UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

Master Degree Project in Logistics and Transport Management

Scenario Development of Waste Import to Sweden

On behalf of the Port of Gothenburg

Emelie Wallgren and Katja Dvali

Supervisor: Rick Middel
Master Degree Project No. 2014:50
Graduate School

Abstract

This report deals with surrounding conditions for the relatively new import flow of combustible waste to Sweden. In recent years transboundary transportation of waste has increased considerably, which is mainly driven by EU regulations regarding landfill minimization. Other driving forces of this flow have been the overcapacity at Swedish incinerators, the available waste treatment techniques and the increased trading interest for this commodity. However, the importation and particularly the flows that demand maritime transportation constitute a complex logistic chain with practical and economic constraints. There is still no standardized transportation solution for this cargo and actors involved are investigating if it has a future potential for deliberation of possible investments in logistics.

The study was commissioned by the Port of Gothenburg with the purpose of mapping the current flow and identifying driving forces and certain/uncertain influencing factors for these import volumes. The identified factors have been divided under the sections *regulations*, *market and capacity development*, *logistics* and *environment.* Further, in order to provide a basis for possible investments, trends and factors are processed in a so-called scenario planning model. The model used for scenario development in this research is a case adapted version inspired by previously published models.

Acknowledgments and Thanks

First of all we want to thank our advisor Rick Middel for all input and support throughout the process of this thesis. The help we got has exceeded our expectations. He encouraged us all the time and gave valuable feedback. He knew exactly what was best for us from the beginning and his advices were highly appreciated.

We would also want to express our deepest gratitude to Jacob Minnhagen and Viktor Allgurèn at The Port of Gothenburg for giving us this project and putting a lot of effort to guide us during the whole period. Due to their enthusiasm towards this subject but also due to the trust they showed us, they kept us motivated all the time. This positive attitude has inspired us to explore more.

Further, we would like to thank all participants in the interviews for giving us such detailed and useful information for this research. They helped us to understand the industry in depth and identify future trends. Without their participation, development of reliable scenarios would not be possible. By this we also want to give special thanks to interviewees at Profu, Avfall Sverige, Renova and Gothenburg Roro Terminal.

Katja Dvali

Emelie Wallgren

Table of Contents

List of figures

Abbreviations

ETS	Emissions trading system
F2F	Face-to-face
GDP	Gross domestic product
JIT	Just in time
LSMDO	Low sulfur marine diesel oil
LSMGO	Low sulfur marine gas oil
MSW	Municipal solid waste
NGO	Non-governmental organization
OECD	The organization for economic co-operation and development
OPEC	The organization of the petroleum exporting countries
PWP	Paper/wood/plastics plants
RDF	Refuse derived fuel
SECA	Sulfur emission control area
SRF	Solid Recovered Fuel
WFD	Waste framework directive
WTE	Waste-to-energy plants
SEK	The Swedish currency

1. Introduction

This chapter provides the reader with background information for introduction of the case. The problem formulation and the purpose section explain the driving forces for this research and why it is important to investigate this issue. Finally, the chapter concludes with delimitation of the subject and thesis disposition.

1.1 Background

In recent years, minimization of waste on landfills and turning it into a resource has been important objectives of the EU. Situation differs significantly in European countries. Some members of the Union are at the forefront of innovation through effective transformation of waste into an energy resource, while other members landfill most of their waste in anticipation of better solutions (Avfall Sverige, e2013:06). EU Landfill Directive imposed State Members to set up national strategy for the reduction of biodegradable waste going to landfills. The directive had set up goals for EU countries that must be achieved in a certain timeframe (1999/31/EC). This in turn has led to extensive investments in waste disposal methods in most EU countries, both within recycling and energy recovery. However, costs for changing the landfilling strategy are very high, licensing processes are time consuming and lead times are long, making it difficult for some members to introduce drastic change in coming years. For this reason, exporting waste to other countries has become as an option to meet the milestones (Avfall Sverige, e2013:06). However, this type of cargo is characterized by its very low value meaning that cost related to the transportation, handling and gate fees must be low for it to be economically viable (Tolvik Consulting, 2011). The level of landfill tax in exporting countries determines the willingness to pay for these transports (Avfall Sverige, e2013:04).

Sweden is one of the countries that recover most energy from incinerating household waste. The recovered energy includes both electricity and heat, covering a part of the households´ and industries´ needs (Avfall Sverige, f2012:04). The network of district heating is cheap and more environmentally friendly alternative compared to other heating options. To keep prices low, it is necessary to have constant supply of municipal solid waste. However, the financial crisis that occurred in 2008 has led to less consumption and less waste volumes for incinerator plants. In addition, the country´s enforcement in implementation of recycling programs has given the result of even more decreasing combustible waste volumes (Avfall Sverige, e2013:04). Naturvårdsverket, the Swedish environmental protection agency, investigates if there is possibility to introduce further milestones for recycling. This will lessen domestic combustion waste further if implemented (Avfall Sverige, e2013:04).

Simultaneously, the capacity of incinerator plants is steadily increasing. More and more municipalities apply for expansion of their existing plants and some additional are already under construction. If carried out, in 2020 the incineration capacity in Sweden will reach between 6.6 and 7 million tons, leaving more opportunity to alternative solutions (Avfall Sverige, e2014:03). Importing sorted municipal solid waste from foreign countries has become an emerging business in recent years. Volumes have increased significantly, especially after the financial crisis. WTE (waste-to-energy) plants do not only get fuel for heat and energy recovery, they also receive money by providing service. Hence, profitability in this business but also high prices on fossil fuels evokes more interest (Avfall Sverige, e2013:04).

Transportation of waste across national borders is highly regulated and involves many actors such as municipalities, authorities, companies, governments, transportation providers, etc. The port of Gothenburg is one of the participants in this complicated supply chain. It is the biggest port in Scandinavia handling one third of Sweden's foreign trade that offers direct routes to 136 ports around the world in countries like USA, India, China, Middle East etc. For further transportation of the cargo, every day, more than 70 trains depart or arrive at the port linking up many important cities in both Sweden and Norway. The company´s vision is to "be the obvious freight hub for sea transport in Scandinavia" (Port of Gothenburg, 2014). For this reason they are trying to facilitate good conditions for effective and sustainable cargo handling. Imports of municipal waste are relatively new phenomena for the port. Hence, as waste is a new product, it is risky to put investments into handling equipment, without knowing the future potential. By creating a picture of current situation and by designing possible future scenarios, it will be easier to see the trends. These will provide a basis for correct strategic decisions.

1.2 Problem formulation

As already mentioned, EU has in recent years taken steps to bring Europe further up in the waste hierarchy. The amount of waste going to landfill is still very high in many European countries causing major environmental damage to both air and water quality. In order to achieve EU objectives, many member states have begun to overlook better disposal techniques. However, not all of them have the capability to quickly build the required capacity. This fact in combination with relatively high landfill taxes increases the need for exports to countries with overcapacity. Sweden is one if such states where the situation is characterized by extending combustion overcapacity in relation to domestic waste. Both increase in recycling and other established target achievements has led to a reduced amount of domestic combustible waste. To fill the gap, import has been a necessary solution (Avfall Sverige, 2008:13) (Waste

Refinery, 2013). The situation changes all the time in terms of imported volumes, waste suppliers, competition, but also regarding the level of gate fees. For this reason, a thorough examination of different driving forces is vital to predict the future in this industry.

Reports published by Swedish organizations have identified some trends regarding the handling of waste. These are: 1. Increase in importation of Municipal Solid Waste (MSW) to Sweden. 2. Expansion of Swedish incineration capacity. 3. Growth of recycling in Sweden -leading to reduction of domestic combustible waste. 4. Less dependency of petroleum products for district heating, etc. (Waste Refinery, 2013) Due to these trends the need of transportation and logistics solutions arise. Also, there is a need for information regarding the flow and its future. A challenge for this new phenomenon is to find the most suitable dimensions of resources, since uncertainties that might affect the future is difficult to predict. The phenomenon of waste importation to Sweden is relatively new; hence literature lacks information of the flow and its prerequisites. In addition, various trends are pointing into different directions, making it challenging for some actors such as the Port of Gothenburg to make investments and develop reliable strategies. If the port offers a well-functioning logistic solution, it may encourage operators to steer the logistics chain through them. This would provide economies of scale, which may facilitate further development of logistics flow.

The fact that waste is a cargo type with significantly low value puts great pressure on the logistics chain. Transports should preferably consist of return shipments, which would have gone empty otherwise. In addition not all incinerators have access to railway all the way to the facility, which often results in truck transport all the way from the harbor. Waste also places other requirements on logistics. For example, it can attract rats or other vermin, which makes it necessary to avoid storage. There is usually no additional storage space at the incinerator, more than the filling space adjacent to the oven. Hence, the incinerators are depending on high frequency deliveries.

The phenomenon of waste imports is an interesting field both in terms of the complexity of the chain and also due to the economic and environmental effects related to the issue. The challenge of facilitating the flow lies partly in streamlining logistics and reducing the transport costs. In addition the industry copes with society's reluctance to the imports. Transportation of this specific type of cargo entails negative opinions from people and organizations. Even authorities have a hesitant approach to the flow. For this reason, various laws and regulations surround waste handling. Changes within these will have very high impact on the industry.

1.3 Purpose

The main purpose of this research is to look at different trends in waste management industry and foresee their development in the future. Movement of solid municipal waste across borders has got interest in recent years. For this reason only little information is available about how this new product is transported or which incineration plants take care of foreign waste. The investigation of current situation and prediction of future trends will represent the basis for the port of Gothenburg to make reasoned investments for enhancement of logistical flow. This information can help them maintain or improve their competitive position. The company is steadily working on finding new product flows in order to increase the income and gain economies of scale. The sorted municipal waste could be a new product generating growth for the company.

This paper will focus on mapping the current situation of the MSW import flow in the perspective of the Port of Gothenburg. Furthermore, a scenario planning for the next five to ten years will be presented in order to visualize the potential of the industry and provide a foundation for investments. Consequently, this study will investigate the variables that may have an impact on this particular flow. Hence, some objectives that this research is expected to fulfill are: *1. Oversee of the current situation including all imports of municipal solid waste to Sweden, the ways of transportation and existing obstacles. 2. Choose an adequate method for scenario planning applicable on the industry. 3. Identify all certain and uncertain trends affecting the industry. 4. Provide four possible future scenarios based on key uncertainties. 5. Give recommendations to the Port Authority*. In order to achieve the research purpose, the research question that this report is expected to answer is:

What changes will the Port of Gothenburg face in five to ten years concerning imported municipal solid waste?

Two sub questions to the main question are:

What is the current situation today regarding this import flow?

What future scenarios may be the most relevant for this import flow?

1.4 Delimitations

To sharpen the focus of the research, but also due to time limitations, some aspects are left out from the investigation. The thesis will concentrate only on the imported municipal solid waste by incinerators,

omitting other types of waste such as biofuel and woodchips. Cement industry that is another waste importing actor is also excluded from the study. The imported volumes by this actor are quite small and the target is to decrease the share even more. Further, time constraints do not allow deep review of foreign countries´ waste export need or deep understanding of their regulation. Instead, the authors rely on the information gained from Avfall Sverige, Profu and other Internet sources on this issue. In addition, concentration is on those states that already export waste to Sweden or have high potential in the future.

Interviews with incinerator representatives, but also to other actors have contributed to the mapping of the current situation. These interviews will not be transcribed due to some interviewees´ desire of being anonymous. Instead the information will be used as a compilation of secondary sources.

In the recommendations part possible investments/improvements for the future logistics flow will be described from a broader perspective. Usually, this process is quite complicated including various aspects such as resource limitations, different contracts, regulations, etc. The focus of the study will instead be on mapping current situation of solid waste import and visualizing of the future trends. Further, this study excludes the implementation step in the scenario development model. This step needs to be conducted by the company.

To conclude, the investigated circumstances affecting the flow will be limited to actors, regulations, logistics and economics. This excludes unexpected actors that may have an impact on the industry.

1.5 Thesis Disposition

The following chapter includes theoretical overview of scenario planning. It introduces different types of scenario planning techniques and what methods will be used for implementation of the research. The third chapter will review the methodology used to answer the research question. It consists of data collection, including interview design and data analysis. The next chapter will present empirical findings for this subject identifying all relevant actors for the industry. The fifth chapter will analyze the trends and their drivers. On key uncertainties four different scenarios will be developed visualized by story maps. The last chapter will consist the conclusion, recommendations to the Port of Gothenburg and description of subjects for further research.

2. Theoretical Framework of Scenario Planning

This chapter presents the framework of theories applied in this paper. It begins with the definition of scenario planning and description of its benefits. Further, based on multiple scenario developing techniques, a customized model is presented including six steps analyzed in depth. Finally, some challenges with this concept are listed.

2.1 What is scenario planning?

As stated by Postma and Liebl, “Scenario planning is a strategic planning tool to develop and think through possible future states and paths”. The process aim to increase the understanding of paths that lead into different scenarios and it tries to align the strategy to possible big changes. In order to make the best strategic decisions, managers often prefer to look in the future and get a hint of what it holds. Scenario planning is a model based on several approaches for applications in corporate environment (Postma, T., Liebl, F., 2005). The purpose is preparation, why uncertainties are identified and elaborated. During the process all uncertainties and possibilities given the certain context are captured. This step stimulates managers to discuss important issues relevant for the long-term perspective that would be unanticipated otherwise. Further, based on these uncertainties, “possible futures” or “scenarios” for either continuous or single use are constructed to visualize the sequence of events. Each scenario should be customized to the case and provide enough details to enable the manager to predict success or failure of different strategic actions executed by the company. These multiple scenarios facilitate strategic decisions when, already at early indications, it is possible to reveal the chances for possible futures. Through these scenarios managers will be prepared to major changes that the future may bring. Consequently, the method allows more advanced prediction and better preparation and adaptiveness for changes in the industry. This can then be used as an opportunity to grow or get advantages over other actors or competitors (Konno, N., Nonaka, I., Ogilvy, J., 2014) (Schoemaker, P., 1995).

The history of organizational scenario planning originates from the military, which used this method in war games. The technique was further introduced into the civil market by the non-profit institution RAND Corporation during and after World War Two. Since then, different actors for strategy development have successfully used the concept of scenario planning. The first company to use the technique was the Royal Dutch / Shell. After some time it was found that the concept helped the management and purchasers at Shell to be prepared for major changes in the industry. This was especially

noticeable when Shell handled the 1973 oil crisis significantly better than their competitors. During the crisis Shell was successfully practicing its adaptability to create great benefits such as reduced costs and less usage of resources (Van der Heijden, K., 2005).

