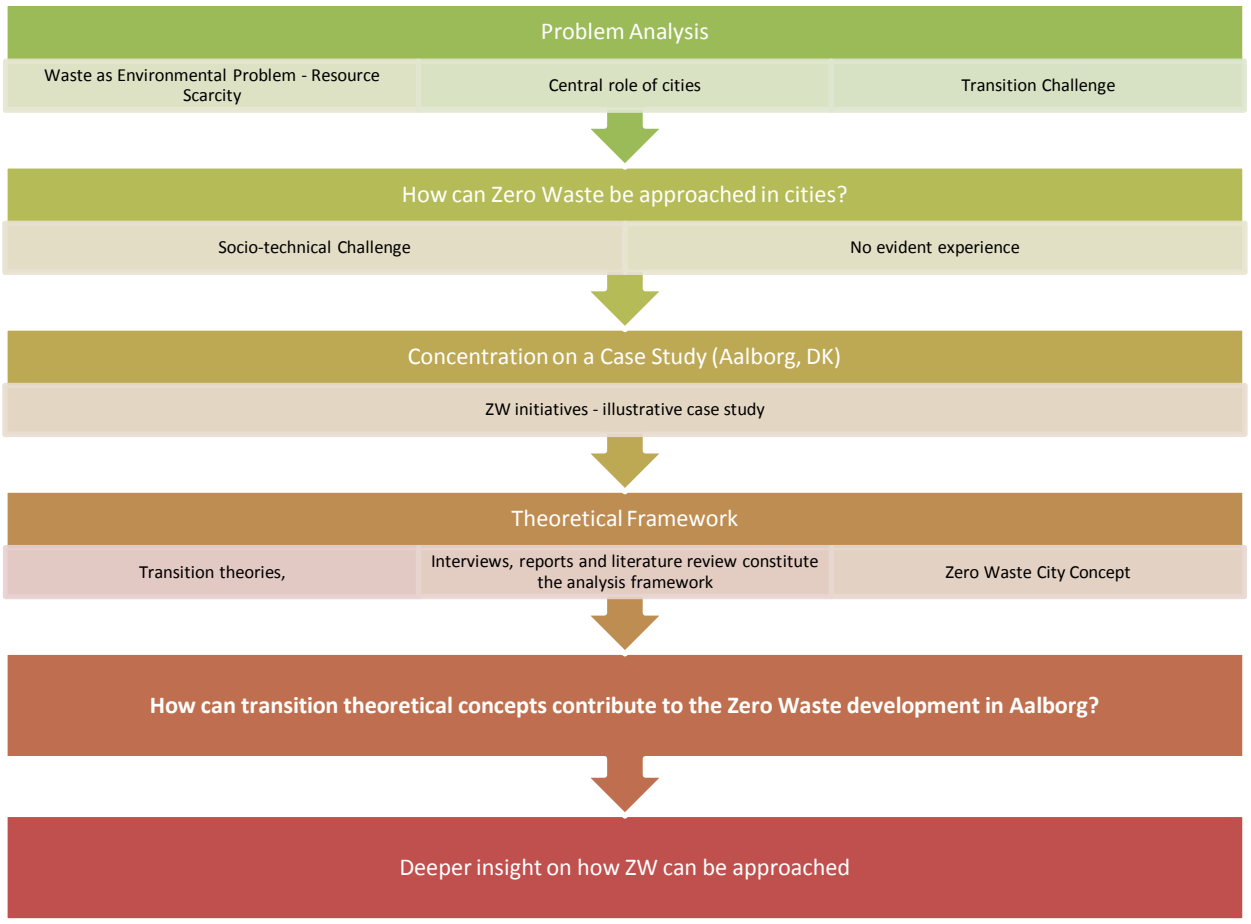

Figure 5 Research Design

3.4. Data Collection

The research question will be analyzed qualitatively, which enables a deep analysis of the mechanisms and structures of the initiatives that are taking place in Aalborg. A qualitative analysis is chosen, because the focus of the thesis lies on the understanding of the different motivations and backgrounds of the stakeholders that are involved or connected in any way to ZW developments in Aalborg. The aim is not to prove that ZW is the right way to go it is the aim to understand how this can be done and what can be supportive.

Document analysis

Literature review is an important data collection method and includes documents like previous project reports, literature studies, scientific journals, information from websites, municipality reports and legal texts. The selection of these documents was taken from libraries, academic databases or by referral of stakeholders. Literature review is the basic methodology to gather data and knowledge which can be used for the foundation of this study. The chosen literature influences the track of this research in a specific way, as these data will play an important role for the analysis. Hence it is important to be aware of the intention and interests of the different publishers of the documents as they influence the gathered information in a certain way (Booth et al., 2009).

Interviews

Interviews were conducted to get on the one hand an overall picture of the initiatives that are going on in Aalborg concerning "ZW" and on the other hand to gather opinions of different stakeholders about the initiatives, to see whether there is an overall interest in this topic or whether this is just promoted by one actor. Following this way, creates a deeper knowledge of what is going on in the municipality and constitutes a picture of the barriers and opportunities that are given through the different plans and ideas of the stakeholders (Booth et al., 2009). The interviews were semi-structured, which allowed directing the interviews on specific aspects which came up during the interviews. It is a part of semi-structured interviews that the interviewer prepares himself with previously acquired knowledge about the concerns and interests of the interviewee (Booth et al., 2009).

Interviews were conducted with following persons:

- Dorte Ladefoged – Aalborg Waste Management department (Aalborg Forsyning Renovation)
- Thomas Lyngholm –Environmental Manager of the Waste Incineration company RENO Nord
- Brian Dalby Rasmussen – Environmental Manager of the Port of Aalborg and Co-Founder of the Business Network 9220
- Anke Sand Kirk - Miljø- og Energiforvaltningen Aalborg Forsyning, Renovation

A non-structured Telephone-Interview was carried out with Lene Marianne Nielsen, who is member of the Business-network for Sustainable Development.

4. Theoretical Framework

This research operationalizes theories as an analysis-tool to see how this knowledge can contribute to the development of the case study. The Theoretical Framework consists therefore out of two theory strands. The First comprises concept of Zero Waste and how it can be applied in a city and the second contains Transition theories.

The Zero Waste concept will be used to have a guideline for the Zero Waste development in Aalborg. With that concept it can be evaluated how far the development in Aalborg meets the principles of Zero Waste. This Analysis will give the chance to discuss what else could be done in Aalborg in terms of Zero Waste.

The second part of the Theoretical Framework is subdivided in Multi-Level Perspective, Transition Management and Transition Experiments. The Multi-Level Perspective is a concept which will not be directly used for the analysis but it builds the basis to understand Transition dynamics and the terms niche-development, socio-technical regime and socio-technical landscape, which are fundamental for the understanding of Transition Management and Experiments. Transition Management and Experiments can be described as application-oriented theories and are used in the analysis to formulate recommendations that would be beneficial for the Zero Waste initiatives in Aalborg.

4.1. Zero Waste and Cities

Denmark's new waste strategy 'Denmark without waste, recycle more – incinerate less' is an important step towards more resource recovery. It gives a picture of how a state can approach the problem of increasing waste amounts and resource scarcity.

The problem about waste is complex and not just of technical nature. Waste is an invention of humankind and only the way how we perceive and define materials makes them end up as waste or goods. To design Waste Management systems more sustainable it needs to challenge the common assumption that waste is a 'misallocated resource', which is unavoidable and has no value. A way to take this challenge is to consider new ways of thinking that concentrate on ideas and concepts that create systems without waste. These ideas and concepts are comprised under the term of 'ZW' which can be in general defined as in the following:

"ZW means designing and managing products and processes systematically to avoid and eliminate waste, and to recover all resources from the waste stream." (Zaman & Lehmann, 2013)

ZW comprises all concepts that deal with circular material flows, reduction of waste and sustainable changes in product design. The scope of ZW covers principles of avoiding, reducing, reusing, redesigning, regenerating, recycling, repairing, remanufacturing, reselling and re-distributing waste resources.

ZW strategies hence encourage not only recycling initiatives but also the restructuring of product design, production and distribution, to prevent emerging waste in the outset. ZW principles focus therefore firstly on the avoidance and reduction of waste by an innovative product design. ZW is a holistic concept and can be applied to any scope.

Cities are especially interesting contexts in terms of ZW, as they are centers of consumption and waste production. Furthermore cities have historically been powerfully shaped of key infrastructural technologies, like waste systems (Guy et al., 2012). Among the established physical infrastructure of a waste system, certain user practices and behavior-patterns developed, which created out of a pure

technical system, a socio-technical system. When ZW is therefore applied and implemented in cities, this could not just lead to an improvement on an urban but also on a global scale.
Zaman and Lehmann applied ZW ideas on a city scale and developed a framework of the different principles that a ZW city should inhabit (compare figure 6). The five principles of the Zero-Waste City concept can help current cities to adapt these ideas and implement them regarding to their local and specific needs.
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Figure 6 ZW City principles (Zaman & Lehmann 2011)

ZW can lead to a change in the metabolism of a city. Current metabolisms in cities are linear, as materials and resources like food, energy and goods are feed in into the metabolism and different kinds of waste come out (see figure 7). Adapting a ZW thinking on a city scale will however lead to a more circular city metabolism as it can be seen in the lower distribution in figure 7. In the circular metabolism the city decreases its dependency on imports as it developed a way to reuse resources in a sustainable manner and also to use the regional hinterland to secure a food supply. This change can be described as an ongoing transformation. This transformation will consist of several transitions within the principles of Figure 6. To manage these transitions it requires a series of holistic strategies based on the five key development principles (See Figure 6) (Zaman & Lehmann, 2013).

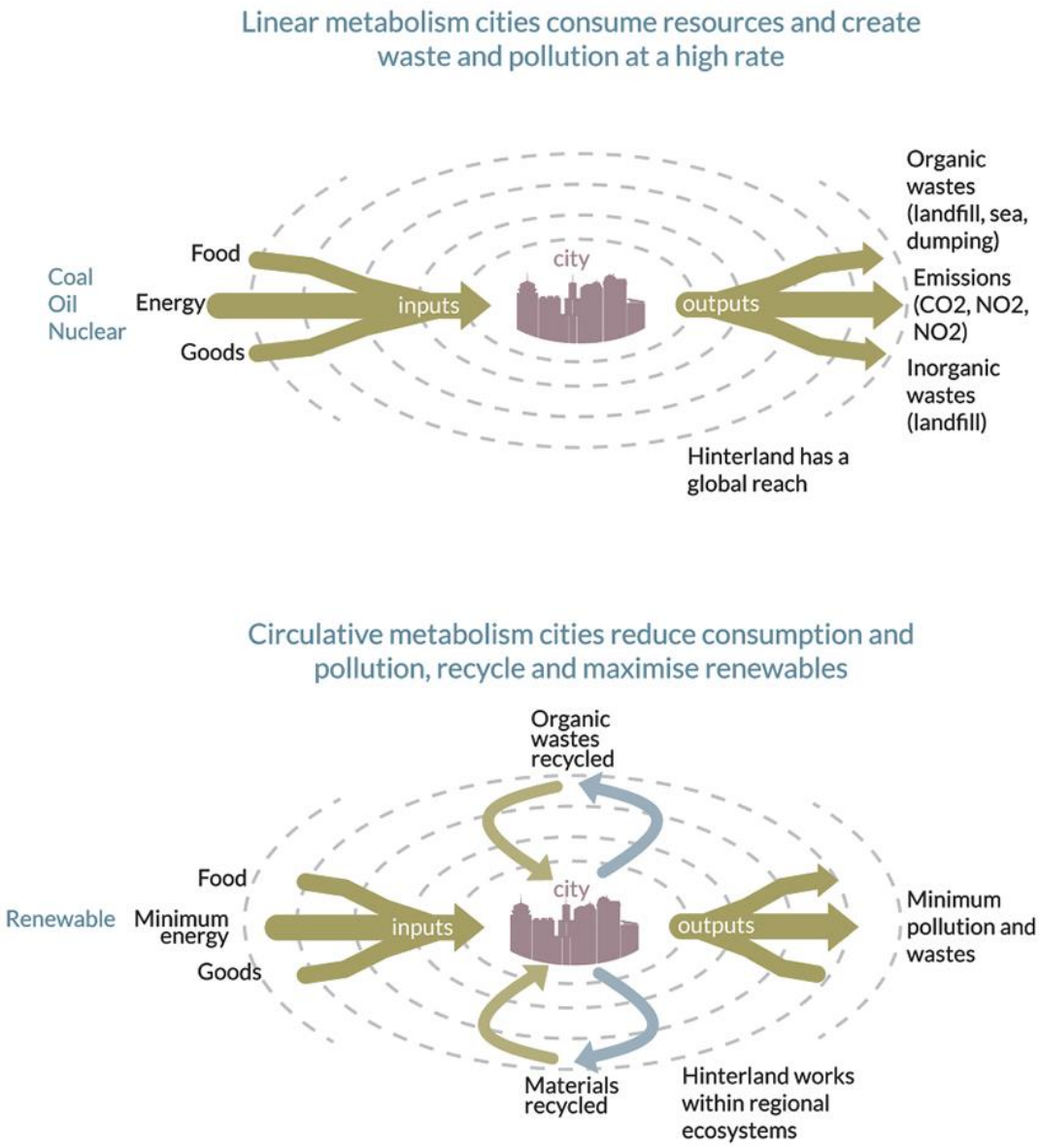

Figure 7 Comparison of a linear and circular city metabolism (Source: Wescape, 2014)

4.2. Transition theory

A Waste Management system can be seen as a persistent problem, which symptoms are becoming more and more apparent. The Problem of Waste Management is deeply embedded in our societal structures which make it complex as it also involves different actors with a variety of diverse interests. This persistent problem cannot be solved by current policies, it requires further institutional and behavior changes. The Problem of Waste Management is related to system failures that are deeply embedded in our societal systems and that for example cannot be fixed by the market or current policies. Such a system failure can also be described as a kind of locked-in flaw (Rotmans & Loorbach, 2009).

"Combating system failures requires a restructuring of societal systems-that is, a transition. A Transition is a radical, structural change of a societal (sub)system that is the result of a coevolution of economic, cultural, technological, ecological, and institutional developments at different scale levels." (Rotmans & Loorbach, 2009)

Obviously it is not easy to direct a Waste Management system in command and control terms. However transition dynamics help to understand how to influence the direction and pace of a transition to a more sustainable direction. Historical transitions haven't led to more sustainable systems, therefore it is important to take the explicit normative orientation of sustainable development into account. Fostering those sustainability transitions is understood as TM (Rotmans & Loorbach, 2009).

The term transition was originally used in evolution theory and describes the impact that different species may exert on each other's evolution. When a change of one species' characteristic occurs due to the change of another species' characteristic, then this can be defined as co-evolution (Kemp et al. 2007).

A transition of a Waste Management system also occurs by several co-evolutions. For example if the way how products are produced or patterns in consumption changes, it will have a direct co-evolutionary effect on the Waste Management system. It is therefore necessary to know how a system is connected to other systems and which effects could occur, if specific actions are taken when i.e. a Waste Management system shall be changed. This requires a deep analysis of the system to understand the existing mechanisms and their relation to each other. It has to be considered that a transition is nonlinear (Kemp et al. 2007):

TM includes thus always a long-term vision with short-term experiments. The process of transition is a long process and can take several-generations. As mentioned before, it is not a linear process and happens in a disorganized process of changes (Rotmans & Loorbach, 2009).

Rotmans stated that when we reach to the point that we understand transitions in societal systems then it would be possible to steer this processes by a TM. In general it is possible to characterize all transitions into four phases (Rotmans & Loorbach, 2009).

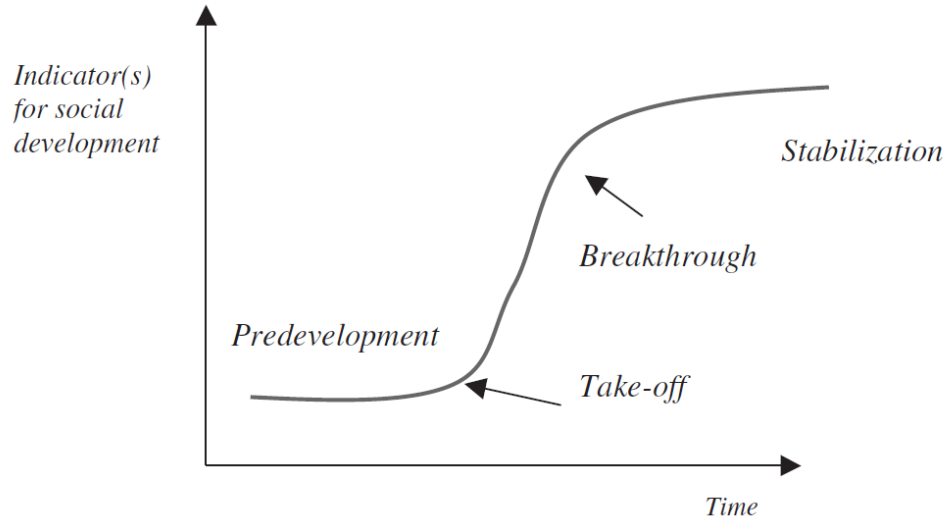

Figure 8 Four Phases of Transition (Elzen et al. 2004)

The four phases can be seen in figure 8, where they are characterized by a S-shaped curve. The different phases are called predevelopment, take-off, breakthrough and stabilization phase. These phases can be understood as follows:

The first phase describes small changes in a system, where actions are mainly taking place on an individual level. Referred to ZW, this phase would describe approaches of businesses and citizens that launch initiatives. The take-off phase already sees a higher level of interaction between actors and considers that a change has already started in the system. This could mean that some businesses already established successfully ZW practices and the topic became more and more on the agenda of politicians. People started to see it as an important topic and doubt whether the current system of how we handle our resources and goods is the right one. A visible change of the system is described as breakthrough phase. Legislations have already been set that require a development towards ZW and demand a similar development of businesses. A system change is inevitable at this point. The stabilization phase is characterized by a decrease of disorder and the establishment of the new system (Kemp et al. 2007). A more detailed description and explanation of these four phases will be undertaken in the next sections.