2.2 Differences between traditional models and scenario planning approach

There are some differences between scenario development and traditional strategic planning, which include prognoses and forecasts. One big diversity concerns the formation of possible future. Forecasts assume that it is possible to predict the future, the strategists only need to "try harder" and be more experienced (Wiltback, R. et al, 2006). This assumption has more rationalistic character in which there is only one right answer to the question how future can be, the art is to come as close as possible to it. This method is very useful in predictable environments where there are minor fluctuations in the industry. However, when the horizon becomes uncertain, this concept becomes problematic. Forecasts do not include unique events into consideration. Instead, they base their assumption on historical and present events to predict the future. Forecasts sometimes, try to include uncertainties in the future prediction by creating upper, lower and middle lines. These are called worst-case, average-case and best-case forecasts as illustrated in *figure 1*. Yet, this method does not always represent the future. The decrease of number of active rigs is a good example to support this statement (Van der Heijden, K., 2005).

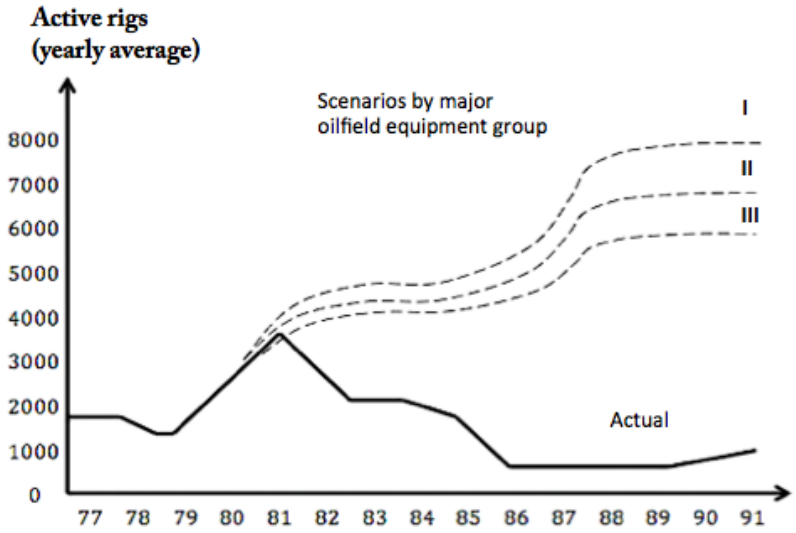


Figure 1: Drilling scenarios USA 1980-1990 *(Source: Van der Heijden, K., 2005)*

In contrast, scenario planning tries to anticipate multiple possible futures instead of one. It has a different starting point: there is not only one best answer of future prediction; instead the future can unfold in

different ways. This attitude helps managers to consider various strategic solutions that may have previously disregarded or ignored. Scenario planning asks “what if” questions in order to develop anticipated narratives of the future (Norrman, R., 2001). Through this concept unique events are taken into consideration to prepare companies for the unknown. While the forecasting is a good tool for a short horizon, scenario planning expands the view by analyzing a company's transactional environment. This enables the analysts see the driving forces that move the industry from one way into another. Hence, the shorter the prediction horizon is the better it is to use forecasting. When time horizon expands, more uncertainties come into the picture and predeterminations decreases. In this case, scenarios have more usability. If the horizon expands even more, there is only hope that the company can rely on (Van der Heijden, K., 2005). This is illustrated in *figure 2* below:

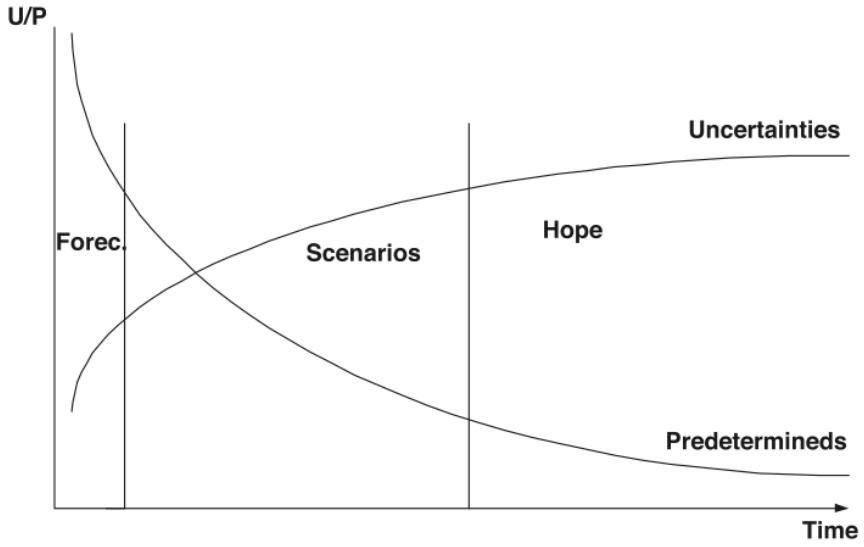


Figure 2: The balance of predictability and uncertainty in the business environment (*Source: Van der Heijden, K., 2005)*

Other differences between these methods are that prognoses tend to limit companies´ adaptability to environmental changes. Scenario planning on the other hand prepares companies to the changes in the environment and thus, increases their flexibility (Wiltback, R. et al, 2006). In addition, forecasts reduce all kind of information into a simple summarized form. This is very good for operational purposes but not sufficient for strategy development. In contrast, scenarios provide the analysts with rich and detailed information. This in turn increases chances to make the right decisions (Van der Heijden, K., 2005).

2.3 Scenario planning framework review

There are several techniques to conduct scenarios. This strategic tool became very popular in the last decades encompassing both companies´ and academies´ interests (Bishop, P. et al, 2007). The most popular scenario planning methods through the history has been the one developed by Royal Dutch Shell through Global Business Network. The concept is company oriented and includes practical recommendations on how to develop strategies. From the academic side, however, most favored models are those created by Van der Heijden and Schoemaker. These provide a more scholastic point of view and give more detailed information of what the different steps should include (Schwenker, B., Wulf, T., 2013). A "crane model" developed by Norrman, 2001, also gives a good overview how the concept should be conducted. Some of these techniques are described in the following chapter.

2.3.1 Shell International scenario development model

The Shell scenario model has been developed and used at Royal Dutch Shell since the 1970´s. The concept contributed to the open mindset and the possibilities to develop strategies for situations that could have happened. This resulted in well-prepared management during the oil crisis 1973. The model is designed in 6 steps, namely:

1. Preparation, a description of the project including goals and resources.
2. Pioneering. Challenging assumptions and finding a blind spot by using iterative cross-disciplinary research. Identification of the most interesting questions for the future.
3. Map-making include general descriptions of convincing futures (scenarios).
4. Navigation concentrates on how to use the scenarios. These can often be used for a period of time in order to shape the strategy of the organization.
5. Reconnaissance, advocates usage of the scenarios for increased awareness and different interpretations of events that occur within the business horizon.
6. Preparation. Since the context is changing continuously, this step include reformulation of goals and resources and if needed building of new scenarios (Shell International, 2008)

2.3.2 Shoemaker scenario model

The model developed by Schoemaker is quite detailed and include ten steps:

1. Definition of the scope of analysis including products, markets, geographic areas, technologies and the time frame. The time frame is depending on e.g. how often changes occur in the business.

2. Description of main stakeholders and their roles.
3. Identification of basic trends, e.g. political, economic and industry related.
4. Identification of key uncertainties regarding the explored issues.
5. Construction of initial scenario themes, which are built on the included trends and uncertainties.
6. Controlling their consistency and plausibility.
7. Development of learning scenarios. After controlling the initial scenarios some themes should appear. Identification of the themes that could be relevant for the future is important, and irrelevancies should be sorted out. Yet, these learning scenarios are subject for further study, not as a basis for strategic decisions.
8. Identification of research needs. Blind spots recognition in the learning scenarios indicates a need of more input for developing more consistent scenarios.
9. Development of quantitative models. Reexamination of the scenarios and exploration if some interactions could be interesting to include in a quantitative model.
10. Evolving towards decision scenarios include construction of scenarios that can be used for testing strategies and exploring new ideas. (Schoemaker, P., 1995)

2.3.3 The Crane model by Richard Norrman

The Crane model by Norrman aims at making the company a “prime mover”, i.e. an organizer of value creation, who shapes the environment. The model consists of 6 following steps:

1. What are we? Identification of the current assets by examining the firm´s competences and the business idea. Finding possible areas of reframing in terms of assets, capabilities, customer relationships and customer bases. Mapping the organization´s strengths and weaknesses.
2. Upframing of business systems include picturing a larger context where the organization is functioning in. This includes mapping the business main operational and strategic issues, but also identification of actors giving input to the system. Further, this step includes redefinition of system boundaries and construction of alternative value constellations.
3. Time framing. Picturing the conceptual future, which can be approached by building contextual scenarios on driving forces, given facts and uncertainties of the business context. Uses what if methodology.
4. Creating strategies scenarios in the opportunity space. This step includes creation of strategy suggestions to meet the conceptual future.
5. Translation of the vision to a business idea. The vision/visions provide foundations for one or more possible strategies. The vision needs to be considered in terms of actions and consequences,

and be tested against the conceptual scenarios. The test may reveal a demand for new assets in the organization.

6. Planning mode. Translation of the new set-up into an action plan. (Norrman, R., 2001)

2.4 Authors model/custom model

All these scenario developing techniques have some variations, but in general all of them follow the same pattern. They include similar actions but the number of steps can differ from six as it is in the case of Shell and Norrman, to ten, described by Shoemaker (Schwenker, B. & Wulf, T., 2013). For example the preparation part, where the scope and main objectives of the model needs to be determined, is included in both Shoemaker´s and Shells first steps. Further, the need of identification of contextual and transactional environment is described by Shell in the Pioneering part, by Shoemaker in the step 2 and 3, and also by Norrman in the Upframing part. Hence, inspired by these models, the researchers outlined an own model, which consists of six steps *(see figure 3).* In general, there is no standard scenario developing tool that applies on every situation. Some steps need adjustments in order to suit the specific case (Schwenker, B. & Wulf, T., 2013). This is the reason to why researchers used customized model in this study.

Figure 3: Scenario planning framework *(Source: own construction)*

2.4.1 Step 1. Preparation

To get started it is important to create a clear picture of what the scenario planning is supposed to answer, what is its purpose and what are the objectives before constructing positive or negative images of the future. Taking time in this step is vital as it prevents misunderstandings and confusions that may show up in the later phases. Determining the focal question in advance will help decision makers to choose the right way from the beginning, without wasting time on unnecessary actions (Hines, A. & Bishop, P., 2007). In addition, scope and time frame needs to be decided at this stage. The analysis of scope can include what kind of products will the firm put focus on, what markets, industries, geographic area, etc. On the contrary, for the time frame decision, the group needs to study the firm´s/industry´s past and identify sources of uncertainties and volatility. This step will provide the group with the information, which will be helpful for time horizon determination. For example, for an oil company, the time frame for a scenario planning will extend to 15 years as the industry is less volatile and as investments are usually long term oriented. On the other hand, reasonable time frame for an IT company is not more than two years, which is an effect of rapid technology development. Other factors that can have impact on the firm are political and environmental issues, competitors, customer´s changes in preferences, etc. (Schoemaker, P. J.H., 1995).

According to Shell International, 2008, there are some start-up questions that the decision makers can ask before conducting the scenario development project. These questions are illustrated below:

* *What is the purpose of the project?*

* *Who are these scenarios aimed to and how will this affect the kinds of produced scenarios?*

* *What are the expected outcomes?*

* *What time horizon will the scenarios cover?*

* *What is the time frame for the scenario project?*

* *Who will be involved, and how much time is required?*

* *How will the scenarios be applied?* etc. (Shell International, 2008).

In order to have diversity and dissent during the process of scenario development, the researchers need to gather a group of people with different backgrounds and positions. The more divergent the group is, the smaller is the risk that important factors or uncertainties will be undiscovered. People who are challenging thinkers and are unorthodox need to be included in this project in order to ensure its success, whether they are managers, consultants, staff or relevant external actors. All of them could be a source of learning. Hence, it is vital to create an environment where these people will have the chance to freely express their thoughts and be creative. All ideas and options should be considered and there is no right or wrong answer. The drawback of this plan is that due to various reasons it is not always possible to gather all these people together for a workshop. To copy with this challenge, scenario developers can conduct interviews both through face-to-face meetings and through telephone interviews (Ogilvy, J. & Schwartz, P. 2004). Hence, preparation for these interviews is needed. It include what questions should be asked and how these questions should be constructed in order to leave space for underlying perceptions and anxieties (Shell International, 2008).

2.4.2 Step 2 Scanning

The process of scanning includes the review of the industry but also the examination of its transactional and contextual environment *(see figure 4).* It is important to distinguish these spheres from the beginning as they vary in terms of influence and control. Within the organization, analysts usually have the control on various events, which evolve in one or another direction. However, in the transactional environment the organization interacts with others. Here it retains influence, but loses control. The more the sphere increases, the less control and influence has the firm on the developments. Hence, in the contextual environment, the firm has neither control nor high influence. Instead, these factors effect on the firm. Developments in this area may be of the greatest importance to the organization´s success or failure. For this reason, these factors need to be considered (Van der Heijden, K., 2005).

Thus, the scanning begins with the examination of the firm's or the industry's transactional environment where different stakeholders exist. These stakeholders are competitors, suppliers, customers, organizations, governments, investors, NGOs (non-governmental organizations), new entrants, etc. The organization is one of the players in this game, which competes for the resources. If the company develops a good strategy, it can turn the game to its advantage. Due to this fact, it is crucial to identify all these actors, explore their strengths, weaknesses and measure their overall impact on the organization. This is the step where the current situation is mapped (Van der Heijden, K., 2005).

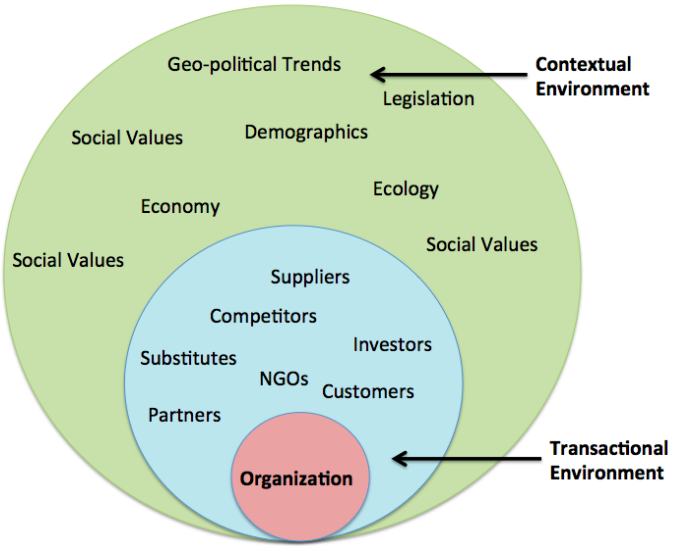


Figure 4: The business in its environment (*Sources: Van der Heijden, K., 2005 and Lindgren, M. & Bandhold, H. 2003)*

The contextual environment is that part of the sphere, where actors set the rules of the game. The leading actor in this environment is the society, which develops technology, conducts politics, steers economy, have some values, create ecology etc. The organization does not have the power to influence on these trends. However, it can prepare itself to changes and future requirements by identifying the trends. A detailed analysis of this environment helps firms to understand the structure and foresee changes in the world. The process of scanning is compared to a chess play: after each move, analysts need to consider changes in the transactional environment, i.e. acts of opponents. Also, contextual environment has to be taken in account, (is the firm still playing chess or have the world changed and there are some other rules?) (ibid).

2.4.3 Step 3 Trend and Uncertainties analysis

The next step in scenario planning is to analyze identified trends and key forces that drive the development. As already mentioned, these trends can be political, environmental, social, technological, legal or industry specific, which have impacts on the firm and on the focal question identified in step 1. Some of these trends may be uncertain, i.e. it is not clear if they will occur in the future, while other trends might be certain. When analyzing certain trends, all participants need to agree that these trends will exist in the future, which makes them knowledgeable futures or forces already included in the pipeline (Schoemaker, P. J.H., 1995). Predetermined trends are not dependent on a particular chain of events. They

are included in every scenario, regardless on how the future will unfold. Usually, they have slow-changing phenomena, they might be constrained to some situations, might be positioned already in the pipeline or be inevitable (Schwartz, P. 1998). Further, certain trends need to be analyzed in terms of their causality. Examples of the questions that can be asked are:

- What is the evidence that this trend is true?
- What are underlying causes of the trend?
- What makes this special issue more reliable compared to the other?

The trend analysis is important when developing scenarios as it clarifies why some events are developing in one or the other direction (Schoemaker, P. J.H., 1995). “As Will Rogers observed, It is not what we don't know that gets us into trouble; it is what we know that ain't so."(ibid). The “Iceberg” analogy *(see figure 5)* illustrates the need of understanding underlying structure of the observed events. Usually, observers only see the top of the iceberg, the observable fact, which is “above the waterline”. However, events are not isolated from the surrounding environment, instead they are linked with a structure displaying some sort of organized behavior. These events are outcomes of some patterns that hide under the water. One situation generally is a cause of another, which is the reason to why scenario developers need to look for the trends and their inter-relatedness to each other. The analysis will help decision makers to see the patterns and better understand the causes of the event. It will also guide to better scenario creations about how pattern may change in the future (Van der Heijden, K., 2005).

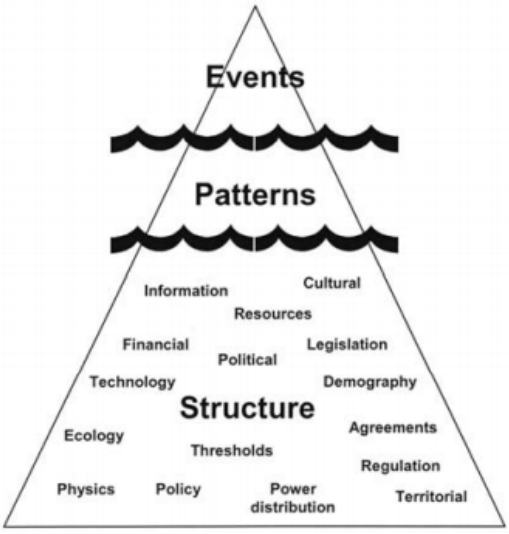


Figure 5: The perceptional iceberg *(Source: Van der Heijden, K., 2005)*

Once the certain trends are mapped it is time to look at some uncertainties, the undetermined trends including some hesitancy. Again, these consider political, economic, social, technological, legal and industry related aspects. Uncertainties can have different forms:

- Risks, where similar events can be seen in the history. It enables estimation of probabilities of possible outcomes
- Structural uncertainties, where an event has sufficient base to be plausible. However, there is no evidence to determine chances of it happening in the future.
- Unknowables, where the event is not even imaginable. There is no clue what these events could be or what are the chances that they will happen (Van der Heijden, K., 2005).

After listing all uncertainties, it is time to determine critical uncertainties. These have very high level of uncertainty while at the same time they have very high impact on the firm. Normally, there should only be small number of key uncertainties. For this reason strategy planner need to determine what really makes the difference. The purpose of scenarios is to concentrate on these key forces and create stories on how future will unfold if any of these uncertainties come true. By combining these key forces with predetermined elements, the firm will have the chance to develop suitable strategies and be prepared to react quickly on changes in the environment (Van der Heijden, K., 2005). One way to determine these key forces is to put all trends (written on post-its) on the grid sorted by their impact on the firm and the level of uncertainty as illustrated in *figure 6*. Secondary elements are those that have insignificant impact on the firm and thus are not considered in the planning process. Trends with higher impacts are those who need more attention (Schwenker, B. & Wulf, T., 2013). Mainly, this step is intended to produce building materials for scenarios. However, it also serves scenario developers to deeply understand the topics they are investigating. It will likely broaden their insights into their business (Shell, 2008).

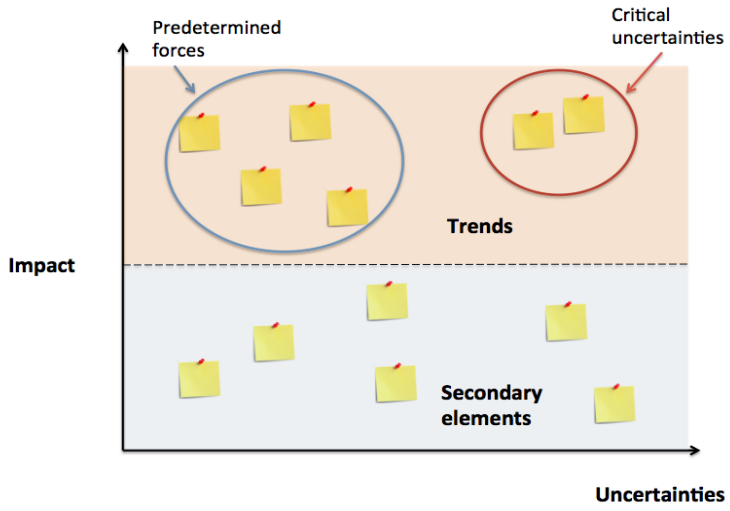


Figure 6: Impact/Uncertainty Grid *(Source: Schwenker, B. & Wulf, T., 2013)*

2.4.4 Step 4 Scenario Building

Now when the main building ingredients for scenario construction are identified, the next step is to develop actual scenarios. There are three various construction approaches to choose between: inductive, incremental and deductive. Selection of these three depends on the purpose of the scenario project. If the purpose is to combine people, build teams, have conversations etc. inductive approach will be more useful. Further, if scenario developers have strong determined believes in how the future will play out, incremental approach is more suitable. Finally, if the purpose is analytical, a deductive approach is more convenient (Van der Heijden, K., 2005).

2.4.4.1 Inductive method

The inductive method builds on the data available and allows scenarios to emerge itself through collaborative work of a very broad group of scenario developers. There is no determined framework of how these scenarios should be developed. Instead, stories are gradually built by combining data. The outcome from this step consists of a long list of mental models for how the future might unfold. The challenge is now to narrow the list down into three or four logically consistent and plausible scenarios. The groups will be expected to have long discussions until they come to a consensus. Lastly, the selected scenarios will be the basis of strategy development (Van der Heijden, K., 2005).

2.4.4.2 Incremental method

This method is used in the teams where there exists a predetermined or generally accepted future. These groups usually rely on some forecast, "official future", which is not an easy task to adjust. In this case, groups need to be convinced of the benefits and opportunities scenario planning can give. The starting point is taking the official Business-As-Usual assumption and analyzes it in terms of threats. In general these threats include bottlenecks or other issues that impedes opportunities. Scenarios are then built on each threat and strategies are developed as a plan for the firm to act by if those scenarios occur in the future. This method is quite simple compared to inductive or deductive approaches, as it does not include in-depth analysis of driving forces. However, it is worth mentioning that this method does not encourage new thinking in the process. Instead it has more "thinking within the box" characteristics (Van der Heijden, K., 2005).

2.4.4.3 Deductive method

Deductive method is the most dominating tool used for scenario development process. Here, the analyst starts with the creation of a framework, i.e. the set of scenarios. These are built on key uncertainties identified after trend analysis. Depending on what characteristics these key forces have, the deductive method uses different approaches (Van der Heijden, K., 2005). One of the most popular deductive approaches is called scenario matrix. It was developed in the 1970s by Kees van der Heijden and first used by Royal Dutch Shell. The matrix is built on two key uncertainties and provides four different scenarios (Schwenker, B. & Wulf, T., 2013), as illustrated in *figure 7* below.

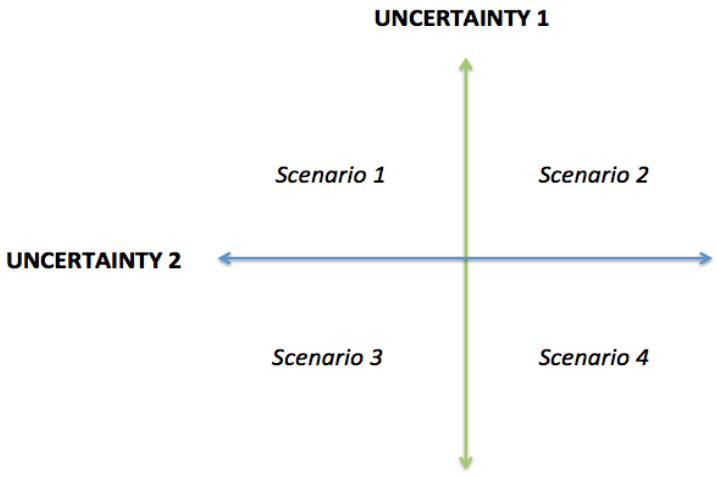


Figure 7: Scenario matrix *(Source: Lindgren, M. & Bandhold, H. 2003)*

The scenario matrix model is very useful as it provides logical pictures of the scenarios. Its main purpose is to develop four stories that are completely different from each other. The challenge now is to think widely and develop storylines about what will happen and what are the implications of every scenario. One way to achieve this is by translating research data into illustrative events, so called story-maps (Van der Heijden, K., 2005).

Further, created scenarios need to be reviewed so that they fulfill some important criteria. Criteria include relevancy, the level of challenge and plausibility. *Relevancy* is measured by comparing scenario outcomes with the focal question. It is vital that the stories take into consideration current concerns but at the same time create a broader view. Further, created scenarios need to be *challenging* so that they allow analysts to see things differently than they did before. However, they should not be too challenging, as there is a risk that the developers will not believe in its content. Finally, scenarios need to be *plausible*. It means that events must be possible, accurate and deeply analyzed. Hence, if scenarios fulfill all these abovementioned criteria, they have high quality and also high utility. These scenarios can then be used for strategy development (Van der Merwe, L., 2008).

2.4.5 Step 5 Strategy Definition

When scenarios are developed, it is time to think about strategies. There might be a lot of suggestions for the company. The starting point is to look at predetermined trends, which are key stones of the "certain future". These are already described in detailed and will be included in each one of the scenarios. Further, uncertain trends included in each scenario should be analyzed. The idea with this step is to decide what the company should start or continue doing in order to be prepared to the potential changes in the business environment. Moreover, analysts need look at the core competences and assets of the organization. It helps to decide what assets should be utilized more or what actions should the company stop doing. At this point there is no good or bad answer, every suggestion should be put on the chart for further analysis (Lindgren, M. & Bandhold, H. 2003).

Consequently, there might be several number of strategy suggestions. To analyze them in detail can be time consuming and expensive. Thus, it is important to find strategies that may qualify for deeper analysis. A starting point could be identification of the suggestions that are useful in every scenario by using the "Wind tunnel" technique. This term is used due to similarities of testing a strategy in different scenarios and testing a plane in a wind tunnel *(see figure 8)*. Strategies need to fit into the scenarios in order to be valid. Wind tunneling helps to test these suggestions in terms of their robustness and reveal their strengths and weaknesses. In addition, it supports decision makers to adjust their business models to

each scenario. The questions in this step can be: will this suggestion survive in scenario 1, 2, 3, 4 or does it only fit one single scenario? (Van der Merwe, L., 2008). To visualize if different strategies has positive or negative impact, single impact analysis table can be constructed *(see figure 9)* (Lindgren, M. & Bandhold, H. 2003).

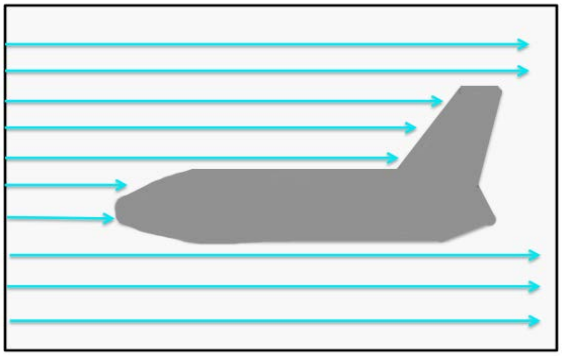


Figure 8: Wind tunneling of strategies *(Source: Own construction)*

In the table strategies (A, B, C, D) are rated with a "+" sign if it suits the scenario or "–" if it does not. This provides an overall picture of which strategies are beneficial in all scenarios. If such suggestions are identified, they should be implemented in the future, regardless of developments in every scenario (Lindgren, M. & Bandhold, H. 2003). Experience show that the less is the time horizon for scenarios, the more strategy elements will fit in every scenario (Ogilvy, J. & Schwartz, P., 2004).

Strategy	Scenario 1	Scenario 2	Scenario 3	Scenario 4
A	++	+	– –	–
B	–	+/–	+	++
C	++	++	+	+
D	–	++	–	– –

Figure 9: Single impact analysis *(Source: Lindgren, M. & Bandhold, H. 2003)*

Finally, the strategies that only fit into some of the scenarios can be further developed in order to complement core suggestions. Presumably, some of them require more analysis and can be filled. It is good to have a number of strategic options available if the environment changes. This enables the firm to be more prepared to unexpected occasions (Ogilvy, J. & Schwartz, P., 2004).

2.4.6 Step 6 Strategy implementation and monitoring

The last step is to implement these strategies into the company´s business idea plan for actions. The challenge is now how to move from theories to the actual activity. Van Der Heijden 2005, suggests, "Future will have to be done within resource constraints imposed on the organization". For this reason strategies need to be refined and choices need to be done. Further, these scenarios and strategies need to be monitored all the time. It consists of continuous comparison of them with the real world (Van der Heijden, K., 2005). The process with scenario development is not complete when strategies are developed. Suggestions should be tested for their robustness all the time. Drastic changes in the environment can occur, including those events that were not imaginable before. Hence, if the firm monitors scenarios, it will be easier for them to survive and be on the top (Van der Merwe, L., 2008).