4.2.1. Multi-Level-Perspective

A system analysis helps to see the dynamics of a transition, which could identify main obstacles, important actors and niche developments, which are crucial for a transition process. To understand how a system like the Waste Management system can be changed it is important to analyse the system in a holistic view (van Bosch-Ohlenschlager, 2010). The MLP gives a broad framework to analyse how a current system is working and which movements and developments outside of this system could influence the current one. This perspective is therefore a helpful tool to use it on a transition perspective. The MLP uses three analytical levels to analyse a transition: The first level is "niches" which describe the locus of radical innovations. The second level which describes the current and consisting system is called socio-technical regimes and can further be defined as the *"the locus of established practices and associated rules that stabilize existing systems"* (*Geels, 2011).* The third analytical level is defined as socio-technical landscape and can be seen as exogenous developments. These three level can further be defined in terms of stability of number of actors and degrees of alignments between the elements. The "highest" level is therefore represented by the landscape and the lowest by niche development. For a TM, the regime level is of primary interest as transition is defined as change from one regime to another (Geels, 2011).

"The niche and landscape level can be seen as 'derived concepts', because they are defined in relation to the regime, namely as practices or technologies that deviate substantially from the exisiting regime, and as external environment that influences interactions between niche(s) and regime." (Geels, 2011)

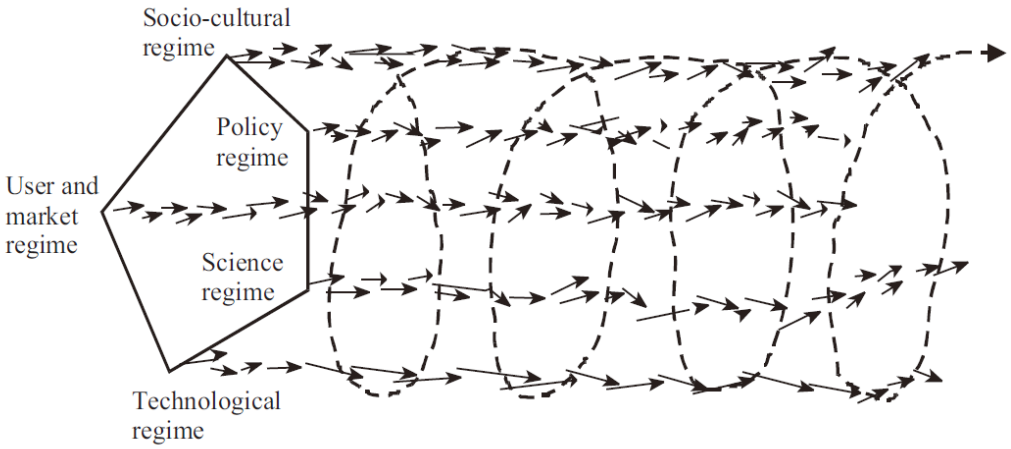

Figure 9 Alignment of ongoing processes in a socio-technical regime (Source: Geels, 2011)

Socio-technical regime

"The socio-technical regime forms the 'deep structure' that accounts for the stability of an existing socio-technical system." (*Geels, 2011)*

It describes the predominant technologies that are used and integrated into a societal system. In terms of Waste Management this would be for example incineration, landfilling and partly recycling. But of course the problem of current Waste Management systems today is not only the treatment process. It is more complex and linked to a society's behavior, production patterns and policies. In this regime, rules are set by actors but these rules also guide and direct those actors in their behavior. Examples of such rules are shared beliefs and cognitive routines, favorable institutional arrangements and regulations, capabilities and competences, lifestyle and user practices, and legally binding contracts. Innovation occurs incrementally in a socio-technical system and leads with small adjustments to stable trajectories, which characterizes existing regimes by lock-in. This lock-in cannot only be observed in technology trajectories, but also in political, cultural, scientific, industrial and market dimensions. The different dimensions interpenetrate each other and coevolve (see figure 9), even though while politics, markets, science, technology, cultural meanings and user preferences have their own dynamics. These alignments between the different sub-regimes can make a system more stable but it can also lead to tensions (Geels, 2011).

Niches

The term 'niches' refers to a *"societal subsystem which can be understood as a (local) constellation of culture, practices & structures that deviate from the regime" (van den Bosch& Rotmans, 2008)*

Niches are 'protected spaces', that can either be subsidized demonstration projects, or small market niches, where emerging innovations can take place and be supported by users with special demands and the willingness to support these innovations. Niche actors (such as entrepreneurs, start-ups, spinoffs) focus their business on radical innovations that differ from existing regimes. They hope that they could somehow achieve a break-through into the regime level and that their novelties could thus replace existing systems or technologies. That is not an easy task as the regime-level can be very stable and some systems are even characterized by lock-in mechanisms. Niche-novelties are also facing the fact that they

are mismatching with existing regime dimension like infrastructure, consumer practices or regulations. Niches provide the seeds that are crucial for a transition as they can initiate a systemic change. Three core processes can be identified in total, that characterize niche development (Geels, 2011).

• *"The articulation (and adjustment) of expectations or visions, which provide guidance to the innovation activities, and aim to attract attention and funding from external actors.*
• *The building of social networks and the enrolment of more actors, which expand the resource base of niche-innovations.*
• *Learning and articulation processes on various dimensions, e.g. technical design, market demand and user preferences, infrastructure requirements, organisational issues and business models, policy instruments, symbolic meanings."*

(Geels, 2011)

The more the networks in a niche development grow (the participation of powerful actors may have a crucial effect in conveying legitimacy and the supply of resources to niche-innovations) and the more the expectations become accepted, the more the niche will gain momentum and increase the possibilities for an integration or even replacement of established mechanisms and systems (Geels, 2011).

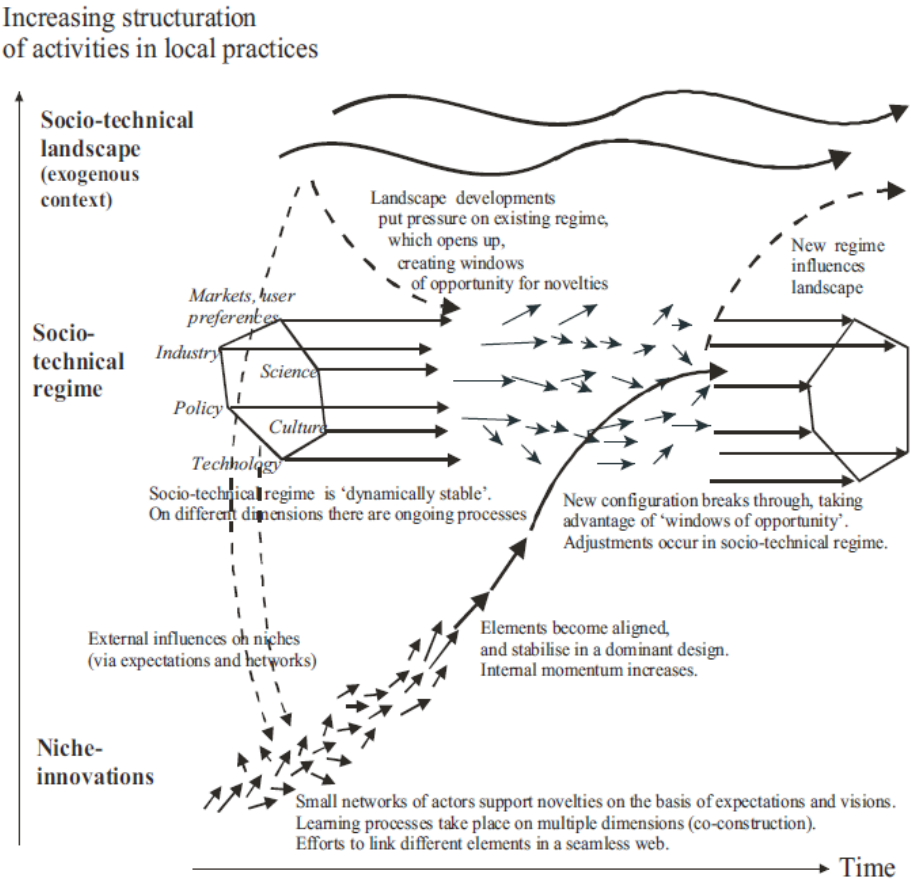

Figure 10 Multi-level perspective on transitions (Source: Geels, 2011)

Socio-Technical Landscape

The socio-technical landscape depicts the wider context, which has an influence on regime and niche dynamics. The landscape level includes not only the material and technical backdrop that a society sustains but also political ideologies, societal values, demographical trends and macro-economic patterns. These factors can be combined as one category within a single landscape, as they form an external context, which cannot be incfluenced by regime or niche levels in the short run. Due to this, the landscape level only changes slowly. An ideal-typical representation of how the three levels interact can be seen in Figure 10. Even though that every transition is context-related and unique, it is possible to identify a general dynamic pattern, which results out of the dynamic interaction between processes at different levels.

a) *"niche-innovations build up internal momentum"*
b) *"changes at the landscape level create pressure on the regime"*
c) *"destabilization of the regime creates windows of opportunity for niche innovations"*

(Geels, 2011)

The figure shows further in more detail which processes come along during the predevelopment, take-off, break-through and stabilization phase (compare section 4.2).

"An important implication is that the MLP does away with simple causality in transitions. There is no single 'cause' or driver. Instead, there are processes in multiple dimensions and at different levels which link up with, and reinforce, each other (circular causality')." (Geels, 2011)

4.2.2. Transition Management Framework

Loorbach and Rotmans developed a TM framework for complex system terms which consists of the following six steps:

Table 1 TM Framework (adapted from Rotmans & Loorbach, 2009)

1. Stimulate niche development (emergence, variation) at the micro level and try to interconnect niches with the same direction. In the TM framework, one does this by establishing and organizing a transition arena, a quasi-protected area for frontrunners (niche players and change-inclined regime players).
2. Try to find new attractors for the system by developing a sustainability vision and derived pathways at the macro level that can act as guidance for niche development.
3. Try to stimulate the formation of niche regimes by creating coalitions and new networks around the transition agenda and the different pathways.
4. Create diversity by setting out transition experiments that are related to specific pathways onto the vision.
5. Select the most promising ones that can be scaled up to a higher level as you learn from these experiments and develop an up- scaling strategy.
6. Try to further modulation between the micro and macro levels (coevolution) by adjusting the vision, agenda, and coalitions, if necessary, by monitoring and evaluating (analyzing patterns and mechanisms) the TM process, after which the cycle starts again.

Figure 11 shows a cycle of TM as a sequence of steps. In the real world there is however no fixed sequence of steps for a TM. The steps often differ in importance in each cycle. TM activities can be carried out in practice in parallel, random, partially and completely sequence. The overall effect of TM is to create a space for frontrunners, who can use this space to form new coalitions around transition arenas and drive their activities in a desired direction. The new build coalitions and networks develop a movement which puts societal pressure on regular policy. Content related activities like integrated system analysis, agenda building, envisioning and experiment are linked to process related activities like network and coalition building, execution of experiments, and process structuring. This framework determines which preferred actor shall be involved and instruments (Rotmans & Loorbach, 2009). Figure11 shows the four activity clusters, which will be described more in detail below:

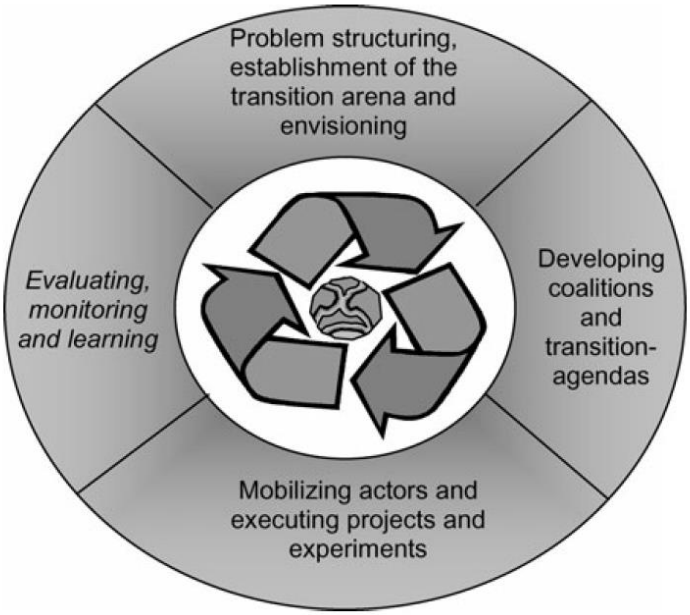

Figure 11 The Transition Management Cycle (Rotmans & Loorbach, 2009)

Integrated Systems Analysis and Actor Selection

Every TM process builds upon an integrated system analysis and uses it as a basis for discussion and debates. This analysis will give a variety of actors insight into the complexity of the system by providing an overview of the connected subsystems, causal relations and the nature of structural problems. Based on this knowledge it is possible to discuss visions, strategies and actions. Furthermore such an analysis helps to identify the main actors who have got a decisive influence on the system in a conservative and innovative way and supports the selection of participants for the transition arena (Rotmans & Loorbach, 2009). The selection of participants is essential and it is recommended to select the participants according to specific criteria and competences. Participants need to be frontrunners and visionaries and they have to have the ability to think out-of the box and to work themselves easily into foreign domains (Rotmans & Loorbach, 2009).

Problem Structuring and Envisioning: Establishment of a Transition Arena

The transition arena can be seen as a protected space which is best comparable to a virtual network, that builds the fundament for an experimental environment in which the participants use collaborative learning as a tool to aquire new knowledge and understanding, which brings up new insights and perspectives about the transition issue (Rotmans & Loorbach, 2009).

Support by political actors or regime powers is vital for such a transition arena, but it is important that these arenas are not dictated by them. Rotmans and Loorbach suggest that in general, there will be around 15 to 20 frontrunners involved in the initial phase of a transition arena, whereas over time only around 5 will align to a core group. The arena offers the fundament for indepth discussions, which are synthesized by facilitators, who work these discussions towards convergence of perspectives, assumptions and ambitions (Rotmans & Loorbach, 2009). In summary a "*transition arena develops a shared understanding of the persistence of a problem at the level of a societal system, the necessity of a transition or radical change, and the definition of the challenge this poses." (Rotmans & Loorbach, 2009)*

The keyoutcomes of a transition arena are a new shared perspective; a definition of the common and leading principles for the envisaged transition; and a common language to discuss the transition. Furthermore individuals may better understand the complexity of their environment, which could make them realize that they can have an influence on a small scale (Rotmans & Loorbach, 2009).

Development of Sustainability Images, Pathways and a Transition Agenda

Transition images represent the guiding principles of the wished transition and need to be appealing and imaginative, to catch the attention of stakeholders and involved actors to inspire and guide them for short-term action. A common and inspiring image on the transition goals are useful for the mobilization of social actors as these images create a consensus among them and evolves over time as new insights emerge. The adjustment of the transition images is constantly influenced by the learning process of the involved players in transition experiments (Rotmans & Loorbach, 2009). "*The transition process is thus a goal-seeking process, in which the transition visions and images, as well as the underlying goals, change over time." (Rotmans & Loorbach, 2009)*

The most feasible, innovative and promising visions and images will be chosen by the actors in the transition process. In general a transition agenda consists out of three objectives, which are content, process and learning related. Even though that the guidelines for transition agenda evolve out of transition images, visions and objectives, it is the transition agenda itself that gives the direction for the frontrunners, on which they can rely during their search and learning process (Rotmans & Loorbach, 2009). Transition images comprise multiple transition pathways that show a variety of possible options and ways.

Initiation and Execution of Transition Experiments and Mobilization of Actors

When a transition agenda is set up including vision, pathways and images; transition experiments can be launched that are related to existing activities or combined with them.

"Transition experiments are high-risk experiments with a social learning objective that are supposed to contribute to the sustainability goals at the systems level and should fit within the transition pathways." *(Rotmans & Loorbach, 2009)*

Solid criteria have to be formulated to select experiments and to make them mutually coherent. An essential point to consider is to measure the experiments and projects via certain criteria to ensure that they meet the sustainability goals and also to see whether particular experiments reinforce other experiments, which could bring up synergy effects. Measuring and monitoring the experiments shall answer following questions (Rotmans & Loorbach, 2009):
Are niches identifiable that could scale up the experiments? What is the relation of the regime toward these niche experiments? The aim is to construct a portfolio of transition experiments that contribute to the sustainability objectives and reinforce each other in a significant and measureable ways. These experiments give the fruitful chance to involve actors, who are normally not involved into long-term issues like: consumers, businesses citizens, local groups, and so on. The involvement of frontrunners is as well an essential issue (Rotmans & Loorbach, 2009).

Monitoring and Evaluating the Transition Process

To ensure a continuous learning process in transitions, it is important to implement a monitoring system. Rotmans and Loorbach distinguish hereby between a monitoring process of the transition process itself and a monitoring of the TM. An in question attendance of the physical changes in the system is needed, when the transition process is monitored, to identify slowly changing macro-developments, seeds of change, movements of individual and collective actors at the regime level and fast niche development (Rotmans & Loorbach, 2009).
The Monitoring of TM involves by far more different aspects. First, the actors who are involved within the transition arena must be monitored with regard to their networking activities, responsibilities, behavior, alliance forming, activities, instruments and projects (Rotmans & Loorbach, 2009). All actions, projects, goals and instruments that have been agreed on in the transition agenda need to be monitored. The experiments that are carried out need to be monitored under the consideration of a specific knowledge, which focuses on a learning aspect and on the question how these experiments could be scaled up to a higher level. Finally, a monitoring of the transition process itself must take place to identify barriers, the rate of progress and the points that need to be improved (Rotmans & Loorbach, 2009). Considering and evaluating these monitoring aspects in the different phases could lead to a process of social learning which is influenced by the interaction and cooperation between the involved different actors (Rotmans & Loorbach, 2009).
All four activity clusters include network and coalition formation of vital importance. The transition arena is a creative space in which new coalitions, partnerships and networks can create a new way of thinking together. Coalitions emerge mostly around transition pathways or around specific subthemes or experiments, where sub-arenas arise.
"The very idea behind TM is to create a societal movement through new coalitions, partnerships, and networks around arenas that allow for building up continuous pressure on the political and market arena to safeguard the long-term orientation and goals of the transition process." (Rotmans & Loorbach, 2009).

4.2.3. Transition Experiments

One tool that has been described in the TM framework will be elaborated further as it constitutes an useful instrument for facing societal challenges like they are given by a transition towards ZW. In the TM language this tool is named 'Transition Experiment' and is defined as *"an innovation project with a societal challenge as a starting point for learning aimed at contributing to a transition." (van Bosch-Ohlenschlager, 2010)*

An innovation experiment takes in contrary a technological challenge as a starting point and aims to contribute to solutions to address this challenge. To understand the difference between both experiments it will be demonstrated among the three concepts of Societal Challenge, Innovation and Learning how these two ways of experiments differ.

Societal Challenge

A societal challenge describes a question that is related to a persistent societal problem, like how to challenge the common assumption that waste is a 'misallocated resource', which is unavoidable and has no value. Because of the complexity of this question it is not possible to address this by a classical innovation experiment as this starts with a clearly defined and well-structured problem or in most cases it already has got possible solutions (van Bosch-Ohlenschlager, 2010). But solutions for persistent problems like the Waste Management of a city cannot be found by following the dominant ways of thinking. New directions for solutions have to be explored that are guided by a challenging question.

Innovation

The second central concept of a transition experiment is 'Innovation' (van Bosch-Ohlenschlager, 2010). A transition experiment is a kind of innovation experiment with the difference that the innovation in transition experiments is understood as a system innovation. System innovations can be defined as *"organization-transcending innovations that drastically alter the relationship between the companies, organisations and individuals involved in the system." (van Bosch-Ohlenschlager, 2010)*

The system is understood in terms of ZW as the Waste system and a system innovation would not just lead to the establishment of a new treatment technology but even more to a change in the way how we handle the sorting or management of resources that we cannot use anymore. In closed-loop- design practices it is often talked about shift from a consumer- to a user-level (Ellen MacArthur Foundation, 2014). Transition experiments take place at a smaller scale (i.e. municipality, neighborhood, several organizations) and experiment radically new ways to fulfill a societal need in a sustainable way (van Bosch-Ohlenschlager, 2010).

Learning

The third central concept of Transition Experiments is 'Learning'. Learning is an active or interactive process, which aims to obtain and develop new competences, knowledge or norms and values (van Bosch-Ohlenschlager, 2010). In terms of a transition experiment the learning process defines further *"a process in which multiple actors across society develop new ways of thinking (culture), doing (practices) and organizing (structure)." (van Bosch-Ohlenschlager, 2010)*

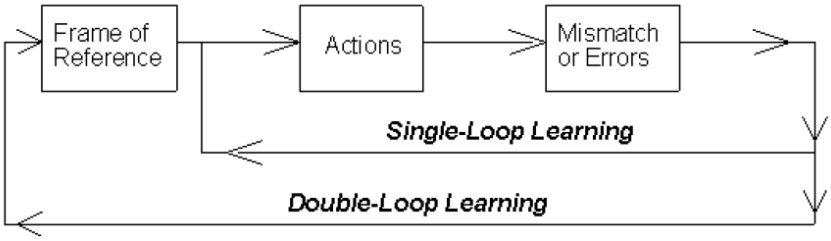

Figure 12 Second order or double-loop learning (van Bosch-Ohlenschlager, 2010)

Transition experiments enable high quality learning, because these experiments aren't carried out in protected spaces like a laboratory, but they are practiced in a real-life societal context. The Learning process in Transition experiments are 'broad', which means that learning takes place about many dimensions (i.e. socio-cultural, institutional, technological, economic, environmental) and the relation in-between those. Learning in these experiments is furthermore 'reflexive', which is necessary to change the course of an experiment if i.e. social values question the implementation of an innovation. The importance of 'social learning' is especially emphasized in a transition perspective. Social learning is "*a process in which multiple actors interact and develop different perspectives on reality. In Transition processes social learning is specifically aimed at 'reframing', changing the 'frame of reference' and perspective of actors involved." (van Bosch-Ohlenschlager, 2010)*

The process of reflexive and social learning is also understood as double-loop learning (compare figure 12). Double loop learning changes the whole frame of how a societal challenge is addressed in a transition experiment. This type of learning can change the whole experimental structure and also guide it in a total different direction.

This type of learning is seen as a distinctive characteristic of innovation and transition experiments. A summary of all distinctive characteristics can be seen in table 2.

Table 2 Distinctive characteristics of transition experiments (adapted of van Bosch-Ohlenschlager, 2010)

	Classical Innovation Experiment	***Transition Experiment***
Starting Point	Possible solution (to make innovation ready for market)	Societal Challenge (to solve persistent societal problem)
Nature of Problem	A priori defined and well-structured	Uncertain and complex
Objective	Identifying satisfactory solution (innovation)	Contributing to a transition (fundamental change in structure, culture, practices)
Perspective	Short- and medium-term	Medium- and long-term
Method	Testing and demonstration	Exploring, searching and learning
Learning	1st order, single domain and individual	2nd order (reflexive), multiple domains (broad) and collective (social learning)
Actors	Specialised staff (researchers, engineers, professionals, etc.)	Multi-actor alliance (across society)
Experiment context	(partly) controlled context	Real-life societal context
Management context	Classical project management (focused on project goals)	TM (focused on societal transition goals)

In Transition Theories three mechanisms are identified that can contribute to sustainability transitions within Transition Experiments. These three mechanisms are defined as deepening, broadening and scaling-up and will be explained in the following, to demonstrate how sustainability transition can be achieved theoretically.

Deepening

The mechanism of deepening is defined as "*a learning process through which actors can learn as much as possible about a transition experiment within a specific context." (van Bosch-Ohlenschlager, 2010)*

The concept of deepening shouldn't be confused with the process of a very deep and narrow learning it is more connected to the types of learning that have been explained above. The learning in Transition experiments should be characterized by broad, reflexive and social-learning. These types of learning should help the actors in a transition experiment to shift the dominant local way of thinking, habits and routines, shifts in doing things, values and perspectives and a shift in organizing the economic, institutional or physical context (van Bosch-Ohlenschlager, 2010).

The notion that *"structure produces behavior and changing underlying structures can produce different patterns of behavior" (van Bosch-Ohlenschlager, 2010),* can be interesting for the case of Aalborg as the Municipality debates about the introduction of a financial reward system for the citizens, which offers them the possibility to pay a smaller waste-fee when they also produce less waste. The concept of 'deepening' can show in a Transition experiment how such a reward system would affect the actors and how it would change common practices. It has to be considered that the learning processes in Transition Experiments are contextual and the same experiment in another societal, institutional and physical context will have at least a partially different outcome (van Bosch & Rotmans, 2008). It is therefore necessary to carry out Transition Experiments in different contexts to learn as much as possible about the societal challenge (van Bosch-Ohlenschlager, 2010). It is useful to distinguish between niches, which was explained in section 4.2.1 and Transition experiments, to understand the role of learning in transitions better. The circular economy or Industrial symbiosis thinking that takes place in different countries worldwide can be seen as a niche development for example. Businesses in Aalborg are experimenting with Industrial Symbiosis initiatives, which aim to foster the collaboration in-between the companies in sharing their resources and wastes to lower the overall environmental impact. This Experiment can therefore foster the niche development and strengthen the global niche of circular economy thinking. On the other hand the existence of the Industrial Symbiosis-niche is very important as it facilitates the experiment(s), by sharing knowledge for example. In general it can therefore be said that niches facilitate Transition Experiments and Transition Experiments that take place in niches enable niches to develop and grow (van Bosch-Ohlenschlager, 2010). How it is possible for niches to grow and to lead to a regime-shift will be explained by the next two mechanisms.

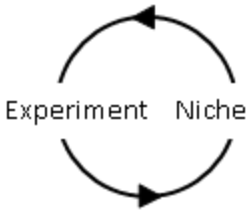

Figure 13 Duality of niches: niches make transition experiments possible and at the same time experiments also create or reinforce niches (van Bosch & Rotmans, 2008)

Broadening

'Broadening' refers to conducting experiments in different contexts. This *"relates to the notion that different experiments that exist simultaneously can build on each other over time and gradually add up to an emerging field or community" (van Bosch-Ohlenschlager, 2010)*

But it is important to no note that this doesn't mean that the same experiment is just carried out in different contexts without further variation. Each experiment is still individual and a new adventure (van Bosch & Rotmans, 2008). Thus the mechanism of broadening creates knowledge how new ways of thinking and practices can be implemented in a real-life context, which will strengthen on the one hand the niche development and will also give the niche development more attention by the existing regime and open up windows of opportunities to scale-up the niche into the regime level. *"In other words, through broadening new application domains or functions for a transition experiment or a societal subsystem are explored" or "the functioning of a societal subsystem is broadened" (van Bosch-Ohlenschlager, 2010)*

With that broadening helps to develop innovations in a variety of contexts, before new practices can break through in the mainstream context. 'Deepening' which will gain knowledge about the content of a transition issue in a Transition experiment can lead through 'broadening' of the 'deepened' knowledge in different contexts to a shift up into the dominant structure (scaling-up).

Scaling-up

The mechanism of scaling-up describes the way how *"transition experiments can influence the way societal needs are fulfilled in a more sustainable direction. In other words, scaling up refers to 'moving sustainable practices from experimentation to mainstream'." (van Bosch-Ohlenschlager, 2010)*

It has to be considered that not the activity of experimentation is scaled up, but the new or deviant ways that have been experienced, developed and learned within the mechanisms of deepening and broadening (van Bosch & Rotmans, 2008). It is difficult to translate sustainable practices into the dominant practice of the regime as the mainstream context only helps practices to fit in that are not too deviant and that can be added without difficulty or too much cost (van Bosch & Rotmans, 2008). The freedom that niches offer for Transition experiments is therefore very fruitful for their development, but this also makes it very difficult to scale-up experiments into the dominant context (regime) (van Bosch & Rotmans, 2008). Due to this paradox it is important to involve stakeholders that have an influence on the regime level like visionary politicians or policy makers and also actors that have an interest in embedding new ways of thinking and sustainable practices in society (e.g. NGOs, frontrunners in a sector or policy domain, Sustainability Networks, etc.) (van Bosch & Rotmans, 2008). *"However a basic notion of TM is that no single actor has the managing capabilities to control a transition process fully in a top-down manner" (van Bosch & Rotmans, 2008)*

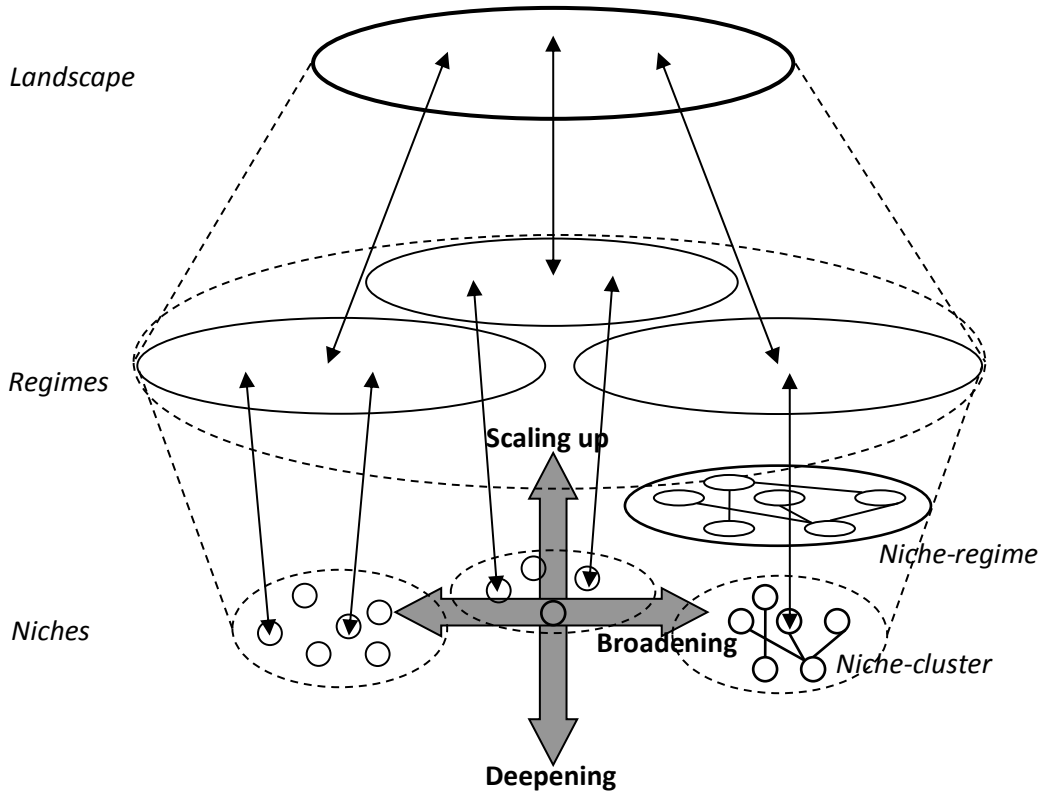

Figure 14 Deepening, broadening & scaling up transition experiments in niches in relation to multi-level perspective (van Bosch & Rotmans, 2008)

Figure 14 summarizes the three mechanism which show how Transition experiments contribute to transitions in a schematic overview:

'Deepening' is carried out in the direct context of a transition experiment (niche) and describes the different ways how actors can learn reflexive, broad and social about new ways and sustainable practices that deviate from the regime (The arrow of deepening is therefore illustrated in figure 14 going to the opposite direction of the regime to emphasize that this mechanism focuses on non-'main stream' related practices). Broadening is illustrated with a horizontal arrow that runs parallel to the regime level. This implies that broadening supports linking between different niches. This can lead to a niche-cluster and the building of a niche-regime (van Bosch & Rotmans, 2008).

"A niche-regime exists at a higher scale level, illustrating its higher stability, power and influence which can challenge the power of the regime." (van Bosch & Rotmans, 2008)

'Scaling up' relates the consolidation of the developed sustainable practices with the regime. Even though that this is theoretically explained as one step, it is taking place in reality in many intermediate steps (van Bosch & Rotmans, 2008).