2.5 Challenges regarding scenario planning

Scenario planning offers a number of benefits. However, it has some drawbacks: it requires time, depending on how complex the process is, and resources in terms of people involved and money invested. In general, the reason of the complexity of the tool lies in the lack of standardization. It is devolved upon a fact that there is no standard tool that applies on every situation. As already stated, scenario developers are imposed to add some adjustments in different steps in order to adapt the model to a specific case (Schwenker, B. & Wulf, T., 2013). Some tools can be company specific, as it is the case with Shell and some more theoretical as Van der Heijden describes it. Hence, to overcome these drawbacks, analysts need to adapt the traditional tool to his specific case (ibid), as it is done in this study. Also, the time horizon needs to be adjusted so that it is not too short, from five years and onwards. Otherwise, scenario will describe the present world and may lose the focus and relevance (Shell. 2008).

Further, the complexity of the tool can also be seen during the process. There are some common mistakes that are made by decision makers. It is crucial to be aware of these aspects when applying the scenario developing tool on a specific case. If not, the outcome of the process can prove meaningless, without fulfilling the main purpose. Some of such mistakes are listed below (Van der Merwe, L., 2008), (Lindgren, M. & Bandhold, H. 2003):

- Have unclear purpose and focal question
- Have a team with less diversity
- Identify too many or too few trends
- Not supporting trends with evidence

- Inability to identify relevant uncertainties
- Building scenarios on uncertainties, which actually are not hesitant
- Putting all the good news in one scenario and all the bad in another
- Developing unrealistic, implausible scenarios
- Developing strategies only on one scenario which seems more realistic at a point of time
- Falling into the probability trap
- Develop strategies that do not coincide with the firm´s vision.

3. Methodology

The aim of this chapter is to review how the process of this research has been conducted and what methods were used. The first paragraph begins with the research design where research paradigm is decided and presented. Following paragraphs explain research methods on how the data was collected and analyzed. Lastly, evaluation of the study is presented. It encompasses examination of the research project in terms of credibility, transferability, dependability and conformability.

3.1 Research design

According to Collis and Hussey (2009), research design is a science of planning procedures for conducting research, which guides the researcher through the subject. The starting point is to determine the research paradigm - if the study has more qualitative or quantitative nature. These two paradigms have different perceptions regarding the reality and the nature of knowledge. If in quantitative research the reality is perceived as multiple and subjective, in quantitative study, it is singular and objective. The same applies on content of valid knowledge perception. In a quantitative study the knowledge is what can be measured and observed independent of the researcher, while in qualitative study, the researcher interacts with the construction of knowledge. Hence, depending on which paradigm characteristics this study possesses, different methodologies will be applied for the implementation. That is why it is vital to decide the characteristics of the research question in the beginning of the research. It helps with the selection of methods and the report structure.

The research question in this study has a more qualitative nature, since much of the information is gathered by conducting qualitative interviews. For this reason qualitative methods were applied for collection and analysis of the data. Instead of concentrating on numbers and presenting statistical analysis, the importance in the report was to examine the subject in depth and conduct exploratory research followed by predictions for the future. Exploratory research is conducted when there is only little information available on the subject (ibid), as it is the case with MSW imports. The purpose for the exploratory process is to identify and analyze patterns, ideas and hypothesis. It usually has a very open nature and focuses on collecting a wide range of data (ibid). This possessed knowledge represents a good basis for the generation of detailed scenarios for future forecasts, which is the main purpose of this report.

3.2 Research Methods for Data Collection

For the research, data collected comes from both primary and secondary sources. It includes as many nuances as possible in order to create a picture that is close to the reality. In this part a description of the collection process is provided.

3.2.1. Primary data

Considering the scarce amount of information on this particular subject, qualitative interviews were used to gather rich and detailed background information. Under interpretivist paradigm, interviews are usually unstructured, which means that the questions asked to participant are not prepared in advance. Instead, they are open-ended and evolve into a discussion (Collis and Hussey, 2009). For this research, a combination of unstructured and semi-structured interviews was used, with more focus on the semi-structured interviews which were conducted over telephone. This is due to the time limit given for the study but also due to the complexity of unstructured interviews. They are normally very time consuming, do not follow any structure and recording of the results might prove problematic. The aim was to understand the respondents "world" which can be quite complex.

3.2.1.1 Semi-structured interviews

Semi structured interviews are a combination of both structured and unstructured interviews which is commonly used in qualitative reports. Some predetermined questions facilitate an interviewee to follow some structure that guides him/her during the process. However, questions are still open ended which gives the respondent opportunity to develop their answers. It also allows the interviewer to ask additional questions and reflections on the topic. The aim here is, beside the collection of information, to conduct a conversation but maintaining the control (Cachia, M & Millward, L., 2011). For this research different interview templates were used for different actors in order to highlight the most relevant aspects. Every interviewee had the chance to express their thoughts and discuss uncertainties within the industry.

3.2.1.2 Face-to-face interviews

There are many benefits with face-to-face (F2F) interviews. It facilitates the opportunity to develop a comfortable communicative relationship and helps to establish confidence between actors. During the process, the interviewer gets the chance to observe the interviewee and estimate his engagement into the research question. The more interested the respondent is on the subject and the more comfortable he/she is with the interview, the more detailed information he/she will be willing to share. It is vital during this

process to give the interviewee both space and time so that he/she expresses his/her "reality" on the issue. It includes what he/she thinks will happen in the future and what trends could be certain respective uncertain. The layout of such interviews usually consumes much time. However performance of these might be essential in terms of the data requirements of the study (Quinlan. C., 2011). For this research, only five F2F interviews were used, while the other thirty were conducted through the telephone. Participants of the study are spread in different geographical areas. Conduction of F2F interviews in various areas in Sweden, also considering their large number, would be problematic. Though, data collected from these few F2F interviews were highly valued.

3.2.1.3 Telephone interviews

The telephone today is perceived as commonly used communication tool in both business and private settings. Telephone interviews enable the researcher reach interviewees in different parts of the world. As long as the participants have access to a signal, it is possible to collect the data. It is not always feasible to travel long distances for collection of information, especially if respondents are scattered over a large geographic area (Quinlan. C., 2011). For this research, telephone interviews were the only way to collect such detailed information from incinerator plants. The number of these plant amount to almost forty, spread in different regions. Moreover, managers or other responsible employees that had insights in the particular area were not always at the work when interviewed. Scheduling F2F interviews with all these participants would be impossible due to the time limit given for this research. The data collected answered most questions that the researchers had, although, these interviews had some disadvantages. For example, it was not always possible to create confidence with the interviewee, as they were afraid to share some company sensitive information. It was neither possible to observe the participant.

3.2.1.4 Interview preparation

It is vital that the interviewer is prepared before the interview. When conducting semi-structured interviews, the researchers need to think through what types of questions could answer the research purpose. Examples of these topic questions are: *introductory*, which are usually general in order to get the process started and help to establish relationship with the participant, *follow-up* questions, which help to develop the answer and clarify if the given information is understood correctly, *probing questions,* which ask to develop a part of the answer, etc. All these possible questions create a guide that help interviewer to keep respondent on the subject, but also serve as a memory list to ensure that vital questions are not forgotten (Blumberg, B., et. al. 2011). However, it is important that these topic questions are not too specific, leaving the space for interviewees to develop their answers. In addition, the researcher needs to

be prepared to alter the order of questions. This is due to their irrelevance or other reasons that may emerge during the process (Bryman, A. & Bell, E., 2011).

Every interview might provide with a lot of data, why in some cases a tape recorder was used to capture the full version. It also facilitated the researchers to concentrate more on conversation, rather than information documentation (Blumberg, B., et. al. 2011). All participants of the interviews in this study have been informed in advance if their answers were recorded.

3.2.2. Secondary Data collection process

Data gathered from references who addressed another research question is known as secondary data. Secondary data has the advantage over primary data as it requires less time and capital to obtain. In addition, already available data can be analyzed instantly. Hence, it is very convenient to include accessible and appropriate data and use it for new purposes. Moreover, reanalyzed secondary data can contribute to new perspectives and broader understanding of the subject. (Blumberg, B., et. al. 2011)

For this research, secondary data is obtained from books, scientific articles, websites, brochures, public documents such as EU directives and reports and statistics from expert organizations such as Profu, Avfall Sverige and Naturvårdsverket. From scientific articles, the data concerned scenario development tools and pros and cons with this technique. In order to build the base for scenarios, information on current volumes of municipal solid waste was collected through both secondary and primary sources. Secondary data also concerned regulation review both on national and EU level, description of the situation in exporting countries, existing competitors, incineration capacity etc.

3.3 Data Analysis

The analysis of quantitative data is quite challenging as it consists of large unstructured textual material collected both from interviews and literature reviews. This part is much more challenging compared to the collection stage. There are several techniques and approaches on how data analysis should be carried out. However, the main features of qualitative data analysis include three steps: *reduction of the data,* where a systematic way of selection of relevant data is found, often by using coding methods, *restructuring of the data,* where information follows some design, and *detextualization* in which data is summarized in the form of a diagram (Collis and Hussey, 2009). Further, from this data, scenario planning technique is used to identify driving forces and trends of the industry. By highlighting the most uncertain trends with most impact on the organization, an analysis of each scenario can be conducted.

3.4 The Quality of the Research

Some scholars argue that the quality of the research data should not only be evaluated by validity and reliability (Bryman, A. & Bell, E., 2011). For this reason, the data in this study is reviewed by four aspects, namely: credibility, transferability, dependability and confirmability.

3.4.1 Credibility

High credibility can be achieved in the empirical part of this research due to its context and the type of data that is included. Volumes and logistics are usually not confidential, making it easy to collect, analyze and present the data. Also, the fact that the whole population is investigated contributes with significant credibility. However, the second section of the research deals with managing multiple scenarios. These are naturally difficult to give any credibility since they only deal with uncertainties. Yet, credibility can be given to the factors that base these stories or to how likely they are perceived to be.

3.4.2 Transferability

The results of this study have a limited possibility to be applicable in other contexts. It could be applied to other cases, given that the circumstances are similar. The starting point for this scenario study is the situation for the importation of MSW to the Swedish incinerators, making the range for where the study would be applicable very limited. It could, however, contribute to studies on other products within the same industry. Still, the validity for these matters is low due to the nature of scenario planning.

3.4.3 Dependability

Similar to credibility, the dependability is expected to be high for the first section of the study, i.e. the mapping of the current situation, and low for the second part, which is composed of scenarios. The result from scenario planning are highly dependent on which factors are included into the study, as well as what weight those factors is given. Hence, the possibility for a unique combination of influencing factors is high. The results would, nevertheless, be possible to use as an action plan in case the reality would come to resemble the scenarios.

3.4.4 Confirmability

Mapping the current situation is possible without involving any personal values, due to its more quantitative nature. During the data collection process there were no perceived difficulties to receive

correct and unmanipulated data from a major part of the incinerator population and some other actors. In addition, the same data could be retrieved both from primary and secondary sources. The confirmability of the first part is therefore considered to be very high. The second part is naturally derived from personal values, since the scenarios are designed through analysis. Nevertheless, objectivity is considered in this part, to a possible extent.

4. Empirical investigation - scanning of the environment

The chapter begins with the determination of an adequate time horizon and justification to why this period of time should be taken into consideration. Further, the environment is "scanned" so that every factor important for municipal solid waste importation is elaborated. This includes incinerator capacity, environmental aspects, regulations, costs, actors and transport solutions. All these factors help to map the current situation, which will be used to conduct a thorough analysis.

4.1 Determination of time horizon

When looking back into the industry´s history, one can identify how often changes occur and the time required for different actors to adapt to the changes in their "landscape." This procedure is important for determination of time horizon when developing scenarios. In waste management industry, some issues need to be considered. One example is the time window a municipality needs to realize a plan of building incinerators including all negotiations around the project. The process may stretch to various periods, but generally it takes between five to ten years until a plant becomes operational. Further, it is vital to look at the regulation development. The time to actually implement regulations proposed by EU in the national law vary between countries. For some EU members the progress has been much faster than for others. However, it usually takes more than five years to actually experience the effect. For this reason, it is decided that scenarios developed in this study will cover a period between five to ten years. Beyond this period the level of uncertainties increase while determinants decrease. Prediction in this case is transformed into a hope, which is not appropriate for scenario development.

4.2 Waste management in Europe

There are only few countries in the world that have developed environmentally friendly waste disposal methods. A low share of landfill, low environmental impact from waste management and high energy and material recovery, characterizes them. Of these countries only one is positioned outside Europe, namely Japan. Otherwise, the development towards better waste treatment takes place mostly in Europe. Countries that have good results in this field are Sweden, Norway, Denmark, Austria, Germany, The Netherlands, Belgium and Switzerland. Among these countries there are only two, Norway and Switzerland that are not members of the European Union and are thereby not subject of EU regulation. All other states has a responsibility to work towards common objectives for waste management (Avfall Sverige, e2013:08).

Within Europe there are significant differences between countries regarding waste management. In Sweden for example, approximately 99% of waste volumes are used for either material or energy recovery. In contrast, Bulgaria and Romania landfill almost 100% of their municipal waste. The *figure 10* below demonstrates European countries waste management in the objectives of landfill, combustion, recycling and biological treatment. From the total amount of waste in Europe, only about 57% is recovered, making landfill still the most used method for waste treatment. In 2011, approximately 140 million tons of waste were landfilled in Europe (Avfall Sverige, e2013:08).

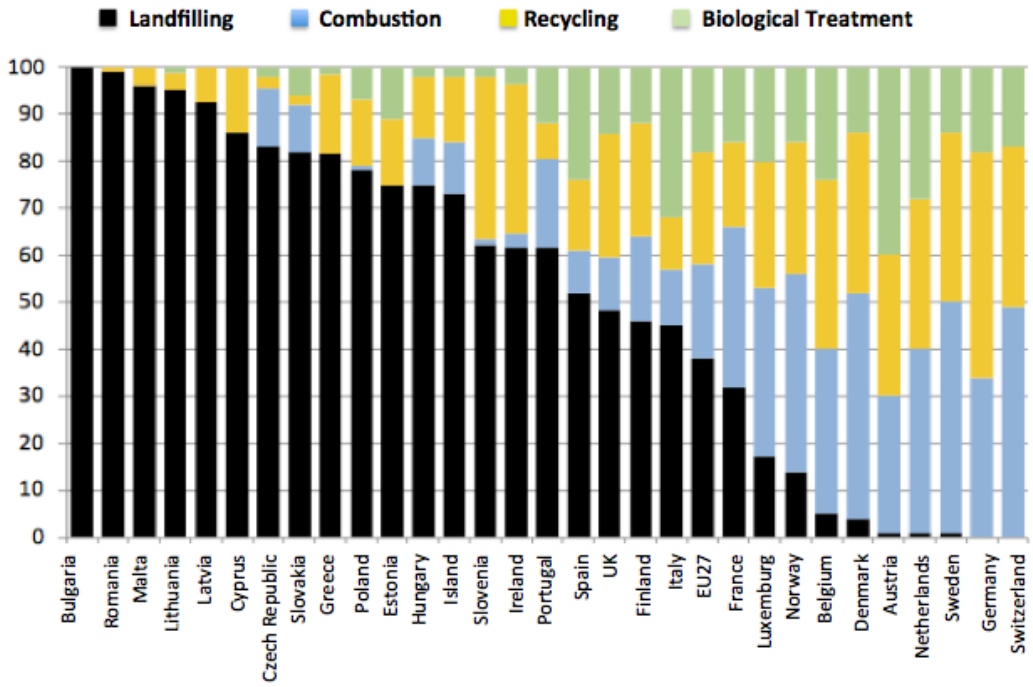


Figure 10: Waste management in Europe; treatment proportion comparison between countries *(Source: Waste Refinery, 2013)*

Swedish waste regulation has derived a very high standard on waste management. For many years authorities and organizations have been working towards better-sorted waste that can be recovered or recycled. Today, Sweden possesses a good position at the waste hierarchy and the vision is to by 2020 impose companies to design reusable or recyclable products, without containing hazardous substances (Naturvårdsverket, 2012:6560). A survey of European energy recovery from waste revealed that Sweden has the highest efficiency for energy recovering from waste and approximately 20% of that energy derives from imported waste. *Figure 11* below illustrates the proportion of different waste treatment methods in Sweden in 1992-2011. Energy recovery has become a crucial disposal method, which together with recycling and biological treatment has replaced landfilling (Avfall Sverige, 2012:10).