4.3. Operational Framework

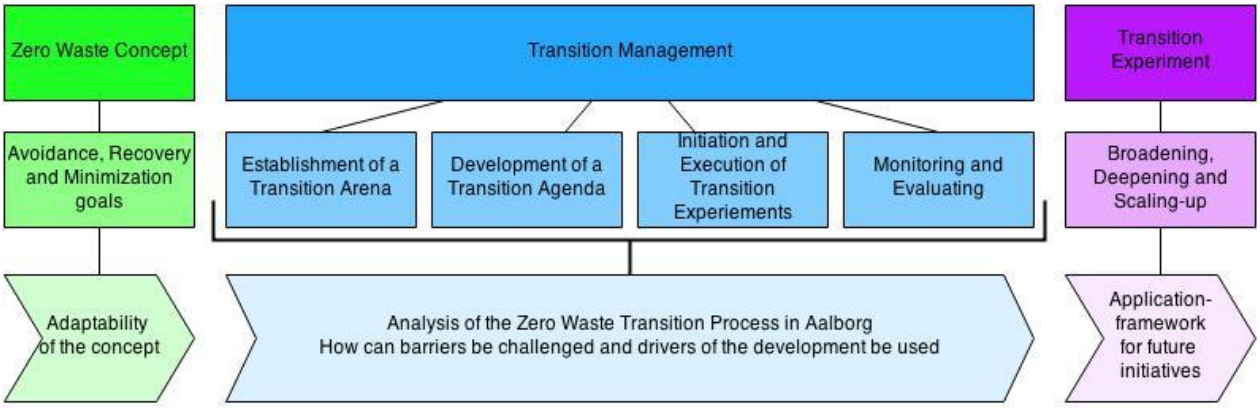

Figure 15 Operational Framework

The concept of Zero Waste, Transition Management and Transition Experiment form the operational framework, which will be used as a fundament for the analysis. The Zero Waste principles are used to analyze how this concept is approached in Aalborg, which will also give an insight about the adaptability of this concept. The Transition Management framework analyses how the developments in Aalborg can be seen by looking at the Transition Management cycle. This theoretical tool will further be used to identify missing features in Aalborgs development that are provided by this framework. Based on that it will be emphasized that the Transition Experiment framework offers a applicable tool for future initiatives to challenge the socio-technical transition towards Zero Waste in Aalborg.

5. Analysis

The operational framework and the data that have been collected are used to analyze how **transition theoretical concepts can contribute to the Zero Waste development in Aalborg.** Along the formulated sub questions in section 2, an analysis-framework has been developed which supports a systematic approach of the research question.

Table 3 Analysis framework

Research question	Points of Consideration	Theory
What are plans and initiatives in Aalborg in terms of "ZW"?	• Analysis of initiatives of the municipality and other actors • Important steps of the TM framework	• Multi-Level-Perspective • TM • Transition Experiments
What are the barriers and drivers of "ZW"-initiatives in Aalborg?	• Stakeholder-consideration • Technical issues • Political issues • Societal issues	• TM
Which features of Transition theory can be supportive for the Zero Waste – development in Aalborg?	• Deepening, Broadening and Scaling up • Transition Management cycle • Niche developments	• TM • Transition experiments • MLP

5.1. Aalborg's plans and initiatives in terms of ZW

Aalborg Municipality

Aalborg is located in the northern region of Denmark and one of 98 municipalities. Its current population is 201.144 inhabitants which makes it to the third largest city in Denmark (Aalborg Kommune, 2012). The Municipal Waste Management in Aalborg goes through an ambitious transition, as with Denmark's new waste strategy "Denmark without waste; Incinerate less – recycle more", up to 50% of household waste needs to be recycled by 2022. This goal is not only a national goal, it is the outcome of a new resource strategy of the European Union and obligatory for all member states. With 42 % of recycled waste in 2011, Denmark is seated on rank eight in European comparison. However 42 % is related to the total amount of waste that is recycled. The average recycling rate for household waste[1] in Denmark is around 25 % (Danish government, 2013). The recycling rate for household waste in Denmark is on the one hand

[1] The European Union defines household waste simply as *waste generated by households* (European Commission, 2011).

as low, due to the high importance of incineration in Denmark and on the other hand to a well-established bottle return-system for plastic and glas-bottles and the exclusion of the garden waste collection-rate, which both don't count into the household recycling rate (Interview Anke Sand Kirk).

Aalborg Forsyning Renovation is a department of Aalborg Kommune and directly underlies political decisions of the municipality. It regulates the household waste collection and treatment in Aalborg and is furthermore responsible for the Waste Management plans and strategy formulation. The socio-technical system of household-waste handling is organized by this institution. The transition of the Waste Management system is planned by this department and can in general be seen as a Top-down approach as it is driven by supra-national political decisions. The new waste plan, which will last from 2014-2026 is still in a formulation phase and when it gets approved by the politicians in October 2014 more concrete strategies will follow (Interview Dorte Ladefoged). The new waste plan follows the former waste plan which was set up for the time period 2008-2016. The big difference between the current and the new plan is the 50% recycling goal of household waste by 2022 and an achievement of 60 % recycling rate of organic waste by 2018. The organic waste recycling goal also includes the service sector like restaurants and supermarkets. These goals will mainly be achieved by the introduction of a new collection system of household waste. Aalborg's new waste plan is not approved by the politicians, yet, however they already decided about the objectives in April 2014.
The objectives are summarized in the following:

- Reduction of waste and soil that is landfilled
- Reduction of the amount of waste which is incinerated
- Modernization of Recycling sites
- Sorting of recyclable materials by households
- Investigation of organic waste recycling possibilities
- Improvement of the Electronic Waste collection
- 25% Energy Recovery of garden Waste by 2018
- Launch of Information and Education Campaigns
- Debate about the introduction of an incentive-system to reduce waste

Dorte Ladefoged emphasized in the interview, that the focus of Aalborg Forsyning Renovation lies on finding the environmental friendliest solutions and that they are *"keeping their eyes open"* for innovations and novelties that could be useful for Aalborg. There is no overall vision in the sustainability strategy of Aalborg about ZW. However the initiatives and actions of the municipality and also developments in the business sector are going into the direction of ZW even though that they are not proclaimed as this.
ZW is a concept that cannot be achieved by one single actor like the municipality. It needs as well citizens and businesses that are willing to achieve the vision of ZW and contribute to it.
A concrete initiative has been done for the implementation of a new collection system to achieve the 50 % recycling goal by 2022.
To find out how much waste can be collected in the municipality, the waste department started an experiment in three living areas in Aalborg in September 2013. The aim of the experiment is to find out

how much plastic, metal and electronic waste can be collected and which way would be the most appropriate for it (Aalborg Forsyning - Renovation, 2014).
The testing-sites were a residential complex in Aalborg-Øst, one in Dannebrogskollegiet, which is a social-housing facility for students and one in a family housing area in Kaerby, which are only single-family houses. The 700 households, which participated, were supplied with two extra bins[2]. The amount of waste that has been collected till now in the three testing areas was used to calculate the waste amounts which can be expected for the whole municipality. The projections for Aalborg's plastic and metal waste collection will approximately reach 1000 tons per year which will not be enough to reach the 50% recycling goal if only plastic and metal waste from household is recycled. A collection of organic waste will also be necessary, when a new collection system will be implemented in the whole municipality.
The biggest problem in the experiment turned out to be the correct sorting of plastics. Anke Sand Kirk reported that *"the biggest confusion occurred with the plastic sorting. The people asked a lot of questions about that."* When plastic waste is contaminated with food residues or different kinds it is not possible to recycle it probably. The municipality calculated that around 40 % of the 1000tons of metal and plastic waste can therefore be recycled. An incremental learning outcome of the initiative, is that information flow in-between the participants and the municipality has to be a central issue as it was mainly ideas of participants that developed and influenced the learning process in the initiative.
Especially the user-practices in the Dannebrogskollegiet turned out to be a problem (Interview Anke Sand Kirk). Waste wasn't separated properly and the reasons for that could have been the wrong approach of the municipality, as they only contacted the participants in the Kollegium in Danish, whereas most of the people who live there come from an international background. Another problem can be seen in the wrong location of the bins, but this couldn't be elaborated further as the municipality doesn't have the capacity to interview the people who live in the Kollegium to find out the obstacles that hinder a proper waste-sorting. With the collection of plastic and metal waste four of the new waste plan objectives are adressed, which are:

- Reduction of waste and soil that is landfilled
- Reduction of the amount of waste which is incinerated
- Sorting of recyclable materials by households
- Improvement of the Electronic Waste collection

One project starts directly as a consequence of the "fremtids guld"-project. This project deals with the problem that waste is not properly sorted in the student-housing facilities. In this project students from an interdisciplinary background will work about solutions for an appropriate strategy to achieve a correct waste sorting in the student-accommodations. The project is comparable to a workshop and limited for a specific amount of time. The project is called "solution camp" and will take place in collaboration with Aalborg University. An Initiative that fully focuses on the education and Information dimension is a school project. Aalborg forsyning Renovation bought an educational-bus which was designed to teach kids how recycling is done in a right way. The project will mainly address kids that visit the 3rd to the 6th

[2] one for plastic and one for metals, whereas the plastic bin had a small inlet for small electronic waste and energy-saving-bulbs

class and it will be a long-term project with the aim to teach children a better perception about waste that they learn that waste is valuable; *"they should perceive waste as gold and as something that is reusable"* (Interview Anke Sand Kirk).
The way how the Municipality changes the Waste Management can be seen as experimental. Before they implement a new system, they test it or exchange with other municipalities about their experiences. They also collaborate with other municipalities in Denmark and relevant stakeholders (i.e. Recycling companies) to get a better picture how they could implement a new system successfully (Interview Dorte Ladefoged).
The experiments that were carried out by Aalborg Municipality can be classified as classical innovation experiments according to table 2. The approach which was chosen by the municipality fits well to the challenges that they identified. The 50 % recycling goal brought up the technological challenge to find a proper collection system for plastic and metals. However this experiment demonstrated further challenges, which are on the one hand of technological and on the other hand of societal background. The technological challenge results from the fact that not all plastics are recyclable and especially plastic waste which is contaminated with food residues is not anymore suitable for recycling. This problem is therefore either a problem of product-design or not suitable treatment methods. Another technological problem is the fact, that the bins are not facilitated in a right way, so that it is more convenient to throw all waste into the bin which is the easiest reachable.
The societal challenge lies however in the relation and perception that people have got to waste. It is one approach to change the collection and treatment system of waste and optimize it towards peoples need, but the overall problem that people do not sort or discard their waste properly lies in the overall perception that waste is something non valuable. This perception is even more strengthened by the fact that the citizens have to pay for the waste disposal. The municipality approaches this societal challenge on the one hand by the "solutions camp"-project and the school project. Both projects are conceptualized however as innovation-projects whereas the consideration of a Transition experiment framework would be more appropriate. Aalborg sets in a transition perspective mainly on the changing of structures to achieve different practices from the citizens.

Industrial Symbiosis

A non-policy-driven development in Aalborg in terms of ZW is taking place in the eastern part of the city. A network established in 2011 in-between businesses that are situated in the industrial area of Aalborg East. The network established to contribute to a common identity in the area and to give the opportunity for new business in the area, but it is also a platform to start common projects whereas Industrial Symbiosis developed to one of the focus projects in this network till now. Industrial Symbiosis describes in general "*when two organizations or more have a transaction of one or more resources, such as waste, by-products, utilities or knowledge. These transactions should be fostering environmental improvements and economic benefits." (EMSS-2012-2, 2013)*
The Network9220 incorporates different focus groups whereas the 'Energy and Environment'-group focuses on Industrial Symbiosis. Brian Rasmussen, who is one of the initiators of the Network and the Industrial Symbiosis-initiative, pointed out that the Industrial symbiosis project is still in a conversation phase and that it would need more attention from the side of the companies. They are looking right now for a way to progress the work and he thinks that a common vision of "ZW" in Aalborg East could

probably move this work forward. Transition Theories support this fact, as the Industrial Symbiosis Initiative will change the common structure and practices in the business area. Compared to the municipal waste management it cannot be easily said that changing structures would also change practices as there is not one single actor who can just change the structure. This change is dependent on a collaboration and agreement between all companies and would therewith require at first hand a change in the common culture, so that all companies see the benefit in an Industrial Symbiosis.
The port itself is not involved in all the projects that go on in between companies that consult about common ways to share sources and waste, but it has a high interest that the industrial symbiosis project is going forward as it is on the one side an aim of the port to foster sustainable development in the area and on the other side it would open very beneficial business opportunities for the port. The port rents out facilities and land to companies, so that an economic and environmental strengthening of the region by a strong network and Industrial Symbiosis could make Aalborg East a more attractive business location for new enterprises (Interview Brian Rasmussen). There is going to start a project in 2015, which is called "smart city" project. Industrial Symbiosis will also be a part of it and Brian Rasmussen thinks that this project could be the framework to boost Industrial Symbiosis in Aalborg-East.

Smart-City-project

Aalborg Kommune plans to take part in the European Initiative on Smart Cities. This EU-wide project has the strategic goal *"to demonstrate the feasibility of rapidly progressing towards the EU's energy and climate objectives at a local level while proving to citizens that their quality of life and local economies can be improved through investments in energy efficiency and reduction of carbon emissions." (European Commission 2014)*

This initiative supports cities in taking ambitious and pioneering measures to achieve a 40% reduction of greenhouse gas emissions towards 2020 through sustainable production and use of energy. The initiative concentrates mainly on green energy, transportation and buildings. Aalborg formulated a first draft of a project description, but a final version will be proposed to the politicians by March 2015 (Interview Dorte Ladefoged). Aalborg's smart city project description says in general that this project should give the framework for a multi-stakeholder-dialogue in terms of green technologies and sustainable living. It also says that Initiatives like the Industrial Symbiosis will be supported, but the description doesn't contain concrete plans (Phone call Lene Marianne Nielsen). The project shall also include more than the three focus areas transport, energy and buildings and will therefore also take Waste Management into account. Different stakeholders like representatives of Aalborg University, businesses, NBE (Sustainability Network), the municipality and the housing association Himmerland are exchanging about ideas and possible initiatives within the smart city project but there is no more concrete plan yet. The smart city project is still in a development phase and the involved actors are still discussing which initiatives should be carried out.

Summary of Initiatives

Figure 16 Initiatives in Aalborg according to the ZW city principles

Figure 16 summarizes the initiatives that could be identified by the data collection that assign to the principles of a ZW city. The Initiatives in Aalborg focus very much on the technical sphere of ZW, like 100% Recycling of Waste, Zero-Landfill & -Incineration Legislation and 100% Resource recovery from Waste. Aalborg Municipality is however also limited in their range of influence as in contrary to the Zero-landfill and –Incineration principle, the other four principles are also very much dependent on businesses and citizens. The smart-city project could offer therefore an ideal condition to involve these stakeholders into the ZW development of the city. Assigning the ZW development in Aalborg along the four phases of a transition process (compare figure 16) it can be said that the city is located in the take-off phase, as a higher level of interaction between actors has already started with the launch of Industrial Symbiosis projects, the new waste policies and the smart city project.

5.2. Barriers and Drivers of ZW developments in Aalborg

The review of Aalborgs and Danish waste strategies as well as the four interviews which have been conducted show that Aalborg's 50%-recycling goal is mainly triggered by the EU-policy. However there has always been the overall goal in Aalborg's waste planning to strive towards the most sustainable solutions for its Waste Management. The representatives of Aalborgs Waste Management are convinced that sustainability is the right path to go and they want to find the environmental friendliest solutions for Aalborg's Waste Management.

A study which compared the environmental impacts of an anaerobic digestion plant for Aalborg's organic waste and the one of Reno Nord came to the conclusion that it hasn't got an environmental benefit to build an anaerobic digestion plant in Aalborg, as the current incineration plant works highly efficient and has a lower environmental impact as if the organic waste would be gasified (Hill, 2010). This study moved Aalborg's focus for the new waste plan on the recycling of plastic and metals, as they don't know which would be the environmentally friendliest solution for the organic waste (Interview Thomas Lyngholm and Dorte Ladefoged).

"Why should I ask people to sort the waste that we can put into a biogas plant if we don't get a better environment from that." (Interview Dorte Ladefoged)

The treatment of organic waste has also a "dark history" in Aalborg as the municipality already planned in 1994 to implement a collection and treatment system for organic waste. However when the bio gasification-plant was built and the bins and trucks were ready for collection, the municipality suddenly decided to stop the implementation of an organic waste treatment, which was due to the fact that costs seemed to be too high (Interview Anke Sand Kirk and Dorte Ladefoged).

A bottom up approach in terms of ZW takes place in Aalborg-Øst and is driven by an Industrial Symbiosis project in between businesses of the Network 9220. This project developed simultaneously with the emergence of the Network, which was initially started to create a common identity in the industrial area of Aalborg-Øst (Interview Brian Rasmussen). A frontrunner in this project is the port of Aalborg who is facilitating the meeting and has got a high interest in the development of an Industrial symbiosis. This interest originates on the one hand in the goal of the port to foster sustainable development in the business district in Aalborg-Øst and on the other side it would open up very beneficial business opportunities for the port. The port rents out facilities and land to companies, so that an economic and environmental strengthening of the region by a strong network and Industrial Symbiosis could make Aalborg East a more attractive business location for new enterprises (Interview Brian Rasmussen). The Environmental Manager of the port expresses this with the following statement:

"If we could go around in the NV9220 and define it (Industrial Symbiosis) as a project and give the approval that we are all going for this zero-waste project and we can make it public. I think that is the kind of thing that could involve more companies. This would somehow create a picture of Aalborg's Business district as an innovative and collaborative place. I think that could move a lot." (Interview Brian Rasmussen)

As barriers for Industrial symbiosis sees Brian Rasmussen small obstacles like regulations and taxes that make it difficult to reuse heat and water of other businesses (compare Interview Brian Rasmussen). But a main barrier is still the relative small importance of environmental issues in the top-management of the companies. Brian Rasmussen thinks that "*the companies are doing the obvious things but they could do*

more, even though there is not much money to be earned in some cases, but it could have a positive effect for the environment." That's why he sees a potential in the "smart city" project which could move the topic of "zero-waste" more into focus of the companies.