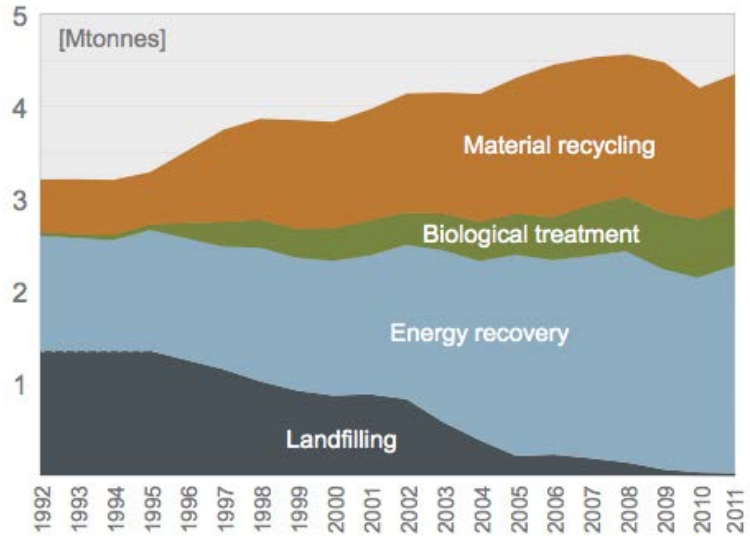


Figure 11: Proportion of waste treatment methods in Sweden 1992-2011 *(Source: Waste Refinery, 2013)*

4.3 Driving forces to increased waste imports to Sweden

There are many factors contributing to the developments of waste management. Incentives appear on different levels of authorities, where the global environmental conventions and EU regulations set the outer framework. For Swedish regulations, the National Environmental Protection Agency (Naturvårdsverket) provides a more comprehensive description of desirable handling of waste. This is the central authority that supports Swedish government to fulfill EU goals. It develops national directives and controls the compliance of the same (Naturvårdsverket, 2013). In addition to this, the incinerator industry is affected by a number of important parameters such as political will, government policy instruments and also the general environmental opinion. The introduced instruments and objectives have implications for all market participants related to the importation of waste and the options for waste treatment (Sahlin, J. et al, 2013).

According to Waste Refinery 2013, in 2009 19% of the district heating system in Sweden was fuelled by waste. Forecasts demonstrate a continued demand for this fuel type and in 2020 its share is expected to increase to about 35%. Since 2009 the Swedish incinerator industry is characterized by an overcapacity in relation to domestic waste. Three reasons are considered to be the basis for this condition. The first is that domestic waste volumes have decreased since 2008 as a consequence of the economic crisis. Second, the more extended recycling has resulted in decreasing volumes of combustible waste. This trend is expected to continue in the future reducing volumes even more. Finally, the Swedish incinerator capacity has been

expanded all the time, resulting in higher overcapacity (Source: Avfall Sverige, e2013:04). All these factors have escalated the need of waste imports, which in turn heightened competition between Swedish incinerators. In addition, other countries like the Netherlands and Germany compete for the same sources. This development has set high pressure on gate fees throughout Europe. The incinerator market is thereby changed and the gate fees have more falling characteristics (Interviewee 2, 2014).

Hence, the situation with overcapacity derives an increased importation of waste from other European countries. During 2010 Swedish environmental protection agency has licensed permits for more than 1,3 million tons of waste import, of which more than one million tons (about 80%) consisted of combustible waste for energy recovery (Avfall Sverige, e2013:04). Yet, the actual imported volumes during 2011 were estimated to 813 000 tons, including both household and industrial waste. Although the actual number is less compared to permitted volumes, it shows an increase of 7,8% to previous year (Greentech, 2014). In the future, at least to 2017, imports are expected to increase even more (Waste Refinery, 2013). This will put the industry into a challenging situation in terms of logistics solutions, as they will still need to maintain environmental and economic objectives (Avfall Sverige, 2011:01). *Figure 12* below illustrates differences in waste imports and exports to and from Sweden during 1999-2010. The volumes include all kind of combustible waste including municipal solid waste. Here, significant changes in import volumes can be detected after the financial crisis in 2008. The level of import has never before been as high as in 2010 (Naturvårdsverket, 2012:6520).

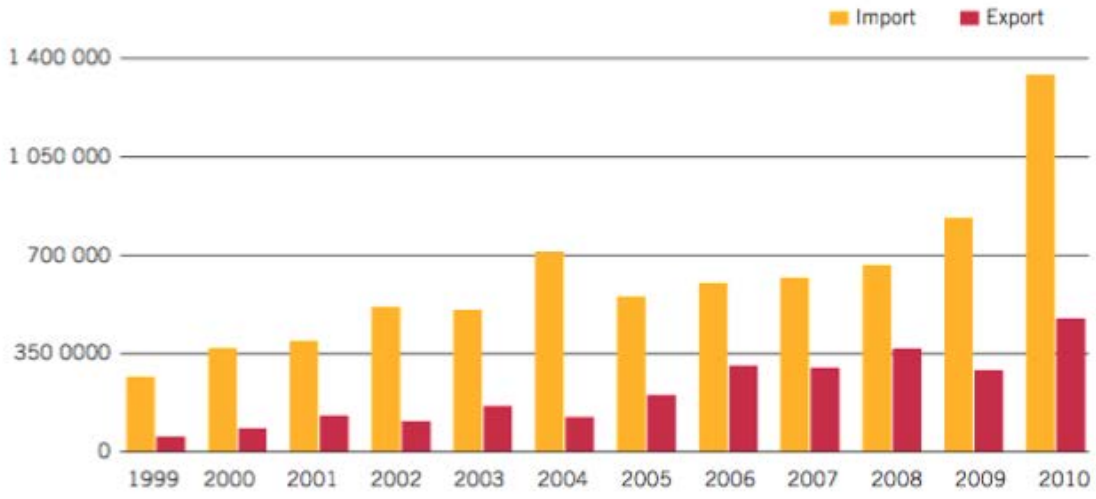


Figure 12: Import and export of waste from 1999 to 2010 (tons) *(Source: Naturvårdsverket, 2012:6520)*

Waste Refinery has published a forecast on expected import waste volumes until 2020 *(see figure 13).* In the forecast, factors as capacity level and supply of domestic waste are included, which play an important role. The remarkable increase in imports that are assumed to last until 2017 is mainly based on the incinerator capacity expansion that exists today. There are additional plans to increase the capacity after 2017, but uncertainty level is still quite high, especially for those without environmental permits. If these plans will not be realized, the industry will experience stagnated or decreasing import levels. The decline after 2017 is explained by expected increase of domestic waste caused by growing Swedish population and consumption (Waste Refinery, 2013)

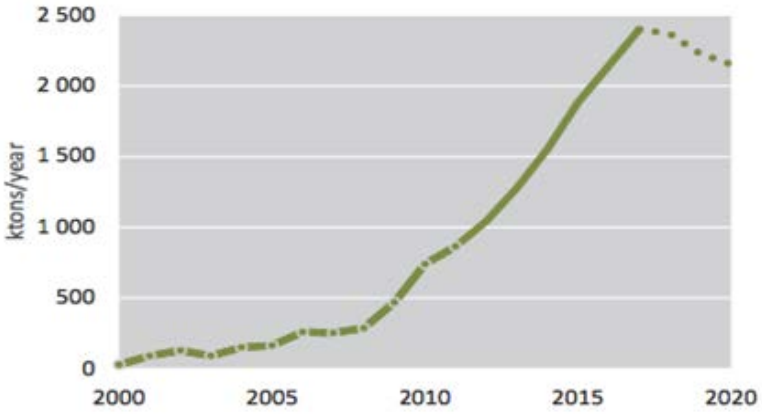


Figure 13: Historical and forecasted import volumes of combustible waste for energy recovery, 2000-2020 *(Source: Waste Refinery, 2013)*

Removing waste going to landfills is a main objective in EU. To achieve this goal different types of approaches will be relevant in various time perspectives. In the short term for example, transboundary transportation will be needed in order to achieve the targets within the time frame. This is due to the inertia in development of waste disposal techniques in many EU states. Consequently, the import of waste can be viewed as a temporary solution to rapid improvement of the overall situation. Further, the medium/long term perspective discussion shall process the sustainability of the importation and the transport of waste, and investigate possible investments from both profitability and energy efficiency viewpoint. In the future, domestic waste in every country is expected to be handled by national capacity (Sahlin, J. et al, 2013) (Avfall Sverige, 2014).

4.4 Logistic solutions for waste transportation

Waste transportation is a subject that entails diverse opinions from different stakeholder groups. This topic involves both environmental and economic aspects and it should be examined in various points of view. For example, transporting waste from less developed countries to Sweden for incineration with its high efficiency and flue gas cleaning, is calculated to be an environmental benefit in a global perspective (Sahlin, J. et al, 2013). As stated before, the EU objective is to move the total European amount of waste higher up the waste hierarchy. On the other hand, the transportation and combustion of foreign waste on Swedish territory can be viewed as a local problem. This is due to the extra strain the combustion causes to the immediate surroundings but also due to increased congestion on Swedish roads. These facts lead to some reluctance to the phenomenon among private individuals and organizations in Sweden. Using return shipments for waste transportation that otherwise would be empty could be an important factor for defending both the environmental and economic objectives of the operation (Interviewee, 2014).

The current flow of imported waste is transported by various modes. From Norway for example, the waste is mostly transported by truck, while UK and Irish waste requires a combination of vessel and truck transportation. The importation from not bordering countries that require maritime transportation has increased in recent years. For this reason actors involved are testing different cargo transport units and logistics concepts in order to find the optimal solution. At present, the most common solutions that are used for import to Sweden are:

- Baled waste transported in bulk ship, necessitating transshipment both in loading port and destination port, with additional truck transportation (interviewee 31 & 33, 2014).
- Baled waste transported on a cassette (this solution is currently used by the Port of Gothenburg and the Port of Helsingborg), a trailer or loaded into a standard container. Cassette transport requires transshipment, while trailer and container can be loaded upon truck for further transportation.
- Non-baled waste transported in a container (Interviewee 31, 37, 41, 2014).

Still, the current concepts are considered to be unsatisfactory due to problems with costs, capacity and risks. For example, transshipments of baled waste imply risks, especially when unloading the bales directly from the ship. Due to the circumstances, the risk for breaking the bale and drop the content into the water is quite high. In addition, the handling in terms of transshipments needs to be reduced, as these are very costly. Container utilization is considered to be a solution. It can significantly reduce the risk of contaminating water or surrounding environment and reduce handling at the ports to some extent. A

container also has the flexibility to be loaded directly on train or truck. However, this solution derives a challenge in terms of contamination. A thorough cleaning of the container is required before loading any other cargo than waste. Even after cleaning, some commodities such as food, clothes or furniture cannot be loaded in the same unit. This complicates the situation and increases the need of careful planning (Interviewee 3 & 4, 2014).

Hinterland transport constitutes a large part of the total transportation cost. The calculated average for hinterland transportation cost is between 30-100 SEK per ton. The price difference depends on chosen transport mode but also the distance. Many actors mention railway as a less competitive transport mode, due to extensive handling when the railway does not have direct connection to the incinerator plant and the fact that railway have lower frequency than truck transportation (Interviewee 18 & 41, 2014). However, railway is considered to be economically competitive at distances exceeding 150 km. For shorter distances truck is perceived to be quicker and more flexible. In this calculation, only the transportation distance is included. All associated handling costs connected to the transport are not considered. Thus, the effectiveness of railway will determine whether this mode of transport is really profitable at this distance (ibid).

As stated above, railway has environmental advantages over truck, both in terms of emissions and congestion. Switching from road to rail reduces traffic in ports and cities that leads to better urban environment. Railway also lessens the noise and land use linked to road transport. However, when using this mode handling stops increase in number. For example, transshipments are needed at least once during the change from ship to train, and often once again at a terminal some distance from the incinerator plant. If there is no industrial track all the way into the incinerator plant, (this fact applies to many Swedish incinerator plants), the waste have to be loaded on truck for the last part of the route (Avfall Sverige, u2011:01). Usually handling expenses are quite high why actors in the industry try to minimize it as much as possible. This fact increases interest for truck transportation (Interviewee 4 & 10, 2014).

Yet, various actors have tested waste transports on railway. In 2008, the standard container for this cargo was the roller flatbed type. This unit type requires special railway wagon with a rotating function during loading and unloading. A truck with special equipment can then pull the container on the chassis. Ordinary railway wagons on the other hand require standard containers or roller containers with retractable rollers. Hence, the transport needs either a certain kind of combined container for both truck and railway wagon, or a special wagon, which can rotate the container (Avfall Sverige, u2011:01).

Another aspect for the last part of the transport is that incinerators generally are designed for unloading from the back of the truck, requiring a tilt function on the truck with container, alternatively a “walking floor” trailer (Interviewee 31, 2014). Unloading of baled waste from the container adds an additional challenge, because these do not always have optimal dimensions and can therefore be difficult to move out (Avfall Sverige, U2011:01). Bales also require crossing before delivering to waste bunker. Hence, the size and the form of the bale play an important role for available equipment (Interviewee 34, 2014). Further, if there is industrial railway connected to the plant the handling process will be different, which also requires a special system. In Germany for example, large-scale plants use side-tilted containers. Waste can then be unloaded directly from the train, either from the side or underside of the container (Avfall Sverige, U2011:01).