The Incineration-tradition in Aalborg doesn't seem to hinder a change as the supply of waste is secured by other municipalities around Aalborg and Waste imports from England. Furthermore a study which was carried out by the consultancy Ea Energianalyse, Dong Energy and the Danish government about the adaptation of the incineration-capacities in Denmark, confirmed that decreasing waste amounts won't be a problem for incineration facilities in Denmark. The study came up with the main-finding that in 2050 all current 27 waste-incineration plans will be substituted by five new efficient incineration plants which will be able to deal either with a waste-decrease from the current 3.5 Million tons per year to less than 2.5 Million in 2050 or a further increase of the waste amounts to 4 Million by 2050. The new Incineration facilities will be located in Odense, Tvis, Aalborg, Aarhus and Copenhagen (Ea Energianalyse, 2014). Even though this prognosis is not a guarantee that the development will take place like described, but the Interview with Thomas Lyngholm of Reno Nord showed that the municipality relies on that study and considers it for future development. Aalborg Forsyning Renovation is a non-profit organization and finances itself by the waste-fees, which are collected. This limits the scope of action of this institution as it turned out in the interviews that this organization would like to do more to improve the waste recovery and recycling in Aalborg, to foster a development towards ZW.

Table 4 shows a summary of the drivers and Barriers of Aalborg's transition towards ZW, which could be identified in this analysis.

Table 4 Drivers and Barriers of Aalborg's path towards ZW

Drivers	Barriers
• European and Danish Waste strategy • Sustainability Vision of the Municipality • Industrial Symbiosis – projects in Aalborg-Øst (Port of Aalborg/NV9220) • Smart-City project • Pro-active Waste Management Department	• Uncertainty about Recycling and Organic Waste treatment (no facilities available in Denmark) • "dark political history" of a failed organic waste collection and treatment system • Regulative and tax obstacles that impede Industrial symbiosis-projects • Missing Environmental awareness of Industrial Symbiosis project-partners • Limited financial scope of action of Aalborg Forsyning Renovation

The barriers and drivers that have been detected are related to the single initiatives that have been introduced in the beginning of the analysis section. Seeing these barriers and drivers in a more general view it can be said that the transition to ZW is driven and hindered by the different perceptions of Environmental awareness and focus of the involved stakeholders. Resource scarcity is a driver for the national and supra-national ZW development, but this couldn't be identified as a driver on the city scale.

A barrier of ZW development in Aalborg could also be seen in the missing vision, which Brian Rasmussen got to the heart with the quote that *"an ambitious vision"* could move a lot, which is also a central part of the TM framework.

5.3. Contribution of Transition Theories to ZW-development in Aalborg

ZW is part of the sustainable development in Aalborg, even though that there is no overall Zero-Waste vision. Closely related developments to ZW in Aalborg are the aim of a fossil-fuel free municipality in 2050, or the maximization of resource recovery out of wastewater (Aalborg Kommune, 2013). The TM cycle and the mechanisms of Transition Experiments offer a framework to analyze how a transition can be brought forward and how it could be structured. Both are used to analyze which points could be beneficial to consider in Aalborg's further path towards ZW.

Problem Structuring and Envisioning: Establishment of a Transition arena[3]

A 'protected space' for niche developments like the Industrial Symbiosis is partly given, as the Network for Sustainable Development (NBE) is working together with the companies in Aalborg East to establish an Industrial Symbiosis. However is this collaboration not taking place constantly and since the funding for the initiative ended, not very much progress was going on (Interview Brian Rasmussen). A promising development is the smart city project which will mainly take place in Aalborg East. This project takes Industrial Symbiosis as one focus to reduce and reuse the amount of waste collaboratively in-between the businesses. The smart-city project is still in a development phase and ideas are still collected till the project formulation will be finalized by March 2015. However this project sets ideal conditions to apply the TM framework on it as the framework of the smart city project focuses on a multi-stakeholder approach by involving citizens, politicians and businesses. This project could therefore constitute a transition arena, where i.e. stakeholders of the Industrial Symbiosis initiative can collaborate and work about a common vision. But such an Transition Arena wouldn't be only focused on Industrial Symbiosis in the business area. The area of Aalborg East could be seen as a Transition arena where the smart city project offers the chance to different stakeholders to create transition images and a common vision, that could foster sustainable development in the area.

The Waste Management department in Aalborg incorporates a more passive role as they are looking for novelties that could be implemented for their organic waste treatment or recycling, but they are not researching by themselves as they also do not have the financial capabilities as a non-profit organization.

Development of Sustainability Images, Pathways and a Transition agenda

Aalborgs Sustainability images in terms of ZW are defined in the sustainability strategy with the goal to achieve a *"Responsible consumption – to promote sustainable consumer habits"* and by *"managing waste by maximizing the use of resources" (Aalborg Kommune, 2013)*. The TM framework suggests creating imaginative and appealing images which catch the attention of stakeholders that could boost a transition. Niche-actors like Brian Dalby Rasmussen, who is a frontrunner in the Industrial Symbiosis-initiative would wish that such ambitious images would be set:

[3] A transition arena is defined as a *"quasi-protected space for frontrunners that develops a shared understanding of the persistence of a problem at the level of a societal system, the necessity of a transition or radical change, and the definition of the challenges this poses." (Rotmans & Loorbach, 2009)*

"We should set up a very ambitious target. Like 'We want this area[4] *to be a ZW area' In 5 years we don't want waste at all. That is a very ambitious target. It is a very ambitious target but when we do it we will have a complete new mindset."* (Interview Brian Dalby Rasmussen)

In the case of Industrial Symbiosis, transition images could help, to convince other businesses to collaborate and share the ideas. The Smart City project could be a protected space where such a vision could be created and communicated to bring more attention and guidance for the niche development. An appealing ZW goal for the whole city of Aalborg could involve a greater variety of stakeholders like it is already done within the vision of a fossil-fuel free Denmark by 2050. That Zero-Waste also becomes a national goal in Denmark can only be suggested, but the current developments strive into that direction as the Danish Ministry of Environment also published a paper about possible ways how Denmark could look like without waste. The Paper is called 'Fremtids-billeder, af et danmark uden affald' and comprises possible visions that should inspire organizations and municipalities in Denmark to think about ways to improve and increase the minimization and reuse of waste (Miljøministeriet, 2014). The publication suggests that the three trends of 'Collaborative Consumption'[5], new product-design which enables an easier reuse and recycling of products and the establishment of a return system instead of a waste collection system, as future trends that are vital for the development towards ZW (compare Figure 17) (Miljøministeriet, 2014).

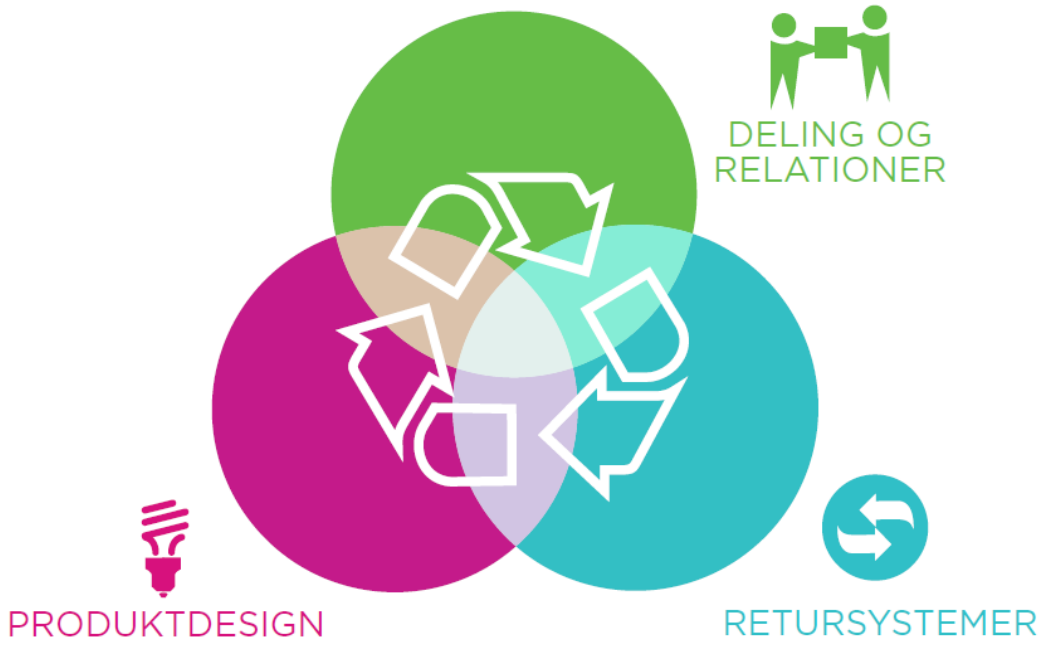

Figure 17 Future trends of Waste reduction and valuation (Miljøministeriet, 2014)

Initiation and Execution of Transition Experiments and Mobilization of Actors

Experimenting and testing has always been a part of Aalborg's Waste Management and Planning. The concept of Transition Experiments introduces a new way to carry out experiments that face societal

[4] Aalborg East
[5] Deling og Relationer

challenges like the ones that are given by a change towards ZW. An overall vision about ZW would help to select promising niche developments and transition experiments and could help to develop an up-scaling strategy to achieve a transition of ZW practices to the regime-level.
The Nulskrald-project is a good example of how a transition experiment could be carried out. This Experiment started 2013 in the Municipality of Hjøring[6], where consumers were encouraged to join a project to reduce the waste that they produce. The volunteering families were producing five weeks as less waste as possible, by developing a strategy to separate their waste better, by composting at home, by avoiding food waste and by shopping wisely. The project was organized as an open process and the citizens could share their experiences among each other.

"The desire to share knowledge and experiences with other people was very great, and it helps to prove that the future waste solutions must come from the citizens themselves." (AVV et al., 2013)

The families reduced the amount of garbage by 51% over the five weeks and they also began to think about how to use things better and avoid buying too much. This experiment can be seen as part of a niche development which can be described as 'changing consumption patterns'. It shows that people are willing to reduce their waste and that they are also not satisfied with the current solution of producing enormous waste amounts.
An implementation of this experiment in the context of Aalborg could show how the learning outcomes in this project are applicable to a different city-context (Broadening). The Mission of the Nulskrald project is to implement this project all over Denmark (AVV et al., 2013). This initiative could be supported collaboratively by different stakeholders (i.e. Himmerland Housing Association, Aalborg University, Aalborg Municipality, etc.) in Aalborg, which would strengthen this new way of thinking and could lead to the formation of a niche-regime[7]. A niche-regime, that promotes citizen-driven waste-reduction strategies.

Monitoring and Evaluating the Transition Process
The ZW initiatives are all in a starting phase in Aalborg, so that a monitoring system of the ZW developments in Aalborg couldn't be identified. To monitor the improvement of the recycling and reuse of waste is an easy task, because this is automatically done by the gathering of data through waste collection. To monitor the transition process towards ZW the Zero Waste index that is developed by Zaman and Lehmann offers an appropriate measuring tool (Zaman & Lehmann, 2013). This index includes in contrary to the 'waste diversion rate'[8], the potential demand of virgin materials, carbon pollution, energy and water in a city and assesses thus the overall performance of the waste management system in a city (Zaman & Lehmann, 2013).

[6] Municipality north of Aalborg
[7] *"A niche-regime exists at a higher scale level, illustrating its higher stability, power and influence which can challenge the power of the regime." (van Bosch & Rotmans, 2008)*
[8] Used by municipalities to calculate the recycling performance

6. Discussion

Comparing the concept of Zero Waste with the national strategy of Denmark and the Initiatives that are taking place in Aalborg, it can be said that in terms of definitions Aalborg doesn't go for a 100% towards Zero Waste. There hasn't been identified a movement or initiative that addresses a change of consumption behavior and consumer responsibility, whereas it is also the question to which extend this could be addressed by a municipality. The interviews also couldn't identify initiatives that go into that direction. A change of consumption behavior and consumer responsibility need to evolve from the bottom-up, whereas Transition Experiments like the Nulskrald project in Hjøring show exemplary how incentives can be set to trigger a bottom-up development.

The concept of Zero Waste faces the same issues as sustainable development in general. Both concepts are empowered by increasing problems like climate change, resource scarcity, environmental pollution and social inequality. These problems change perceptions and foster the thinking that sustainable development is the right way to go. However it can be seen globally but also on a small scale like the case of Aalborg, that people have different perceptions of what sustainability is about which makes it difficult to set common goals. A Transition requires the change of structure, culture and practices. The development towards Zero Waste affects very much the cultural sphere as the changed perceptions imply that this is the right way to go. To strengthen this development it could be beneficial to introduce a system (structure) which supports this development and strengthens the cultural sphere which will have an influence on the common practices.

An idea of Eckart Wintzen (1939 - 2008) which is called Ex'tax could offer the certain structure which would foster Zero Waste development in a wide perspective. Eckart Wintzen was a Dutch entrepreneur and developed Ex'tax based on the concept of Value Extracted Tax. Ex'tax proposes to redistribute tax from labour to resources. The rise of taxes for resources will create a proper incentive to reuse abundant and recycled materials instead of scarce ones (The Ex'tax project, 2014). "*Lower taxes on labour would make it more affordable to benefit from the abundance of capacities of people, boosting manpower, craftsmanship and creativity" (The Ex'tax project, 2014)*

"*Sustainable development is possible, but only if we begin managing the environment according to sound business principles. The goal of every company is to ensure its continuation and economic growth for the benefit of its employees and its shareholders. Is it not time then for us all, as equal shareholders in Earth Inc., to guarantee the sustainability of our own future prosperity? We must do this neither out of pie-in-the-sky idealism nor vague messianic ambitions, but out of pure economic necessity, a source of inspiration that has been the mother of so many fruitful inventions in the past*." -Eckart Wintzen

7. Conclusion

The underlying research created a picture of how a city moves its path towards ZW. The principles that characterize a ZW city are easy to understand however it is the question how such a transition can be made. To understand how this transition can be managed the Transition Management framework has been applied to the case of Aalborg to analyze potentials that could foster the development towards Zero Waste.

The initiatives that have been described are all showing that Aalborg addresses mainly a technical approach and focus very much on changing the structure in the waste system than concentrating more on the societal challenge that ZW incorporates. This societal challenge could be addressed, if Aalborg would have a Zero Waste Vision and if a transition arena could be created for frontrunners like the port of Aalborg that wants to drive the Industrial Symbiosis initiative or the Nulskrald project who aim to foster consumer-driven waste-reduction strategies. A common vision like it has been communicated by Brian Rasmussen, but as it is also supported by the Transition Management framework would support ZW developments in Aalborg. The vision of i.e. a fossil-fuel free Energy production by 2050 supported initiatives a lot in Denmark and there has also been a report published that this transition is possible (Vorrath, 2014).

The Smart city project could be the framework to create a transition arena for Zero Waste thinking in Aalborg. The Interviews with Anke Sand Kirk and Dorte Ladefoged demonstrated that the municipality aims to approach the citizens on an eye-level to achieve a close collaboration when it comes to the establishment of a new collection-system for the whole municipality in January 2015. The fremtidsguld project already shows that a close exchange between citizens and municipality is needed and that the people have to be involved in the transition process. The Nulskrald and the fremtidsguld initiative also show that people are willing to sort and that they care about their waste. These tendencies are important findings to create Transition Experiments for changing consumption behavior and consumer responsibility.

Transition theories give a hands-on framework to plan and to carry out experiments that could lead to a ZW transition. Aalborg's development can benefit of these theories by adapting the Transition Management framework and the Transition Experiment mechanisms to the envisioned Transition Images. It turned out in the Interviews that next to the obvious initiatives that are taking place in Aalborg, a lot of different ideas about Zero Waste are discussed, but not yet formulated to something more concrete.

8. Limitations

The focus of the thesis was to analyze among a case study how Zero Waste can be approached in a city. Transition Theories offer the overall framework in this thesis how transition towards sustainable development can be achieved and which features it needs to consider. Based on this theory and the concept of a Zero Waste City it was possible to identify drivers and barriers of Zero Waste development in Aalborg and points that need to be considered to promote Aalborg's Zero Waste development. It was however just possible to show in general that transition theories are a suitable tool to be used for a Zero Waste transition and that further translation of the Transition Management Framework and the Transition Experiment mechanism need to be performed for the specific initiatives and Transition goals.

A stakeholder analysis could bring up vital information about who is actually interested in Zero Waste in Aalborg and which influence specific stakeholders could have on the development in Aalborg. Due to the limited time frame it was not possible to carry out a stakeholder analysis in this research, but this could build a central part for further research on that topic in Aalborg. A stakeholder analysis could have brought up further information about initiatives and ideas that are going on in terms of Zero Waste in Aalborg and could have enriched the discussion about how Zero Waste can be approached in a city. Furthermore it would have been beneficial if my Danish language skills would have been better as it is more convenient for the interviewee to talk in her native language.

9. References

Aalborg Forsyning, Renovation (2014): Fremdtids guld - dit skidt. Available online at http://www.fremtidsguld.dk/ checked on 12/05/2014.

Aalborg Kommune (2012): Befolkningens bevægelser 2011 i Aalborg Kommune. Available online at http://www.aalborgkommune.dk/Om_kommunen/fakta-om-kommunen/befolkning/Documents/Befolkningens-bevaegelser-2011.pdf. Checked on 12/05/2014

Aalborg Kommune (2013): Introduction to Aalborg´s Sustainability Strategy 2013 -2016.

Aalborg Kommune (2014): Smart City Aalborg - et følgebrev til magistratens møde den 7. april 2014. Available online at http://www.aalborgkommune.dk/_controls/PageLayoutsControls/Pdf.aspx?pdfnavn=18131949.PDF&type=bilag&id=26915. Checked on 15/05/2014

Aalborg Kommune / Renovation (Januar/2007): Affaldsplan 2008-2016.

Amanda Louise Hill (August / 2010): Life Cycle Assessment of Municipal Waste Management: Improving on the Waste Hierarchy. Master Thesis. Aalborg University, Aalborg. Department of Planning and Development.

AVV, Aalborg University, Tankegang, Brønderslev Kommune & Hjørring Kommune (2013): Nulskrald - baggrund. Available online at http://www.nulskrald.dk/baggrund/baggrund, checked on 8/06/2014.

Booth, Wayne C.; Colomb, Gregory G.; Williams, Joseph M. (2009): The Craft of Research, Third Edition. Chicago: University of Chicago Press (Chicago Guides to Writing, Editing, and). Available online at http://gbv.eblib.com/patron/FullRecord.aspx?p=432155.

Clugston, Chris (2010): Increasing Global Non-Renewable Natural Resource Scarcity - An Analysis. Edited by The Oil Drum. Fort Collins, CO, USA. Available online at http://www.theoildrum.com/node/6345, checked on 31/03/2014.

World Bank (March 2012): What a Waste. A global review of solid waste.

Danish government (November 2013): Denmark without waste, recycle more - incinerate less.

Ea Energianalyse (2014): To scenarier for tilpasning af affaldsforbrændingskapaciteten i Danmark. With assistance of Dans Affaldsforening Dansk Fjernvarme og KL DONG Energy. København. Available online at http://www.danskaffaldsforening.dk/documents/23264/0/Affaldskapacitet+slutrapport+marts+2014.pdf/95f9e233-62d3-46e7-8ea2-993c2ac82672, checked on 12/05/2014.

EEA (2013): Managing municipal solid waste. A review of achievements in 32 European countries. Luxembourg: Publications Office (EEA report, No 2/2013).

Ellen MacArthur Foundation (2014): Towards The Circular Economy. Accelerating the scale-up across global supply chains.

Elzen, Boelie; Geels, Frank W.; Green, Ken (2004): System innovation and the transition to sustainability. Theory, evidence and policy. Cheltenham, UK, Northampton, MA: E. Elgar.

EMSS-2012-2 (2013): Industrial symbiosis in Aalborg. Study Case - Network 9220. Group-project. Aalborg University, Aalborg. Department of Development and Planning.

European Commission (2011): COMMISSION DECISION of 18 November 2011 - establishing rules and calculation methods for verifying compliance with the targets set in Article 11(2) of Directive 2008/98/EC of the European Parliament and of the Council (notified under document C(2011) 8165) (2011/753/EU).

European Commission (2014): General Union Environment Action Plan to 2020 - Living well, within the limits of our planet.

European Commission (2014): SETIS, Strategic Energy Technologies Information System. European Initiative on Smart Cities. Available online at http://setis.ec.europa.eu/set-plan-implementation/technology-roadmaps/european-initiative-smart-cities, checked on 28/05/2014.

European Union (2010): Being wise with waste: the EU's approach to waste management. Luxembbourg. Available online at http://ec.europa.eu/environment/waste/pdf/WASTE%20BROCHURE.pdf, checked on 22/05/2014.

Geels Frank W. (2004): The multi-level perspective on sustainability transitions: Responses to seven criticisms 1, pp. 24–40.

Global Footprint Network (Ed.) (2014): Worl Footprint - Do we fit on the planet? Available online at http://www.footprintnetwork.org/en/index.php/gfn/page/world_footprint/, updated on 28/03/2014, checked on 31/03/2014.

Guy, Simon; Marvin, Simon; Medd, W.; Moss, Timothy (Eds.) (2012): Shaping Urban Infrastructures: Taylor & Francis.

Habib Komal (2011): Waste to Energy in Aalborg - A Historical Perspective of Global Warming Impact based on Life Cycle Assessment. Master Thesis. Aalborg University, Aalborg. Department of Development and Planning.

Hodson, Mike; Marvin, Simon (2010): Can cities shape socio-technical transitions and how would we know if they were? In Research policy : policy and management studies of science, technology and innovation 39 (4), pp. 477–485.

Lehmann, Steffen (2011): Optimizing material flows and waste streams in urban development through principles of zero waste and sustainable consumption: Molecular Diversity Preservation International.

Miljøministeriet (Ed.) (2014): Fremtids-billeder. Af et Danmark uden affald.

Kemp René, Loorbach, Derk &. Rotmans, Jan: Transition management as a model for managing processes of co-evolution towards sustainable development. In: International Journal of Sustainable Development & World Ecology, vol. 14, pp. 78–91.

Rotmans, Jan and Loorbach, Derk (2009): Complexity and Transition Management 13 (2), pp. 184–196

The Ex'tax project (2014): Ex'Tax - The Big idea, http://www.ex-tax.com/big-idea/ checked on 9/06/2014.

United Nations (2010): World Urbanization Prospects, the 2010 Revision. United Nations, Department of Economic and Social Affairs, Population Division. New York, NY, USA.

van Bosch, Suzanne den; Rotmans, J. (2008): Deepening, broadening and scaling up. A framework for steering transition experiments. Delft: Knowledge Centre for Sustainable System Innovations and Transitions, TNO Strategy and Policy (Knowledge Centre for Sustainable System Innovations and Transitions (KCT), 02).

van Bosch-Ohlenschlager, Suzanne Johanna Maria den (2010): Transition experiments. Exploring societal changes towards sustainability. [S.l: s.n.].

Vorrath, Sophie (2014): Danish report finds 100% renewables feasible by 2050. Reneweconomy - Tracking the next industrial revolution. Available online at http://reneweconomy.com.au/2014/danish-report-finds-100-renewables-feasible-by-2050-2050, updated on 26/05/2014, checked on 9/06/2014.

Wescape (2014): Regenerative Ecology. Available online at http://wescapelife.co.za/all-cases-list/regenerative-ecology/, checked on 9/05/2014.

WHO (2014): Urban poulation growth Situation and trends in key indicators. Situation and trends in key indicators. Available online at http://www.who.int/gho/urban_health/situation_trends/urban_population_growth_text/en/, checked on 10/04/2014.

Zaman, Atiq Uz &. Lehmann Steffen (2011): Challenges and opportunities in transforming a city into a "zero waste city": MDPI.

Zaman, Atiq Uz &. Lehmann Steffen (2013): The zero waste index: a performance measurement tool for waste management systems in a ‘zero waste city’ 50, pp. 123–132.

10. Appendix

The Interview questions are underlined and marked as italic

Appendix 1: Interview Dorte Ladefoged

28th of April – 9:00 am till 10:20 am

Why is Aalborg addressing the Zero Waste issue?

DL:There is a national strategy of Denmark and it says that you have to reuse 50 % of the municipal solid waste by 2022. But it's not about 50 % of the total amount, so it is not garden waste and it is not waste from buildings. So that makes it quite a lot harder. Because when you take the total amount, we are already there and we are there for years. But taking these parts out you can't get actually to 50% without recycling plastics and metals and things like that but also the organic waste.

Ah so it is only about the household waste.

DL:Denmarks national waste strategy is mainly concentrating on households. But the legislation was changed some years ago. Before we had the responsibility for all the waste. But they took out all the recyclable parts from the industries, we cannot do anything about that in the future. We cannot control it we cannot treat it, we can just tell the industries to do sth and reuse and recycle. We are not allowed to do that anymore. That took away a big amount of the waste of the communities. We are not quite satisfied with that, because we would like to have a greater impact. Big amounts of wastes are in the industry. Now there is a lot of focus on the organic waste and big amounts of organic waste is in the restaurants. And we would like to make a system to collect the organic waste from the restaurants. The big ones are okay, they will find a way, there is a solution for them because our company is interested into them because there is money. But no one cares about the small restaurants. So we are interested into developing a system. We would actually do what no other company would like to touch. But it would be good for the environment.

And how is everything collected right now in Aalborg?

DL:We have two bins. One for paper and cardboard and one for the rest. And then we have containers for bottles and metals but also batteries and lightbulbs. There are also 5 big places for recycling.

You said there is this national strategy. You said that you also want to increase the recycling rate and I would like to know what are you actually doin. What are the projects about? What are you planning?

DL.As I wrote you in the email, the politicians admitted the goals which are summarized in the waste plan. And we know where we are going now. Write now I am sitting on the actual plan. We plan to supply every household with 2 additional bins one for metals and one for plastics and we are about to find out which solution it will gonna be, whether there will be also some small bins for mobile phones and all the small parts which are too easy to put in a bin.

We have the same problem with batteries and so on in Germany

DL: We have to find an easy way to get rid of small electronics like batteries and energy-saving light bulbs. They are really a waste problem. We were thinking that the people could just put their light-bulbs and batteries in a little bag on their bin and we will collect it with the normal waste collection. It has to be easy! Because otherwise you just put it into your bin. It is not a problem with bigger electronics like a television or sth similar. It is the small parts about which you really forget about quickly.

Are you working alone on the waste plan or is it a bigger team?

DL: We have a bigger team. We have our own company (Aalborg Forsyning Renovation). They collect waste in a little part of Aalborg and they have a lot of people out there that know a lot about waste. They are a company taking care about the waste in Aalborg and they are also responsible for the recycling.

So you are planning with them together how to address the Zero Waste strategy and what to do?

DL: Yes and we are discussing how it is possible and they are quite good and know what works and what doesn't work.

Is there a concrete project or initiative that you are working on right now? Or is it still in the starting phase?

DL: it is in the middle. Because according to the government we have to have a new plan by the 1st of October this year. I don't think we will be there by the 1st of October but 1st of January. There is a political process ahead of that and that is quite long. So we have to be ready before summer. So it is getting there. Before doing all that, we are making tests in a small area in different housing types, like family housing, social housing and in a Kollegium. So we are testing in these different ways of living how to collect the waste to see how they adapt to it, how are the problems and what to do.

What is the name of that area?

DL: One is called Kaerby and then there is in Aalborg-East a bigger amounts of household and the danebrogskollegium. There is a homepage for that kollegium and it is called "Fremtids guld"-Future Gold.

and this is for collecting metals… ?

DL: It is for collecting metals and plastics and the bulbs. It is in total three areas. One in Kaerby one in Aalborg East and one in a "Kollegiet". You can actually get data from all three of them. Because we could see that there is a difference between where the people lived. The hardest place was the Kollegium.

Really?

DL: We were quite surprised. Because young people are living there and they know a lot. But we made a mistake that we informed them in Danish. A lot of them have an international background. That was the first mistake. So we know about that before we inform the whole community. So that was our fault. But still it is quite hard to get those people sort the right way. I don't know why but maybe there are so many people, so that no one feels really responsible.

It worked much better in Aalborg East and kaerby. Because in this cases the people have got their own bin and that is not a problem.

So Kaerby is single houses and families?

DL: Yes and this are always the easiest places to get sth new. In Aalborg East they have someone who is looking for their waste. There is one guy who is employed who is controlling whether they sorted it right. He has the responsibility of the waste their right now. So the biggest problem right now is the Kollegium. So we contacted the university to find someone who would like to research what we could do about that to get to the young people and tell how we should inform them. Maybe we do it the wrong way. Maybe it is not enough to just inform them by letters or emails. Hopefully we get some students looking at it.

Maybe because it surprised us so much. But we have to focus on that. There are a lot of students in Aalborg and we have to focus on that.

This are the three projects to test waste collection?

DL: Yes and the biggest problem that we found out is plastic, because you can only recycle pure plastic and people don't really know what it is. So that is a problem for most people.

DL: That is a problem that we have to get out to the community. I think information is the key word.

And are you doin sth in the information sector. Let's call it awareness and education sector?

DL: Yes but only in these three areas. We haven't started anything for the whole community, yet. So we want to get some experience what works and what doesn't work.

Are you working together with business about reuse and recycling?

DL: No they care about their own waste but there is some work going on in the networks. We have quite a lot of networks within the community.

We have a waste person sitting in the NBE network. Her name is Anke Sand Kirk.

You said that everything started after the new waste policy of Denmark?

DL: Yes it is a policy, but I guess that there will be legislation later on. That is the strategy which the government wants to go. The initiatives started because of the national waste strategy. We know that sth would come up and it is political correct to reuse waste more. And our own politician also wanted to see some action as well, as they are quite interested in waste at the moment. Right now they are really interested.

I think Aalborg is a really interesting place because it has this big incineration plant which supplies the whole city with heat and energy. So I was wondering whether you would somehow see waste reduction and reuse as a problem, because the waste supply decreases.

DL: No I don't see it as a conflict. Because I think everybody – I am sitting in the same office as the heat planner so we work there together instead. We are not in a competition. Because everybody can see that it is the right thing to do to recycle more and we want heat for the city as well, but we don't really see it as a problem. Because they won't get that much waste from Aalborg and the community here but they can get it from somewhere else. Like waste from other places. In the moment we get a lot of waste from England and well they don't have incineration plants, so it is better to get it to Aalborg than dumping it.

So right now you are already importing waste?

DL: Yes we are already importing. I know it sounds wrong, but it is better than dumping it in England. It is better to get heat and electricity out of it.

I was just wondering why Aalborg cares about reuse and recycling as the waste treatment system is already quite satisfying.

DL: That is up to the people who are sitting and living here. Well I am also educated with that way of sustainable thinking. And that is my focus. And someone has to find out what we will do if we don't have that amount of waste any longer. Because we need to use the heat in a right way. But it is interesting and it could be a conflict. I think where we could conflict is on organic waste. It is hard to find out what is the right way. Is it more environmental friendly to incinerate the organic waste or gasify it. At the moment the government says it is better to make biogas out of it, but they cannot really proof that it is better for the environment. Why should I ask people to sort the waste that we can put the organic waste into a biogas plant if we don't get a better environment from that. So I think that is a big discussion right now. I know it is the phosphor part that they say that it has to go back to the earth, but it is a really really small amount.

I think that is a really interesting discussion. And that is probably why we are saying in Aalborg that we want to concentrate first on plastic and metals instead of organics. We will do it when the technical parts are ready for it. When we will have the right solutions for it. And there is a bit of history to that as well.

15 years ago there was the plan to sort out organic waste and deliver it to a biogasplant. We had everything, we had the techniques the infrastructure we just needed to hand out he bins to the community. And then suddenly the politicians said "we don't want to do it". And they cut everything. Everything was ready – but …

So that's part of the history in Aalborg. So I think it takes half a generation longer before.

But why did they decide different?

DL: That was pure politics. Noone could understand it. At that time it was actually an environmental benefit to do it at that stage. But Aalborg said no and Aarhus was actually already sorting and they stopped it as well. So two of the big cities in the North of Denmark just sitting and waiting about that because they have a history (dark history).

There was the plan to compost?

DL: No it was biogas. We already had the biogasplant. Everything was ready.

And now what did you do to that biogasplant?

DL: That biogas plant is sold now. That is also a question about the biogas plants. Can they really take it. Because they have to hygienize the organic waste.

Is there an overall sustainable thinking in the municipality?

DL: Yes there is an overall sustainability strategy.so waste is just a part of it. So we have some overall goals and now we have to find out how to get there.

Are there also different experiments in Aalborg about Zero Waste?

DL: We did these three because we wanted to know how we could do it and what we could do when we reorganize the waste management system.

But of course we are testing different things all the time. Like checking whether opening hours are long enough. so we are testing some things. But of course we have small things that we test all the time.

Is there an overall vision in the environmental department for the waste? I.E. waste reduction of 50 % by 2000-sth.

DL: We don't have a goal on how much waste we want to produce. It is pretty hard to get there from the community site, as we cannot really influence the packaging practices of companies. That is more in responsibility of the national government. It is hard sitting in Aalborg and telling Siemens what they should do with their waste. Of course we could do that through networks but they also have experts on that and probably know what and how to do on that. They actually do quite a lot because they want to earn money, but they also want people to buy.