Challenges related to the logistic issues of waste is often linked to the legal and practical issues such as temporary storage, port availability, regulations, time for loading and unloading, size and durability of the bales, etc. Some ports refuse to undertake this type of cargo due to specific problems linked to it. Yet, as the importation of waste to Sweden is expected to increase, the facilitating infrastructure is expected to meet the increased demand for this service (Bisaillon, M, et al, 2013).

The durability of the bale wrapping plays an important role during all handling. Insufficient wrapping can lead to more complicated and time-consuming handling and leakage. The risk of leakage is noticeable, especially during reloading. For sanitary issues, such accidents have to be controlled in terms of what the leakage consisted from, the extent to which the damage occurred and where the substance caused contamination. Ageing material of this cargo type also includes risks, why storage is highly avoided. Instead, the deliveries are JIT for being loaded into the replenishment bunker (Interviewee 4, 2014).

One important aspect that needs to be considered in waste transportation is the new limit for sulfur content in ship fuel operating in SECA area. Today, the maximum sulfur content is limited to 1%, which demand Low Sulfur fuel types. In 2015, however, the new limit of 0.1% will demand LSMDO (Low Sulfur Marine Diesel Oil) or LSMGO (Low Sulfur Marine Gas Oil). The price for these cleaner fuel types was about 33% higher than the ordinary Low Sulfur fuel in April 2014 (Bunkerworld, 2014). This fact might increase the shipment cost; yet it is not clear how it is going to affect the maritime transports within the area (Interviewee 1 & 34, 2014).

4.5 The European Union

European Union is an important actor for waste management. This actor creates exterior framework for Swedish law and sets milestones for environmental improvements. Some of important waste regulations issued by this authority include Waste Framework Directive (2008/98/EC) that streamlines waste legislation incorporating rules of a number of issues, Landfill Directive (1999/31/EC), which strives to dispose landfilling, Waste Incineration Directive (2000/76/EC), that has the aim to limit the release of pollution into air, Regulation on Shipments of waste (2006/1013/EC) that intents to ensure safe shipments of all types of waste, and others (European Union, 2010). The directives´ main purpose is the minimization of waste volumes through prevention and reuse. However, as waste is still generated, it should be handled in accordance to the hierarchy. The first step in this formation promotes material recycling as much as possible. The following step supports energy recovery from materials that cannot be recycled. The final step represents landfilling, which is not a favorable method from an environmental viewpoint and should be ceased (2008/98/EC). The waste hierarchy is illustrated in *figure 14* below:

Figure 14: EU´s Waste Hierarchy *(Source: Own Design)*

Apart from the waste hierarchy, municipal solid waste has to be handled in a proper way. EU members need to take all necessary measures to ensure that waste management is conducted without endangering human health or harming the environment. Risks of spreading hazardous substances to the nature or landscape should be minimized and waste should not cause nuisance through noise or smell. In addition, every EU country are required to present a national plan in order to gradually reduce the amount of biodegradable municipal waste going to landfills (2008/98/EC). The maximum level of landfilled waste in comparison to 1995´s produced quantity might be equal to:

75 % of the total amount (by weight) in 2006

50 % of the total amount (by weight) in 2009

35 % of the total amount (by weight) in 2016 (1999/31/EC)

For Union states that landfilled more than 80% of municipal waste in 1995, some exceptions are applied. They are given opportunity to move these targets four years forward. For UK for example, these levels should be reached in 2010, 2013 respectively 2020 (Avfall Sverige, e2013:06).

Further, in the Waste Framework Directive some additional targets are presented. Latest 2020, members shall arrange separate collection of recyclable waste such as paper, metals, glass and plastics. The share of material recovery from these substances should be at least 50 %. Simultaneously, latest the same year, the Commission advocates that recycling of construction material should be increased to at least 70% (2008/98/EC). It is estimated that only 10 European countries will reach these goals. Today, Sweden has almost reached these levels besides recycling of plastics. For this reason, Naturvårdsverket has developed milestones to achieve this target (Sahlin, J. et al, 2013).

Latest December 31, 2014, European Commission shall examine if these targets are met. Every third year, all EU countries are obliged to report to the Commission to what extent they have achieved these objectives. If milestones are not met, the reasons for this should be stated including an explanation on how these requirements will be fulfilled. During the meeting, the Commission will need to deliberate if waste reduction objectives need to be strengthened. Propositions should be reported and sent to the European Parliament and the Council for review (2008/98/EC). This meeting can result in stringent objectives, enforcing countries to speed up the implementation of directives into their laws and regulations. With stricter regulations, exports of waste from these countries may increase (interviewee 1, 2, 4, 2014).

Proximity and self-sufficiency principles imply that Union members can cooperate with each other if it is necessary to establish an adequate network for waste handling. This network shall enable the Union as a whole to become self-sufficient in waste disposal and recovery. Waste should be recovered in one of the nearest facilities that possess the most appropriate methods and technologies. Protection of Environment and public health should be a high priority. However, this principle does not mean that appropriate facilities should be within each Member State. Instead, the aim is to enhance the overall situation. Further,

members can protect their network or limit incoming or outgoing shipments of waste to incinerators if this result in national waste having to be treated in inappropriate way. Landfilling is an example of such treatment (2008/98/EC).

As already mentioned, transportation of waste across borders should be conducted in accordance to waste shipments regulations. Before the transportation, both exporting and receiving countries need to apply for permits. These permits are issued by environmental authorities from both countries, who requests information regarding the energy recovery plan for the waste, how effective the method is, approximate economic "value" and how the ashes from incinerating will be handled afterwards (Avfall Sverige, e2013:06). The exportation permits are not given to countries that are not members in the Basel Convention, or if they are not covered by the OECD decision. In addition, no permits are given to countries that do not comply with requirements of effective waste handling (2006/1013/EC).

Further, in the Waste Incineration Directive distinction is made between incineration plants (which combust waste with or without heat recovery from this process) and co-incineration plants (whose main purpose is energy generation or the production of materials). Examples of co-incinerations are cement and steel plants, in which waste is used as a fuel (1999/31/EC). With the introduction of emission trading system (ETS), it was determined that co- incinerators should be covered by this regulation, while incinerators could be excluded. Yet, two state members, Sweden and Denmark, decided to introduce this regulation on all incinerators regardless purpose or fuel used. An exception was made towards plants that are very small or those who only combust biofuel. This restriction, which came into effect in Sweden in 2013, has led to substantial cost burden to all incinerators. Today costs for carbon emission permits are quite low, so that price increase is not as noticeable. Yet, it may increase in the future (Interviewee 2 & 37, 2014). Consequently, the Swedish plants can lose their competitiveness towards import (Sahlin, J., et al 2013).

The main purpose of ETS system is to decrease carbon dioxide emissions from the industries. A predetermined cap limits all plants that are covered by this regulation. If a total emitted amount exceeds this level, companies have to buy the allowances they need. The other solution is to take measures to reduce carbon footprint. Hence, depending on the price of allowances, different purification measures will be profitable. Today, incinerators that supply heat through a district- heating network are allocated a certain number of allowances free of charge. The system aims to give some adaptation time to these plants so that they have time to take certain necessary measurements. During the period of 2013 - 2020 the number of the free permits is determined to decrease. After 2020 the next trading period begins, where issuing of free allowances will be ceased. As waste is a heterogeneous product, the need for number of

allowances depends of its content. If it contains high proportion of fossil products, such as plastics, it will entail high CO2 emissions. Thus, costs for these emissions will be higher including expenses for administration of emission measurement. Depending on price level on allowances it may be necessary to sort out the plastic from waste, or try to avoid volumes with high plastic content (Sahlin, J., et al 2013).

4.6 Naturvårdsverket - Swedish Environmental Protection Agency

EC (European Commission) Regulations apply entirely in Swedish legislation, and constitute the outer framework for waste management. Within these frames, the Swedish Ministry of Environment set national regulations, such as the Environmental Code "Miljöbalken". On behalf of the Government, Naturvårdsverket designs a national waste plan. Further, below the national level there are regional and municipal authorities, which control the compliance of the law through inspections and enforcement. Municipalities also have the obligation to collect household waste within the municipal boundaries for treatment and design their own sanitation plan and local regulations regarding waste. All country transboundary transportation of waste requires permits from Naturvårdsverket and the application should be sent in advance. In addition, transportation should be notified before it is conducted. Through this system the authorities can see the trends and control the flow (Avfall Sverige, u2009:06). Generally, the licenses are not fully utilized and the actual imports are less than what is permitted (Avfall Sverige, 2012:03). The *figure 15* below illustrates each export county´s approved licenses at Naturvårdsverket from January 1 - November 15 2012. As shown, most licenses were given to Norway and UK (Avfall Sverige, e2013:04).

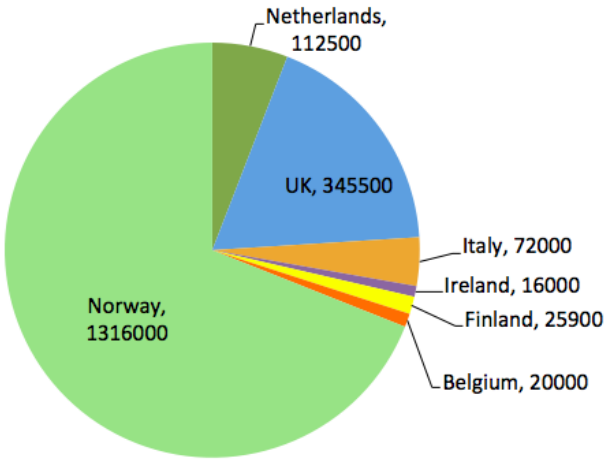


Figure 15: Issued permits for import of waste between 1 January 2012 and 15 November 2012 *(Source: Avfall Sverige e2013:04)*

Since 2000, Naturvårdsverket has by different means reached goals concerning waste management. One example of this is the decrease of domestic waste going to landfills, which was an outcome of landfill tax, introduced in 2000. This tax has been gradually raised during following years, until it was entirely replaced by a landfill ban on combustible waste. Mostly, the reduction of landfills has been possible through incineration. As waste volumes required thermal treatment, the capacity of heat and electricity plants has increased considerably (Greentech, 2014). However, this expansion has not only followed the domestic waste volumes. The industry instead is characterized by the overcapacity (Avfall Sverige, e2014:03).

To further improve waste management and move Sweden up the waste hierarchy, the agency has set several milestones. The purpose is to prevent waste in the first place, and thereafter reuse and recycle. Some of the milestones in the Swedish waste directive, Avfallsdirektivet, are:

- Increased housekeeping of resources within the food chain, the goal is to separate at least 50% of all food waste for biological treatment by 2018.
- Increased resource housekeeping in the construction sector, by 2020 70% of all non-hazardous waste should be prepared for reuse or recycling.
- The extended producer responsibility for increased recycling of wrapping and used products. Producers are obliged to receive and take care of waste in a sustainable way that arises from their products (Legislative Council Secretariat, 2013).

The long-term goal is not to incinerate waste, but to further develop Swedish waste management according to the waste hierarchy. For this reason, possible economic control measures are discussed in order to encourage better treatment methods such as reuse or recycling. One tool that is being discussed is the combustion tax, which was abolished a few years ago. This tax would affect the cost and profitability of waste incineration and consequently, make waste import less interesting from a business point of view (Interviewee 1 & 2, 2014).

4.7 Heat and power plants

There are 35 municipal solid waste incinerators in Sweden with a total capacity of 6,3 million tons per year (Avfall Sverige, e2014:03). These plants provide the society with energy and heat to a relatively low price, by using efficient and environmentally friendly techniques (Interviewee 1 & 2, 2014). As stated before, in 2009 waste stood for almost 19 % of incinerator´s fuel demand, a proportion that is expected to increase in coming years. In 2030, waste together with biofuel is expected to almost replace usage of

fossil fuels such as coal and oil. This development has a potential to lessen dependency on OPEC countries (Waste Refinery, 2013).

The capacity of waste combustion incinerators is steadily increasing. Out of the 35 existing plants (see appendix D), three of them have become operational recently. These are:

- Filbornaverket in Helsingborg, which started commercial operation in the beginning of 2013
- Sigtuna located in Brista, in service since November, 2013
- Kraftvärmeverket in Västerås, which is still in the test- run phase.

In coming years, two more incinerators are expected to be ready for use. Nybro kraftvärmeverk is estimated to be in service in 2015-16, while Högbytorp, which is located in Upplands bro, is scheduled to start the activities in 2017-18. Further, beside new facilities, the old incinerators are expanding their ability to combust more. They apply for environmental permissions in order to either increase the efficiency or build new pans next to the old ones (Interviews, 2014).

As described above, there is considerable interest of building new incinerators. This interest is driven from the energy sector, where high fossil fuel prices make waste an interesting commodity (Avfall Sverige, f2012:04). Municipalities and other energy companies have developed building project plans that are at different stages in the process. Some of them have already applied for environmental permits and are under negotiation phase, while others still cope with multiple uncertainties. If all planned projects will be carried through, Swedish incinerator capacity will reach between 6,6- 7 million tons in 2020, as illustrated in *figure 16* below. This number can vary depending on if all plans will be realized. There is a possibility that some of the projects are changed or abandoned. Most uncertain are those without environmental permissions, even if the permit is not a guarantee that plans will be implemented. Moreover, completion of planned facilities can take longer time than expected (Avfall Sverige, e2014:03).

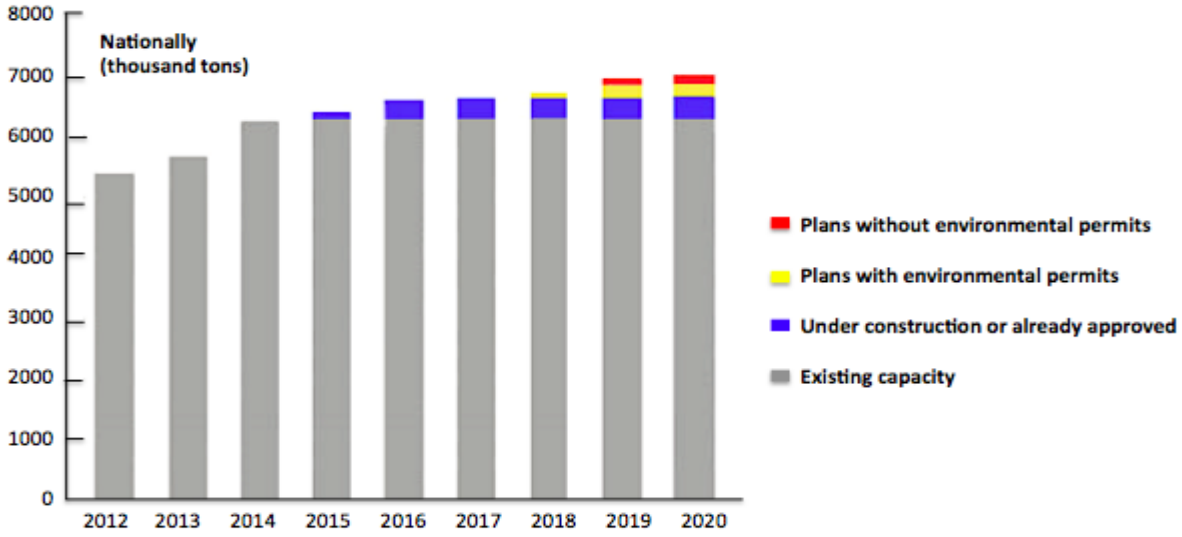


Figure 16: Existing and planned technical incineration capacity of household and commercial waste, and PWP (Paper/Wood/Plastics) *(Source: Avfall Sverige, e2014:03)*

While the combustion capacity at incinerators increases, recycling has become a more and more effective mean of waste treatment. In 2010, 36% of total municipal solid waste went to material recycling, a proportion that is expected to increase in coming years. In addition, biological treatment of the waste is expected to expand on behalf of better sorting of food waste from restaurants and organic waste (Waste refinery, 2013). If the national milestones of environmental quality proposed by Naturvårdsverket will be realized, they will steer away approximately 875 000 tons of waste from combustion plants by year 2020. 500 000 tons will encompass food waste, 75 000 tons will include construction waste and finally, 300 000 tons will be reused or recycled. This development will free up more capacity at incinerators plants (Avfall Sverige, e2014:03).