I think as a municipality you could talk to the community and tell them not to buy light bulbs or sth like that any longer

Do you know about initiatives that are done by citizens? (Story about Repair-Café)

DL: We have a project like that ourselves. People can put things in a container where they think that they are too good to throw them away. We take it to this project and they earn quite a lot of money with that.

Have their been some special actors who influenced the waste plans?

DL: It is mainly driven by our organization. And there is also an organization which represents all communities. So when we want to affect national policies then we meet together in this organization and suggest policies to the government. When the government wants to do sth new they also talk about that in the group. There is also a group for north of jutland and there is also a group for the parts who

own the incineration plants. There is a special environmental waste planning group. In smaller communities they don't have a planner like me. ERFA NORD is the group.
But we have also a group for mayors. They are talking about common issues. I.e. they were fostering a fusion of 3 incineration plant companies in the north of jutland.
Some things come from the TOP.
You said before that there is this common thinking that you want to reuse more, what do you see as the benefits of the old system? What are disadvantages of the old system?
DL: I think times have changed, people wants things just to be easier. There has been always the overall goal to recycle as good as possible. We always follow the best way to recycle. We haven't really changed the focus. We don't want to dump anything and then we have to take care about the hazardous waste. That is for example missing in the national strategy. We hardly have anything goin to landfill. But still it is too much. We should better sorting it.
Do you have ideas for other initiatives oder experiments?
DL: We haven't really decided how to collect the metals and the plastics. Whether we divide one bin or sth like that. There are also communities who sort everything first in a sorting plant (Rostock). Or did you hear about the project Rene-science? You should look into that. It is a project going on in the Copenhagen area. They actually take the bin from the households and crash it a bit and mix it up with enzymes. And then in the end it can be degraded to organics. So we are looking in all those different options, so we are looking if someone invents sth that we could use. We are waiting a bit.
So are you also looking at this Nulskrald project in Tversted?
DL: Yes we might as well learn sth from their project. But we are really interested into that CPH-project. DONG-Energy is behind that program. I am following that project. That is really an interesting project.
The only problem within that project is that farmers don't want the compost from it because farmers say it is not clean enough. And you have to follow that. Because if you cannot put it back to earth then you need to incinerate it and then we are back to discussion whether we should do it if it is not really environmental friendly. So there are quite a lot of different ways to go. Nothing is the right solution in the moment.
Actually we only see if things work when we try it.
DL: Yes and it is also about finding out whether it is okay to mix different plastics. For example the citizens would wish to have a bin for glas at their household. And some communities also takes glas into their plastic waste. But that's a problem because glas sticks into plastics and you cannot get it out anymore, so you have to incincerate it. But we want to have the hard and the soft parts of plastic. Our glas system is actually working quite well. I know that people find it annoying to give away glas but they do it. It works.
What do you see as barriers when you want to implement, i.e. zero waste initiatives in Aalborg?
DL: It depends on what it is. Some things are really logical to do it. But definitely financing is a big thing. We are lucky that we are not tax-financed, but we are collecting a fee. We can regulate the fee. But of course politicians don't want the fee to grow. But it is a easier way of working when you have a fee. So when we work right now with the new waste system we have to give out 100.000 bins and new trucks. So when we are doing one action then we also analyze the whole system and see whether people would stop using some other part in the system. For example in term of organic waste we found out that the waste which people give away one time per month for the bulky waste collections contains around 80%

garden waste. This garden waste is incinerated. What we are doing now is that we are talking to the politicians and tell them that the bulky waste collection is actually a garden waste collection. So what shall we do? Shall we just collect the garden waste with the residual waste and incinerate it. Most people take the garden waste to recycling plants. So politicians have to decide what to do with garden waste.
We categorized garden waste. Big parts are put into the heating plants instead of coal. Small parts are composted and people can pick it up for their gardens. And the middle parts are used for the regeneration of landfilled areas.
Questions that have to be decided by politician are barriers. Because they cannot decide about essential things, like shall we incinerate or compost sth.
Before we put sth into practice we always get sure whether we can get rid of all the waste. Because we know that it is not possible to recycle up to 100 %. We are now sorting by hand because we want to find out what actually cannot be recycled. And we found out that it is sth around 30 %. Maybe that is okay. But then we have to take this 30% and need to put it somewhere to incinerate it in another country in Europe or should we do sth local before we sort it out. That are some of the big questions. Why shouldn't we put it in our own incinceration plant. That are some of the important questions before we are asking people to sort it. And it is okay for me. I want that the people know that 30 % is recycled. You always hear that terrible stories afterwards. So it is important that people know it from the beginning.
Thank you very much for all the information
DL: Yes no problem.

Appendix 2: Interview Anke Sand Kirk

21st of May 2014 – 10:00 am to 11:00 am
The Transcript is not the original conversation, as the interview was conducted in German

What is the fremtidsguld project about?
ASK:In Joering is a project which is called Nulskrald. It is a little city. What we are doing in Aalborg is called Fremtidsguld and this test includes 700 households and three test area, where we have got, single-family houses (around 600) in kaerby, Kollegium for students (young and international students 34) and an area in Aalborg-East which is social-housing complexes where they share a common place for sorting waste (around 150 people). the same system is in the kollegium. one sorting place for all inhabitants. The family houses have their own bins. They have one bin for plastic and one for metal and in the metal container is a small bin for collecting small electronics energy saving bulbs. The reason for this little case in the metal bin, is that the electronics won't get stolen by other people.We wanted to hide it a little bit. it is for batteries, mobilephones, cabel and stuff from the household
How did the project start?
ASK:The whole project started because of the new resource plan of the EU. The plan says that we have to recycle 50 % of all householdwaste. But their is no garden waste and construction waste included. Actually we have a lot of garden waste in Aalborg. They have a formula with which you can calculate the recycling rate. this formula is valid for whole europe. When they launched this new strategy they asked whether we have some comments to it and we told them that it is a little bit injustice that whole Europe is compared on the same level, because we have all the take-back system with bottles, plastic-bottles and cans and that doesn't count into the recycling rate, neither. We haven't get any respond yet from

them. They also said that Denmark shouldn't have an incineration-culture which is quite hard because we are burning a lot. But it was decided that we have to recycle more and to incinerate less waste. And that is the whole basis why we stared this test. Because we knew that we have to collect more to reach the 50% goal. Because if we don't do this we would only reach a level of 25% recycling like it is in the rest of Denmark. So we are missing 25%.

How did you start the project initially in the three testing-sites?

ASK:So we started with plastics, electronics and metal. And the test showed till now that we can collect 1000 tons of plastic for whole Aalborg per year and around 1000 tons metal. But this numbers are estimated based on the data that we collected from our testing areas.This is not really much and we will also not reach the 50% goal if we only collect plastic and metals, so I guess that we also have to collect the organic waste seperately to reach the 50 %. But right now we don't know where to treat it. So we set the condition that we would like to know first where it is possible to treat it, before we collect it. In 1994 we started to collect organic waste and we would have liked to do that in the whole municipality but the politicians decided that we cannot do it because that is too expensive. There is also a report which says how good our organic waste was. But nowadays technologies became much better, but we will wait till we find a good solution. and we guess that it will also became a trade-good. especially in consideration of denmarks plan to have a fossil-fuel free energyproduction in 2050. and I guess that biogasification will be a part of an energy-mix.

What is the biggest challenge of the project?

ÁSK:The challenge of collecting plastic is that there is a lot of useless stuff inside. I estimate that we can somehow use 40% of the collected plastics. We sort many hours on it after the collection.Right now we sort it by hand. it is really hard for the people to understand that the plastics shouldn't contain any residues of food or other material when they are thrown away. If there is only a little bit food residue on one plastic-component then it doesn't take long that also other plastics will be contaminated by this in the bin.So we need to show a huge engagement that we inform the people and to teach them how to sort it right. that is the biggest challenge.

How are you involving the participants in the project?

ASK:We invited the people to a meeting when the tests began and around 75 people showed up. On the 10th of April we had again a meeting and there were around 40 people. But they also recieve news every second month about the collection and they can also inform themself via the homepage. we found out that Informing the people is the most important. Our experience shows that the people are very willing to sort their waste, but they should just learn how to do it right. The people didn't like that they have so many bins in front of their house that is why we decided to introduce bins with separation walls inside. so that they can throw plastics and metals in one bin. So we also have to buy cars who fit to these bins. But the political decision has to be met first, whether this system is also supported by the politicans.

When did the project start and which problems occurred since its launch?

ASK:The project started in September 2013. We noticed that Dannebrogskollegiet doesn't work really well. And especially after weekends when there were probably some parties. And the reason for that is that the bin for incineration waste is a bit more far away, than the bins for plastic and metal. And it looks like if they would just choose the bin which is the closest to their door. We also tried to move the bins a bit but that also didn't help. The bin for incineration is in an extra room where they have to open a door, so we guess that it is more convinient for them to just throw everything in the closest bin.We also

noticed that we have to inform them in english and then it became a bit better. We also wanted to make some interviews but we had no capacities. So we are looking for a student who could do that for us.
We were picking up the metal bin a few hours ago and the driver told us that there had been a lot of bottles in that bin. They don't have a bin for bottles, because they have to go 500 meters down to the supermarket to bring them back. and this needs to be orgnaized different for the students. And we think that the information for young people need to be done by young people. So we need better information from the beginning when the people move in. There are also different cultures in that Kollegium and they might not know how everything works in Denmark.

But are you also doing some educational training on the minimization of waste?

ASK: So right now we only send out information and train how to sort right but I think that there will come a lot in terms of waste-minimization in the future. But that will not only come from our side but also from other areas. We plan to implement a mobile school-bus with which you can get better in contact with kids and show them how everything works with recycling. In the past we invited kids to our recycling yards and showed them around. Now we created education material, so that we can make a bigger impact in the educational sector. But we also need help from students who develop that with us.

Which of these three testing-sites works the best?

ASK: The family houses work the best and in Aalborg-East they have sometimes someone who checks the bins and he reported to us that it looks always okay. The only problem is with plastics. There we experience in every testing area problems.

Who would you like to get more involved in the project?

ASK: The project is just done by citizens and the municipality. It would be nice to have students within the project to conduct the interviews in the Dannebrogskollegium.

What was suprising when you analysed the first results?

ASK: We also noticed that 41% of the metalls are alluminium-cans, which come from the german border, because it is so cheap to buy it there and they don't need to pay money for the take-back-system. Around 500 million are bought at the border and brought to denmark and around 23 million of these come to Aalborg when we convert that. 23% of plastics is plastic-bags and when we convert that to Aalborg then it will be around 11 million plastic bags that we can collect every year and we can earn a lot of money with that. But 39% is waste and needs to be incinerated. And we needed around 9 hours every time to sort the waste per collection phase.

Did you think about other ways to collect the waste?

ASK: For example in Copenhagen they only collect hard plastics. But we would like to collect everything and maybe we need to learn something from Joering to be more on one level with the people and share more information. We do not have the facilities to sort the waste when everything will be collected in the whole municipality. We will pay a company for our sorting. And i guess this will be too expensive in the lon-run. But that is a topic for whole denmark, that we need a facility for sorting. Right now we bring everything to Germany.
Plastic and metal are all trading-goods. And i guess that nearly everything of Denmarks plastic and metal is delivered to Germany.

Is there already a timeframe for the project?

ASK: So on the 1st of January 2015 we have to implement the whole system in Aalborg Kommune. But we stil have to wait for the confirmation of the politicans and we will start with plastic, metal and

electronic collection. We are looking for the best solution for the organic waste treatment and the average level of recycling in denmark is around 25 %

Do the participants also make a contribution to the project?

ASK: When we had the meetings with the people, they had a lot of suggestions and comments about the experiment and they also have the possibility to comment on the webpage. The biggest confusion occured with the plastic sorting. The people asked a lot of questions about that.

So do you already know how everything will be implemented in Aalborg by the 1st of January 2015?

ASK: We have a suggestion, but we don't know whether this will be approoved by the polititcians. So we will start with the bin with the separation wall. And we also suggest more flexibility for the citizen, so that people could also order smaller bins. So that the whole waste system gets more flexible. So a kind of reward system for producing less waste.

Is there any other project going on in terms of Zero Waste?

ASK: Yes the schoolproject will be a bigger project. We would like to change the thinking about waste. We would like that kids see waste as "gold" and not as something discardable.

There are somehow 4-5 events in the year where we are participating with waste and there was just one in the library where I told about fremtidsguld and someone else about the project in Joering. That is also our strategy that we are more at the place where the people are.instead of poducing information material. That we get more in contact with the people.

Why didn't you just oriented on practices that other cities or countries do and just provided the whole municipality with additional bins?

ASK: We wanted to test how it works with the bins and how the people accept them and also how good they sort it. Our goal was to find out how much can we collect. And it is important to know which amounts we can expect so that we know how many cars we need to buy and also the quality of the waste. So that we know how much time we need to invest to sort it afterwards. The focus was on collecting experience and we also find out that the way that we started was not the right one. So we tried to adress the people with this test and to give them influencing power and that we could make reliable calculations. Because in the beginning we tought that we could collect much more plastic, but it hasn't been like that.

For example when we started to collect paper waste we gave out bins for a capacity of 40000 tons but only collected 10000 tons.

It is more expensive to collect the plastic waste as it is less and we do not earn that much with that. whereas we earn much more with paper

What do you think could be a barrier that the target of 50% waste-recycling can be achieved?

ASK: I could imagine that we cannot get rid of all the waste. because when we collect it it also has to be ensured that we can give it to a local facility. But we have to collect organic waste to reach the 50% goal.

Appendix 3: Interview Brian Rasmussen

1st of April 2014 – 11:30 am to 12:35 am– Telephone-Interview

Which initiatives are you working on in terms of Zero Waste right now?

BR: As a company we are focused on our own waste of course. Right now we just have finished the project with waste from the cleaning machines driving around our areas and storage areas and facilities. It is cleaning like 500-600 tons of sand and agricultural products, that are on board the ships, we have just finished the project where all the organics is now sorted and kept as a fraction for itself and is delivered to a biogas plant. The rest of the organics are sorted and used for composting. Another company does the sorting for the port. When we clean the areas we clean it more strictly, so we don't mix too many kinds of materials. So when we had storage of a ship out on the (Key area?) we cleaned them up first and go to this company with the material and then we go back and clean the rest of the area which mainly consists of sand and then we go back to the company and bring them the sand. By the pre-sorting of the material the company has a much easier job to clean it.

So from last year 2013. We delivered nearly 500 tones to the incineration plant. Most of it is water and sand. Now we are 100% recycling nearly.

Now we are looking at slop-oils from the ships and like 650 tons a year. It's a residue of the machine. When the ships clean the oil there is a fraction with is left over and they put it in a tank with water and different kind of waste-oil, waste products, so they just get rid of their slump-oil tanks when they come to the port. Around 100 ships per year in Aalborg. And we collect around 50 tones of slopoil. That's the next project. We are working on different kinds of projects, like trying to reduce the amount of waste going to incineration and to recycle and reuse as much as possible.

Initiatives in the network?

BR: Industrial Symbiosis initiative. Some of the groups in the networks focus on reduction and reuse of materials. 2-3 companies in the network deals with metals. They are painting, bla bla clean it. They use sand for cleaning the metals. A lot of dust and rust emerges. And then you have sand mixed up with iron and different kind of metal dust and sand. Even the smallest company has around 50 tones of that material every year and one of the big companies has 2000 tones. It is a huge amount. 3 companies working together to extract the metals out this sand-metal mixture again. And then you have the clean sand that you can use for anything. That is one of the projects.

Are there only some companies working on specific topics? Like 3 companies on waste 2 on water …??

BR: Laundry company works with water. They have a lot of hot water. Dispose the water in local municipal wastewater system. But they could also give it to another company. Like siemens they could use it for cleaning their blades before painting. Obstacles: Siemens needs to know exactly what is in the water. Because otherwise they are not allowed to put it into the sewage system. Even though that it is easy to use the water again the regulations forbid to put it into the sewage system as you don't know which byproducts will emerge after the cleaning of the blades. That is sth needs to be negotiated with the municipality.

There is also 2 – 3 companies workingon -> their raw materials are often covered in plastic and on "Holzpalletten" -> all considered as waste. Last meeting the representative from a recycling company. They are collecting industrial waste products like plastics from north of Denmark and they are recycling it. Representative told how to recyclce and sort the plastics. You have to bery srict with the sorting. When

you buy raw materials.different companies use different packaging plastics- that means you have to find out which plastics your suppliers use and how you can recycle it. This inititative has just started

Are there documents ?

Yes some in Danish

Port is just facilitating the meetings. The port is not participating the meetings. Some projects don't even come to their knowledge. Good solutions are kept in the confidential business. They don't want to share it as much. All they know is in the protocol.

How did everything start-> What are or were the drivers of change?

Was there a certain event which triggered the initiatives?

Did something about the policies in Denmark or Aalborg change that you started the initiative?

BR: The port started everything. It is part of their environmental strategy. To broad the perspective of their own business. They could have just looked on their self but they see it like this. Their product is a service. We are very dependent on the companies around us having good business. When they are succesfull then they will need more transportation and facilities and their products.more buildings ….

We think for us we are a landlord business we have nearly 150000 sqm of land that we are renting out. We profit from the growth of the companies in the area.

The other side is the sustainability perspective. It makes a lot of sense to make their own business sustainable. But if we could use the same amount of resources and focus on our sorroundings and companies around us. It would have a much larger impact If we could move others to start sust development. More value for money to concentrate money on network then on their own business. We started with 25 companies in the network now we are 80. One of the issues beside infrastructure and business opportunities is to use the network as a tool to deliver the message of sustainable development. To get more and more companies to work towards sustainability. A group started in the network dealing with environment and energy. First last year we tried to invite many companies that would be relevant to talk about Industrial Symbiosis. Our idea was to get the people in contact and get to know each other that they can network and maybe start up some projects. First talking in the meeting about waste-heat use and waste water and so on.

Energy and Environment groups organizes everything?

BR: Three or four companies in environment group participate by the Industrial symbiosis. Most of the arrangements and the facilitation of the meetings is done by the port of Aalborg in collaboration with some people from AAU and the network for sustainable business development (NBE)

We have made a contract with NBN to work together on IS. Last year national funding was available so they sat down and wrote a project description and we got some funding for trying to work with IS. And the funding went to NBEN secretary, so they could hire some people to do the work because we have no resources in port of Aalborg, beside ourselves. So we arranged to have some national funding to NBEN so they could do some of the practical work. They have some people sitting there, writing and finding the companies that would be interested in working with IS. They did a lot of work when we had some funding for it. But the funding ran out in autumn last year, so we are pretty much back on scratch and I am looking for some kind of way that we can pogress this work, cause it contains a lot of energy and resources to facilitate this meetings and also to ensure that they feel that there is something going on there is a progress so that they want to participate in the meetings. So it doesn't run by itself, we have to

put in resources, new perspectives and arrange for new suppliers of recycling to get to these meetings and. There is quite a lot of work in it and it is too much work for the port of Aalborg to run it by itself.
There is supposed to be a huge project in Aalborg East which is called "smart city". It think it has been postponed for a year now but I think they are making a project description for a five year project. Then I have this idea that maybe instead of gathering people around a table to discuss whether there is any relevant thing that we could collaborate about, We should set up a very ambitious target. Like "We want this area to be a zero waste area. In 5 years we don't want waste at all. That is a very ambitious target. It is a very ambitious target but if we do it we will have a complete new mindset. To address the problem what kind of materials do we have today and what are we doing with them instead. How do we recycle and how can we use it again. Where will we do it? Shall we do it in the local area. New business opportunities and so on.
That was the idea of the zero Waste and I think it has been put into the project description of the smart city, but I think it has been postponed for at least a year.
This is a very interesting point: Is there right now sth like a vision in the network or in the IS-group? Short-term long-term goals?
BR: It is just the group of IS where the companies work together. There is no overall vision. There is only testing the idea of IS. They talk about implementation and how to collaborate, how to start the process. We are just testing out the idea of IS. But I think if we could make a vision and if we could make the companies adopt the vision then we could make a huge progress. I think this could be used as a driver. You could create some common sense. I think if we would have a vision it would be very inspiring.
Sometimes you have to have big visions, you will maybe not get exactly to it but you'll get far. There is no real criteria for success
I have a question concerning financing: How is everything financed? Do you get money from the municipality?
BR: it is only financed by the companies and they finance it by using time on the projects. There was one project which was funded by a national program and there was a pre-study for district cooling. The incineration-company Reno-Nord and the coming hospital, that they are starting to build now. 3 companies went together and there is a pre-study about district cooling. We haven't heared much of that project. The region who I managing the project did quite a poor job. Mostly the money is kind of wasted. Unfortunately. It is not worth spending time on. Most of the other projects are funded by people like me
I would like to know whether you also see other barriers than financing? External and Internal barriers?
BR: There is different kinds. If you want to reuse waste heat for example. When a company uses electricity to heat up i.e. the laundry service out here. They use electricity to tumble dry the cloth. When you use it it is called processenergy. So when it is named like this you can get refund for it. And by the energy quite cheap. But if you take the waste heat for heating up the office building, then you have to pay the tax because it is not anymore processheating it is roomheating. Then you have to put on energy-taxes. Often it wouldn't be economically feasible. When you are looking at Aalborg area and port and vattenfall/electricity plant on the other side on the fjord. Actually we are producing five times the waste heat that is used in Aalborg in the district heating system. So we have huge amounts of energy wasted. Blown up in the air. A little bit from Reno Nord and a lot from Aalborg Portland and also the electricity plant they just throwing out their heat. Somehow it would be good to find a way to use this heat. That

would be very interesting. I think the structure in putting taxes on energy is a barrier for using waste heat. Then I also think that environmental issues is still a small subject for most countries. Most companies have done the obvious thing but it is not really high up on the agenda of most companies. Like the CEO-level. There is no pressure from Top-Management to do sth about it. One of these nice-to-have. So if it would be able to get it higher on the agenda. If we would have this zero-waste projects in the area then it would have an influence on the CEO-level. And there is money to be earned. So it is a focus problem.

I think also these small obstacles that I told you about wastewater being used by siemens and they are not allowed to do it in the sewage systems. There is no money there to be saved but of course it is easy to reuse the water. There is not much money to be earned but you can save water and energy. But it is also due to the Water-administration thing. They want to know what is in the water before you put it into the system.

Is there a stakeholder you would wish to support the initiatives more?

BR: Of course it would rise the awareness when there is support from the governmental sphere. But it has to come more from the bottom up then from the top-down. If we could go around in the NV9220 and define it as a project and give the approval that we are all goin for this zero-waste project and we can make it public. I think that is the kind of thing that could involve more companies. This would somehow create a picture of Aalborg Business district as an innovative and collaborative place. I think that could move a lot in focus. I think that would be right way to do. If we could turn it around.

You said that there is a meeting for all initiatives is it a common meating or do they meet ?

BR: We have some big meeting where the initiatives can exchange during the breaks. We cannot see the process from here. We are breaking a new ground. The conclusion of the last meeting was that it is really nice to meet each other but it is alo hard to find possible meeting dates. So we guess that we will maybe make smaller groups. It is not the port of Aalborg that develops the progress. We are more interested in facilitating the process and not be involved in it. Our role is a little difficult.

Do you know about other initiatives in Aalborg that are goin on in Aalborg in terms of these

BR: No. I think if you want some more information you should contact the NBEN.

Thank you

BR: Nice thing about private households is that himmerland is rebuilding the most of the existing houses they are very keen on trying to build for the future. They are thinking about, how to make the residential areas easy to save energy and easy to sort your waste. They are looking on building small houses where you can go to sort your waste.they are trying to build up an infrastructure that can support waste-sorting. I think we have good opportunitites in the business infrastructure to do zero waste.

You will get publicity and this would also foster the process. So I think the zero Waste project would be very nice to do that.

Appendix 4: Interview Thomas Lyngholm

06th of May 2014 – 3 pm to 4 pm

Could you please introduce yourself and tell me about your tasks/main fields of work and position in RenoNord?

TL: First of all when it comes to education I have also the same background as you. I am an engineer and I have worked with environmental planning in my studies. I came to Reno Nord about 14 years ago and I am working as Environmental Manager. My responsibilities are to insure, that we fulfill all environmental regulation, I manage projects and I participate in developing the company. There are a lot different things I work with. It is not a large company, when it comes to number of employees.

So everybody is somehow involved in the projects?

TL: We are not specialized as for example in Aalborg kommune

Is RenoNord doing right now sth in the direction of recycling or reuse of waste?

TL: What we do is to take part in minimizing the waste in the incinerator and landfill. We run an incineration plant which is here and landfill which is on the other side of the limfjord. We do a lot of efforts in controlling waste that are comming here, to see if there is a potential for recycling instead.

Ah okay, so before you incinerate it you are sorting it?

TL: We are not really sorting it. We are monitoring it and if we a lot of plastics for example or a lot of cardboard wich could be recycled. And we register that this waste producer brings lots of waste, that could be recycled, then we send this information to the authorities, that can then contact this company and discuss waste handling on their side. Because it is not optimal. We do not run recycling facilites,like other waste companies that collect cardboard and plastic and so on. we do not to that. We incinerate waste that is suitable for incineration. And we see our mission to get as much resources as possible out of that waste. That's basiclly energy, district heating and electricity and then it is metals that we extract from bottom ash., that can further be used for construction purposes.

The bottom ash you recycle yourself or you give it to another company?

The bottom ash is used for road constructions, if someone wants to build a new street for example. They call us and say do you have some bottom ash left, that we can use instead of sand for example. and we say yes. Then we save some of the natural resources like the sand that is taken from somewhere in the nature

That's better than just landfilling it, This waste management plan of Aalborg says that they have the plan to reduce and reuse more the waste. There is also the plan that they want to give more bins to the municipality to sort plastics and organic waste extra. And I am interested how is it for a company who incinerated waste, do you see it as problem, that you say that you will have to less supply of waste for you incineration or do you say it is no problem because you have other sources?

TL: As things are at the moment it is not a problem for this company when the waste amounts are reduced, because we can import Waste from england. There is a lot of waste on the market so we can run and incinerate this plant with full capacity the whole year. But in the long-term it could be a problem. But it depends on how you look at it. Because for an incinerator you get the best economy if you run hundred percent 8000 h a year. So if there is less waste, so you, let's say run 100% only 6000 h per year. Then you won't get the income of sales of energy for 2000 h production. Then it gets more expensive to

handle the 6000h then to handle the 8000 h. But if you are. You know it is the municipality that pays for the waste-service. So if all agree that it is not a problem, that it get little more costs to incinerate then it is not a problem. But if there is a pressure on the incineration plants, that you have to be as cheap as possible, then it is of course a problem.

Because Reno Nord is not 100% private owned?

TL: No it is not private owned. it is owned by 5 municipalities. so it is a joint company

Are you as a company somehow involved in the waste management plans for next year or is it just done by the municipality?

TL: We haven't been involved in this planning so far, but I think we will. Some years ago Aalborg had another waste handling plan and we were involved in capacity planning and in forecasting of the waste amounts.

So like you are thinking that there will be again an approach that the municipality wants to involve you in this waste management planning.

TL: I think so and I hope so.

This is a question more related to your expertise as Environmental Engineer: Do you think that Aalborg can reach a 100 % recycling or reuse of waste. or do you think it is a difficult topic right now, because some other things have to change.

TL: I think in the long term it would be possible to ... Zero Waste, I don't think that this is the right term. But what they mean by zero Waste. We do not incinerate and we do not landfill. I don't know whether you would agree on that?

Zero Waste says also that you cannot reach the 100 % but is going in the direction and say we have to organize our products and resources in a circular ways.maybe it is possible to recycle them or maybe it is also possible to use products by 100 % in terms of Cradle to Cradle thinking for example.

TL: Cradle to Cradle is somehow close to Zero Waste. But just another kind of recycling. It gets waste and then it gets recycled. But some other kind of recycling somehow.If you look at the danish waste study. When it come to incineration in not very precise numbers. Now we have around 3 million tons of waste for incineration and the goal is in 2025 it should be like 2.5 million. That is what the government expects. That is not exactly zero waste. it is a small reduction of the amount of waste for the incineration. So if that is what we are looking for then I think it is not a problem for the incineration plants. At the moment there are around 27 incinceration plants in Denmark, some of them are new, some of them are very old. the problem is that if there is less waste and we have a free market for waste. the waste will go to the incinerators which are cheap. And cheap incinerator are typically the old ones, because all their finance costs are gone. So one scenario that the old incinerators get all the waste. But that is not really smart because then you have to close down all the new incinerators. and the new incinerators are around 20% more efficient than the old ones. They have much better environmental performance. when it comes to fluegascleaning and wastewater handling and so on. So what I think could be the solution of this scenario, it could be more steep. It depends on how the municipalities implement this in the waste handling plants. But right now when you look at this map, we are here, we cover around this area. in a month from now we will merge with a waste company based in hobro, so we will also cover this area. And this incinerator is a very old one. And we will maybe shut it down. We will take this capacity out of the market and collects incinerable waste of a larger area. And in a way you can see that as a solution for the

development of the waste amounts. We close down the old incinerator but we get a larger area that we cover and then we can run this new and efficient incinerator with its maximum capacity.

So it wouldn't be a problem with the waste reduction?

TL: It would not be a problem, if you could do this plant capacity reduction.

So all over Denmark in that way

TL: If you think likewise not a ?? we can take the old plans out and can still have the energy from incineration

So is it also beneficial for the incineration that Aalborg thinks about taking out the organics out of the waste?

TL: It is not a problem. It is not a problem to incinerate waste from food. It could be a problem if you have more waste than the incinerator capacity, then you could treat some of it by making biogasplants. But when it comes to utilization of energy, it is better to incincerate it than to make biogas out of it. Sounds strange because what have been stated about biogasplants is that you make methane and you burn it on a biogasmotor that produces electricity and the electricity efficiency is about 35%. And in an incinerator we can only achieve 28 %. But when you make biogas you loose a lot of energy from heating the process. When you compensate for that it is actually better in burning it in a incinerator.

Did it come to your mind about other initiatives that are goin on in Aalborg about Zero Waste?

TL: Aalborg is doing a lot to try to recycle the hazardous waste and electronics and so on and actually we are involved in this, because we handle all the electronic waste as well.

Is it this fraemtids guld project?

Yeah exactly fraemtids guld. Future gold. Another thing that is goin on that in this part of Aalborg, we have a network between companies where we meet a few times a year to discuss how we can make some kind of circular economy. We use each others waste products

But do you know whether it is already somehow progressing. is there something initiated that companies work together about something?

TL: There have only been a few meetings so far but each time we meet I notice that someone gets to talk, ah maybe we have to work together about sth.

So there are a lot of ideas but not really?

TL: There are some ideas and some things are really happening. Maybe if you are interested you could talk to another guy who is part in running this programm. His name is Brian

Ah Brian Rasmussen

TL: Yes it is a small world

I have a question about the incineration plant here in Aalborg. Do you know how long it will run or how long is the timeframe. Or when do you think that it will be shut down?

TL: I can only guess. But I have seen a report it will be published soon. It is a cooperation between the danish waste association, the danish district heat association and a consultancy company called EA Energy analysis. Unfortunately it is only in danish. This report has made some complicated calculations on how will the energy system in Denmark develop in a timescale until 2050. And the conclusion is that they suggest that there will be some kinde of plant reduction of incineration capacity and what we will end up in 2050 with incinerators in 5 or 6 larger cities in Denmark. That is Copenhagen, Aalborg, Odense,Aarhus and I don't remember the last one or two, but Aalborg is among who they see as having an incinerator in 2050 as well

So reduction of 27 incinerator to 5 in total by 2050? This report is not published yet or is it published? Do you know about that maybe?

TL: You can find it online. It will be published soon.

Like when there will be only 5 or 6 incinerators in the end is it also planned to expand the district heating system? Right now RenoNord is supplying Aalborgs innercity, so I would like to know whether you try to expand that?

Yes Aalborg has big plans of expanding the network and actually it is not only the inner city. I don't know what you think when you say inner city. Aalborg by itself it ends like on the other side of RenoNord. There is no more city so it is all over the city. There are transmission pipelines to a city called Klarup and a city called Gistrup.

Is RenoNord the only facility in Aalborg that treats the MSW in Aalborg?

It is only RenoNord. But of course other companies are treating glas and paper and so on

So you are treating electronic waste and incinerate?

TL: Yeah Electronic waste is just a small business. It is like a favor we do to Aalborg Municipality, but of course they pay for it, but it is not our core business, not at all. The core business is incineration and land filling

I would like to know whether you would think that there are some things that could hinder Aalborgs plans to recycle and reuse waste? Do you think there are some companies in Aalborg or in Denmark that could maybe stop this Zero Waste approach?

TL: I think the main barriers are the economy. It is usually more expensive to introduce more bins and sorting system.

So what do you think drives this reuse and recycling initiative? Do you think it is only because of the new waste strategy in Denmark, that they want to recycle 50 % of the householdwaste by 2022. Do you think that is the only motivation that aalborg or do you think that there are also other reasons?

TL: I think that is the main motivation is that there is a national strategy.

That is also what I somehow got out of the interview with Dorte Ladefoged.

Okay I'll go through my questions to see whether I forgot something.

I do not have any questions left but do you want to know something

TL: Is it a part of your master thesis?

Yes it is a small part to see what are the barriers about the waste management plans in Aalborg. To see what hinders a change in the waste management system and what drives it.

You gave me really valuable and good answers I want to thank you for that.

TL: so you haven't been to incineration plants yet?

No only to sludge treatment.

TL: But if you like to i could show you for 10-15 minutes around.

Yes that would be great thank you.

TL: It hink it would open your eyes to what incineration is all about