Today, the industry is characterized with surplus capacity. In 2013, existing capability consisted of 5,7 million of tons, while the actual Swedish waste volumes reached around 4,6 million tons. The gap between the supply and demand was covered by imported fuel. If the trend with the new incinerator constructions will continue, the excess capacity will reach levels of between 0,8- 2,4 million tons by 2020. Again, the numbers can vary depending on whether project plans on heating- and energy plants will be realized or not. In addition, if the quality of the fuel changes so that calorific value increases, the excess will be limited. Cooling capacity at Swedish incinerators is also a constraining factor that needs to be taken into consideration (ibid). *Figure 17* illustrates actual industry capacity and actual waste volumes. It also includes a comparison between forecast of waste volumes. The red line exhibits waste volumes if

the national milestones will not be successful. In contrast, the green and blue lines embody waste volumes if targets are achieved (ibid).

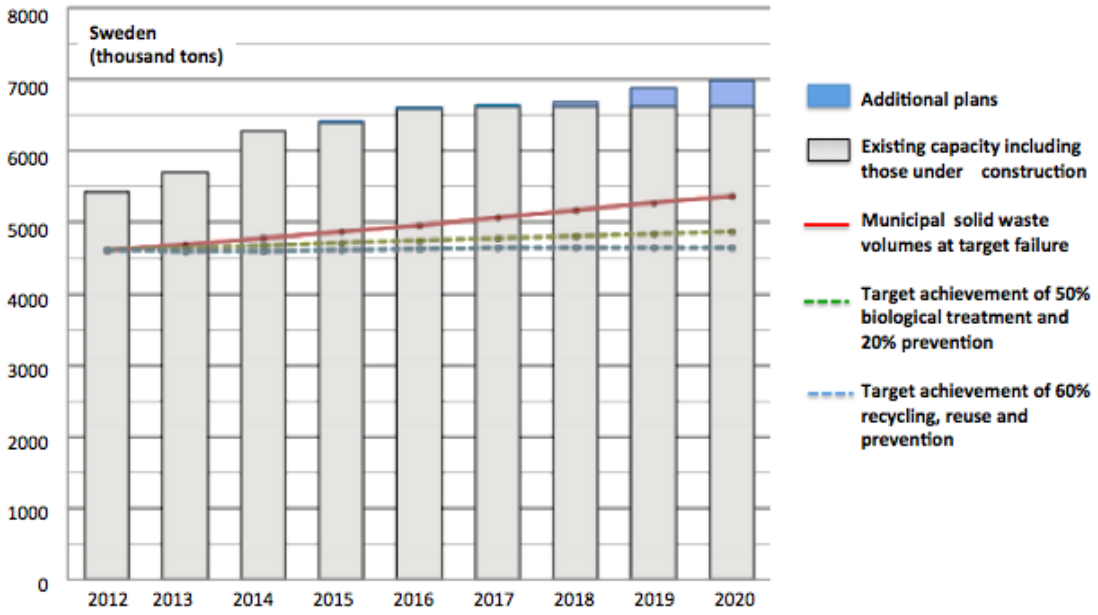


Figure 17: Forecast of waste volumes in relation to incineration capacity *(Source: Avfall Sverige, e2014:03)*

The Swedish system of waste incineration is very efficient and is classified by the EU as "energy recovery R1" (Avfall Sverige, 2013:06). Compared to other European large-scale waste combustion countries, Swedish incinerators recover most energy per ton waste *(see figure 18)*. The energy consists of both electricity and heat, which is distributed by an extensive network to the consumers (Avfall Sverige, 2012:04). District heating is a common method for space and water heating in the country. Expansion began after World War two and today it accounts for about half of all heating for residential and commercial buildings (Handelskammaren, 2009). This network gives a competitive advantage to the industry in comparison to other European countries. In Norway for example, expansion of the network has occurred recently, which imposed significant costs. To cover these costs, the country raised gate fees for both domestic and imported waste. High fees encouraged Norwegian and other foreign European countries to deliberate exports to Sweden, which today offers prices between 360 - 500 SEK (Fee variation depends on various contracts but also on different regions. In some regions for example, competition between incinerators is higher than in others). However, today the situation is changing. Norwegian heat and power plants has almost adapted gate fees to the Swedish level and export volumes are expected to decrease in the future (Interviews, 2014).

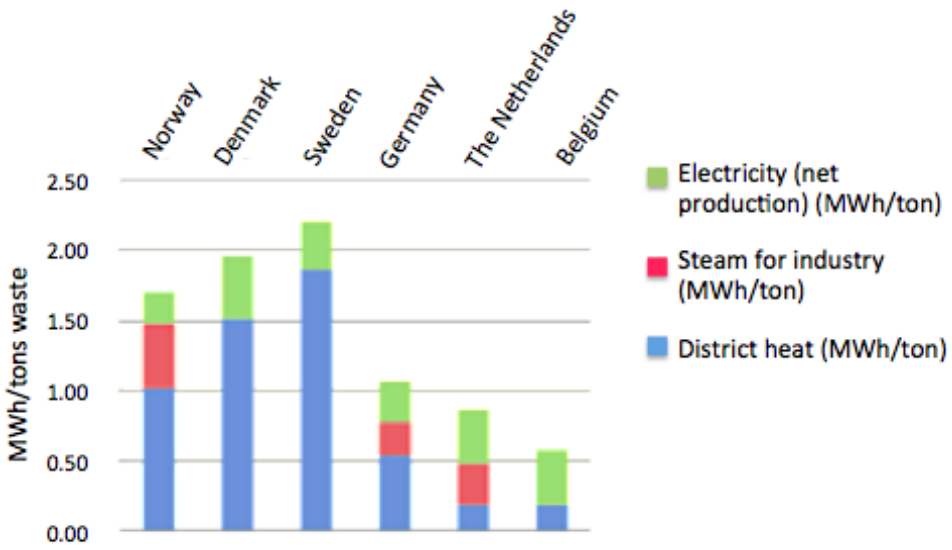


Figure 18: Calculated marginal energy recovery from 1 ton waste *(Source: Avfall Sverige, f2012:04).*

It is important to note that heat and power plants receive money from both waste suppliers and energy consumers. Revenue also comes from metals recovered from the bottom ash, making this business interesting to different actors. However, there are some costs related to the process. These are fixed costs in terms of depreciation and operating costs, and variable costs related to production, landfilled ash and emissions. Compared to biofuel, waste combustion causes more expenses. The reasons depend on fuel consistency, challenges due to transportation, higher need of abatement equipment and so on. These costs determine gate fees for incinerator plants, which stand for the largest income proportion. Thus, if these fees will have downward characteristics, it will not be economically viable to use waste as a fuel. Instead, woodchips or other kind of biofuel will be a more profitable alternative (Interviewee 1 & 3, 2014).

4.8 Society

The general opinion about waste importation is crucial for many actors involved. Despite the fact that transportation of waste do not differ much from transportation of other bulk cargo, it often evokes dissatisfaction among the people. The joint attitude of the society is that waste should not be carried such long distances and that every country should take care of their waste. Therefore, the import is a controversial subject of interest for both public and non-governmental organizations. Reasons for this behavior might be lack of knowledge of the industry´s contribution for better waste management. In addition, people might not see waste as a resource that provides heat and electricity. Instead, more

concentration is directed towards emissions during thermal treatment. Due to the negative attitude for this fuel, its transportation is highly regulated by ports, municipalities and authorities. Involved actors are also investigating the possibilities of improved control of other actors in the chain. (Avfall Sverige, e2013:06).

The delicate situation derived from public opinion results in high-risk awareness among actors. Port authorities as well as traders and agents are aware of, and are trying to minimize the risk of leakage during handling of bales (Interviewee 3, 5, 34, 2014). Incinerators, on the other hand, set requirements on the quality of waste, its parameters, characteristics and also how it should be transported (Avfall Sverige, e2013:06). Hence, the interest for improved logistic solutions with lower risks and better economy are identified among several actors (Interviewee 17, 18, 31, 2014).

4.9 Ecology

Preventing waste or reusing products have many environmental benefits. However, waste is still engendered and requires disposal in terms of recycling, biological treatment, combustion or landfilling. The three first methods stand for almost all waste treatments in Sweden, while landfilling has only a very small proportion, about 1%. Recycling, biological treatment and combustion alternatives are complementary to each other depending on waste content and competition between them is very small. From a climate perspective for example, recycling of materials is preferable to energy recovery. This applies especially to sorted and homogenous materials such as cardboard, glass, newspapers, metal packages etc. However, not all materials can be recycled or digested. In this case, energy recovery has more benefits compared to recycling. Such materials are those that have been contaminated and should not be disseminated to the environment. Also, such materials are those that have too low quality and cannot be recycled (Avfall Sverige, e2013:08).

Again, from a climate perspective, there is a need of removing waste going to landfills. Landfills cause large emissions of greenhouse gases, not mentioning other minor consequences. Expansion of incinerator plants in Sweden have made it possible to remove most of the landfilled waste and turn it into an energy. In addition, the use of other fuels for energy and heat production, such as oil, natural gas and coal, is now replaced decreasing carbon footprint even more. One should also note that combustion allows for metal recovery from the ash left after the process. These metals are usually compound and heterogeneous, making them difficult to tear apart (ibid).

Further, by importing waste from countries that does not have ability to dispose it in an adequate way, Sweden helps them to move one step up in the waste hierarchy. Although waste imports are a

controversial and disputed topic, it can be stated that the process reduces between 500-800 thousand tons of greenhouse gas emissions. *Figure 19* below illustrates emissions generated by one ton imported waste. As shown here, combustion has the most impact on the environment, while transportation stands for only a small share. Substitute to energy recovery could be landfilling instead, resulting in 700 kg of CO2 emissions. Also, alternative heat and energy production would contribute to more damage. The calculations show that as long as the transportation distance to Sweden is less than 15 000 km, the greenhouse gas emission are reduced. This distance means that even if waste is transported from South Africa to Sweden by truck, climate impact will still be less. Of course, such transport is not realistic, as it would cost a lot. However, this shows how much energy recovery reduces environmental impacts (Avfall Sverige, u2009:06).

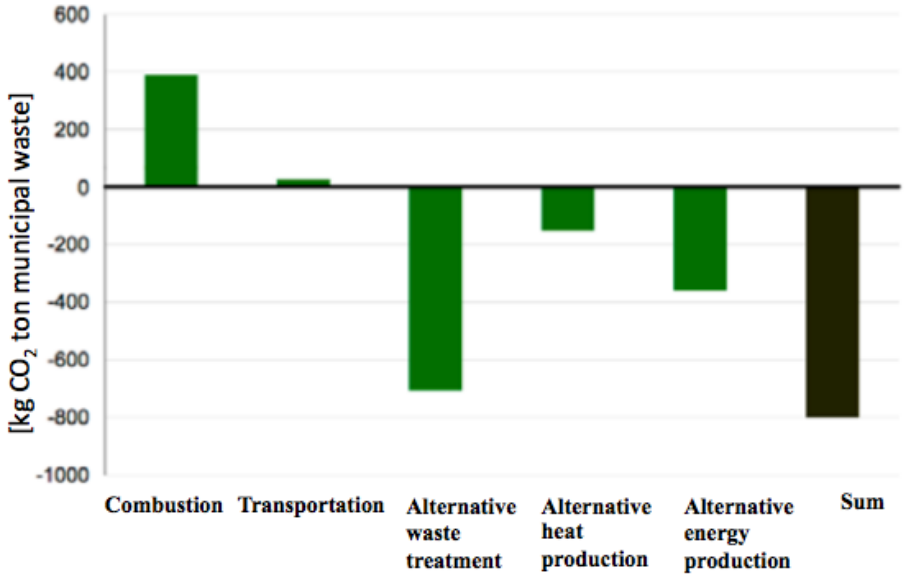


Figure 19: Greenhouse gas emissions when importing one ton of municipal solid waste (*Source: Avfall Sverige, u2009:06).*

It is important to mention that numbers in the *figure 19* can vary depending on (1) what kind of waste is landfilled, (2) the proportion of collected emerged methane gases, (3) the proportion of methane oxidized in the landfill surface layer, (4) the proportion of gas used for electricity production, (5) the distance waste is transported and (6) what kind of transportation is used. Hence, for various European countries, environmental benefits can look different (Avfall Sverige, u2009:06).

4.10 Suppliers

One of the important driving forces for increased waste exportation from some countries is the introduction of waste regulations. EU initiatives for more sustainable waste management have derived certain actions, such as implementation of landfill tax or landfill ban. Still many European states experience lack of domestic sustainable waste disposal alternatives. The process of implementing new incinerator capacity is very slow. This is due to time consuming license processes, long lead times and high costs. As a result of these facts, willingness to pay for the cost of transportation and other logistic costs has been raised (Avfall Sverige, e2013:04). *Figure 20* demonstrates the countries that export most waste volumes to Sweden. These are Norway, Finland, UK and Ireland. According to the prognosis, which is based on data from incinerator plants, import volumes from UK and Ireland will increase significantly during 2014. Finland is also expected to more than double their export to Sweden. Norwegian volumes, on the other hand, will stagnate (Avfall Sverige, e2014:03).

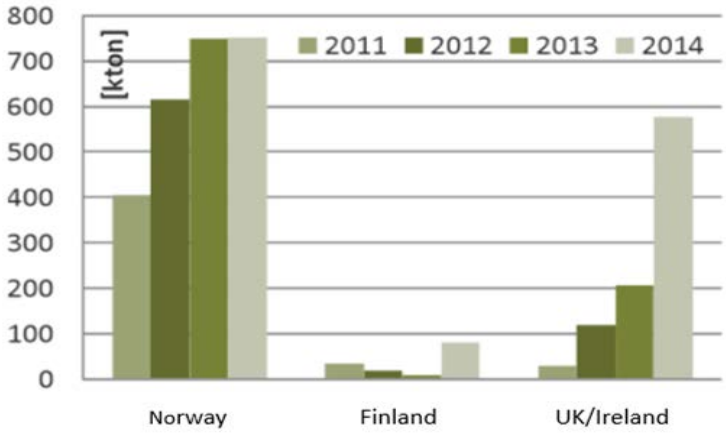


Figure 20: Imported and forecasted volumes of sorted waste and RDF for energy recovery in Sweden (*Source: Avfall Sverige, 2014)*

4.10.1 Norway

Today, the major part of imported waste originates from Norway. Primarily it consists of sorted industrial waste loaded loosely in the trucks. Imported volumes vary between 80-100 000 tons per year, depending on the demand (Interviewee 4, 2014). According to a study made by Waste Refinery, Norwegian waste tends to provide less quality compared to other imported waste fuel. This is judged by its content of gypsum and inert material (Bisaillon, M, et al, 2013). However, these volumes are still appreciated by

Swedish incinerators as their overcapacity is filled (Interviewee 4, 2014). Moreover, the ashes left after thermal treatment is often sent back to Norway for further usage, providing many benefits to the environment (Legislative Council Secretariat).

After Norway has introduced landfill bans in 2009, the expansion of the domestic incinerator capacity has been expedited (Avfall Sverige, f2012:03). This coincided with the financial crisis that freed a lot of combustion space in Sweden. Consequently, exports to Swedish incinerators have been significantly high. However, due to expansion of domestic capacity in Norway, which at the end of 2013 reached 1.65 million tons, exports have slightly decreased. Still, the country experiences a lack of capacity and is in need of finding solutions *(see figure 21)* (Avfall Norge, 2014:3). Yet, if the level of waste production will not increase, Norway might have enough capacity to incinerate all of their combustible waste (Avfall Sverige, f2012:03).

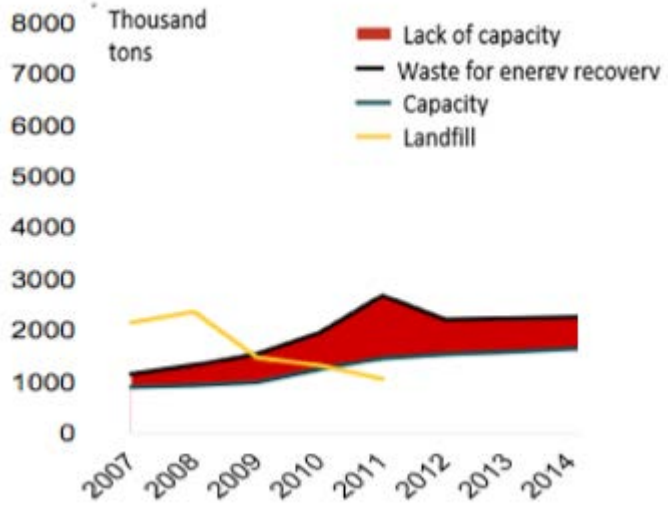


Figure 21: Norwegian incineration capacity *(Source: Revised from Avfall Norge, 2014:3)*

Although the Norwegian incinerator capacity is catching up, not all domestic waste volumes are handled within the borders. Previously, Norwegian municipalities exported a lot of sorted industrial waste to Sweden, leaving overcapacity at own plants. This gap was filled by imported waste, mainly originating from UK. The reason to such development was high domestic fees, making exports to Sweden a cheaper alternative. However, the situation undergoes transformation. Nowadays, Norwegian plants have managed to keep competitive price levels, which eventually may lead to reduced export volumes from Norwegian municipalities. Still, the volumes are not expected to disappear completely. There are no incinerators in the northern parts of Norway, making transports to Sweden more profitable than

alternatives in southern Norway. Plants that may keep these deliveries are those located in Umeå, Sundsvall, Kiruna, Boden, etc. In addition, from these areas Norway can arrange loaded return transports. This is an advantage, which cannot be arranged from e.g. southern Norway (Interviewee 4 & 41, 2014).

Figure 22 below illustrates volumes exported to Sweden during 2009 - 2012. As shown, volumes had growing characteristics until 2011. This development can be explained by Norwegian incinerators price adjustments tailored to the competition with Swedish actors, allowing the Norwegian incinerators to win procurements. In addition, the decrease can also be explained by stored material and a relatively warm Swedish winter (Avfall Norge, 2014:3).

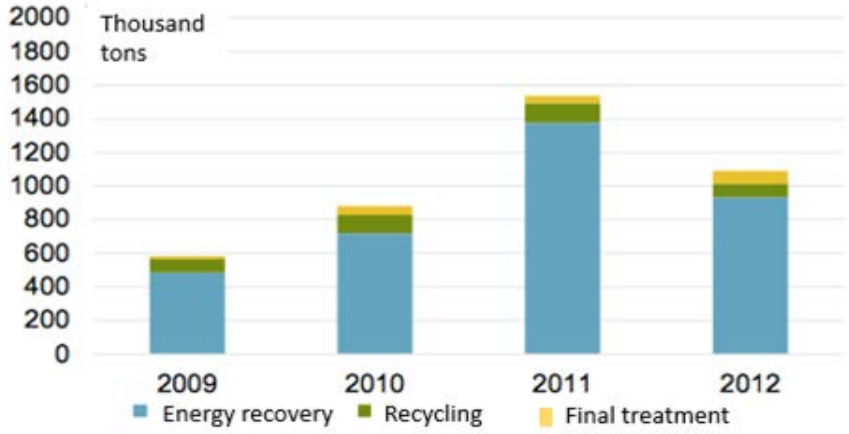


Figure 22: Waste export from Norway to Sweden *(Source: Avfall Norge, 2014)*

4.10.2 United Kingdom

The United Kingdom is considered to be the next major waste export supplier to Swedish incinerators. A relatively large population and a high level of consumption characterize the country, why large waste volumes are produced. The introduction of control measures, such as progressive landfilled tax and diminishing landfill permits, has driven up costs of waste management. The level of the tax is enough high today so that it alone acts as a driving force for landfill reduction and exports (Sahlin, J., et al 2013). Every year, the tax is raised with 8 £ and in 2014, it is expected to reach 80 £/ton. The implications of this development have already shown results. For example, in 2010 the landfilled number amounted to 26 million tons, which is a significant decrease from 39 million tons landfilled during 2007 (Avfall Sverige, f2012:03). This result is mostly achieved by exports, as the expansion of combustion capacity is still very slow. Reasons for this can be attributed to high costs, but also to resistance from society towards thermal treatment (Interviewee 3, 2014).

Waste fuel from the United Kingdom is considered to have relatively high quality due to its dryness, high-energy content and low content of ash, chlorides and zinc. The sorting process is performed mechanically and is centralized, in contrast to the Swedish system where an individual sorting system is used (Bisaillon, M, et al, 2013). After the sorting and drying process, the waste gets new characteristic that is called RDF (Refuse Derived Fuel). The demand for this specific fraction is very high at Swedish and other countries´ incinerators. For this reason, Swedish plants are amenable for cooperation with export actors in the UK (Interviewee 4 & 34, 2014).

4.10.3 Ireland

Ireland is also an important exporter to Swedish incinerators, even if the total imported volumes are less compared to UK (Interviewee 33, 2014). National goals are set for better waste disposal and to achieve the milestones in EU directives. In 2002 for example, taxes were introduced on landfills that amounted to 15 € per ton waste. Unlike other European countries, where taxes have been raised gradually, Ireland remained to have the same tax level until 2007. This levy level was slightly increased between 2008 and 2010, but it soon became clear that it was not acting as a sufficiently strong economic driver. For this reason, the government increased the tax significantly and in 2013, it reached 75 € per ton waste (EEA Ireland, 2013).

Even if this landfill tax has been raised, the majority of municipal solid waste generated in Ireland still ends up in landfill. In 2010, it amounted to 53%, which is a decrease by 24% in comparison to 2001. Recycling and economic recession are estimated to be the reasons of this. With better economy the produced waste levels may increase. This will be a challenging factor, as the country remains underdeveloped in terms of waste infrastructure. For example, the first incinerator has become operational in 2011 and there are plans on building two more. The expansion will take time, making it difficult to achieve EU milestones. Exports in this case can be a solution. *Figure 23* illustrates relation between landfilled volumes and tax level development in the country. As shown, increased taxes have also opened interest for incinerator construction (ibid).

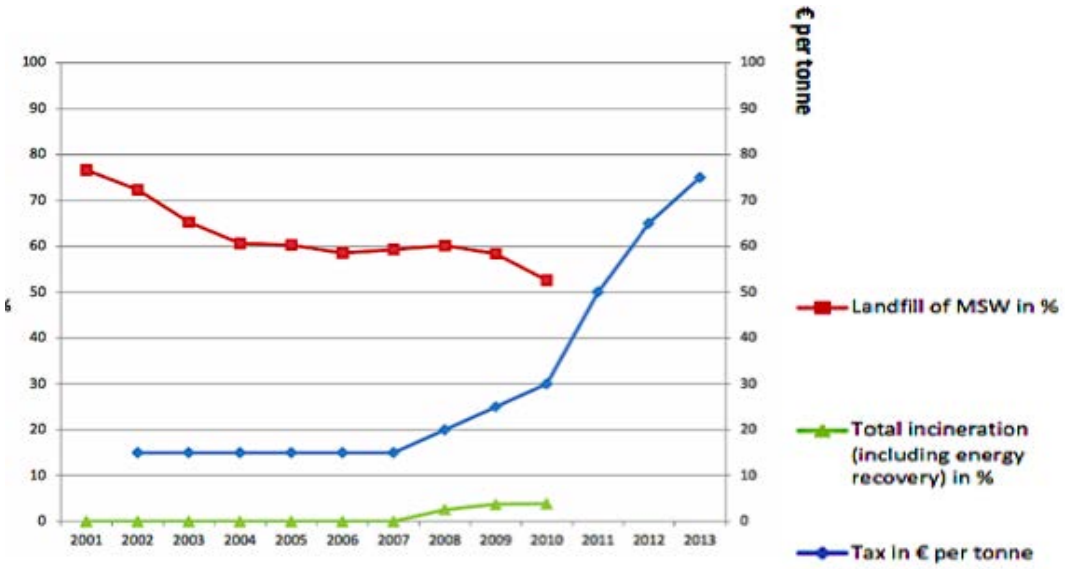


Figure 23: Development of landfilling and incineration of MSW and landfill tax in Ireland *(Source: EEA Ireland, 2013).*

4.10.4 Finland

Finland is expected to increase municipal solid waste (MSW) export to Sweden during 2014 (Avfall Sverige, e2014:03). The driving forces behind this development are the reformation of waste laws, such as the Waste Act and the waste tax, but also the new national waste plans, which are aimed to be fulfilled until 2016. These targets include increase in recycling by 50%, extension of energy recovery to 30% and decrease of landfilling to 20%. Still, the majority of municipal waste is landfilled. In 2010 the number amounted to 1.1 million tons, which stands for 45 %. Yet, in 2010 the country has almost met the EU milestone of leading away biodegradable municipal waste from landfills until 2016. Landfilled number of such waste amounted to 37 % of required 35% so that the probability of meeting this target is very high. Recycling on the other hand has stayed unchanged, 34%, during the long period. If more incentives are not introduced, it will be challenging for Finland to reach the target of minimum 50% going to recycling (EEA Finland, 2013).

Recyclable waste placed in landfills is subject to a gradually rising waste tax, which makes recycling and recovery alternatives more competitive than disposal. In 2013, the tax level reached 50 € per ton, which is paid by all wastes that have an alternative possibility to recovery from an environmental and technical point of view. In addition, a new landfill ban on organic waste sent to landfills will come into force in 2016. However, these control measures have increased combustion capacity rather than encouraged

material recycling. In 2010 for example over 550 000 tons of MSW was incinerated. In coming years the combustion capacity is expected to increase even more. According to Finnish waste plan, approximately 700 000-750 000 tons of capacity will be needed. Though, if plant expansion will continue at the same extent as it is today, there is a risk for Finland to end up with overcapacity. Imports can then be actualized (ibid).

4.10.5 Italy

Today's import of combustible waste from Italy to Sweden is very limited. The country has a good potential of increasing their exports, but there are some obstacles involved. These include the risk of mafia involvement in this business, waste quality issues but also the lack of economically viable logistic solutions. Logistics are though dependent on the tax level in the country. With increased levies, alternative solutions such as exports usually become more profitable (Avfall Sverige, f2012:03). In 2012 the landfilled tax amounted to 19 € per ton, which is still very low to provide incentives for better waste treatment solutions. Hence, landfilling stays to be the most common method, especially in southern regions (EEA, 2014). For this reason, but also due to the lack of capacity for alternative process methods, the implementation of EU directives has been delayed. The goals of reduced landfilling are now postponed with two years. The last goal of maximum 35% of waste going to landfills is thus set to 2018 instead of 2016 (Avfall Sverige, f2012:03). As EU targets still need to be fulfilled, there is a possibility that Italy will increase tax level. Alternative solutions will then be considered (EEA, 2014).

4.10.6 Poland

Poland is one of the less developed countries in Europe in terms of waste management. In 2012 the EU commission proposed penalties for countries that had failed in introducing the EU Framework Directive (2008/98/EC) in their regulation, where Poland was among them. Other proposed countries included Bulgaria, Romania and Slovakia. In Poland, large volumes of waste go to landfills among which many are not approved by authorities. There is a lack of better alternatives, although Poland has been granted financial support from the EU in order to improve conditions for waste handling. However, the situation has started to change in recent years, namely after 2012. The national regulations regarding municipal waste were strengthened and raised tax levies for landfilling are planned to be implemented during 2014. It is though uncertain if these control measures will lead to stronger willingness to pay for waste treatment services and possible exports. It depends on the power of these policy measures, which is currently unclear (Sahlin, J. et al, 2013).

4.11 Competitors

As already mentioned, UK is a very interesting market for waste importers. Several actors investigate opportunities to import RDF fraction from there as it has superior quality. Sweden is not the only country showing interest to this commodity, Germany and the Netherlands are engaged as well. Both countries have excess combustion capacity and as they are closely located to the UK, they have more competitive advantages in terms of lower transportation costs. *Figure 24* illustrates permits that were issued to British municipalities by different countries, during the period of 9 September 2010 and 9 September 2011. The red stacks represent the actual exports during the same period. As seen from the chart, the Netherlands dominated both in terms of issued permits and actual imports (Avfall Sverige, f2012:03). Even if the situation differs today in terms of both permitted and imported volumes, this chart represents a good overview over which countries compete for the same commodity and what market shares they have.

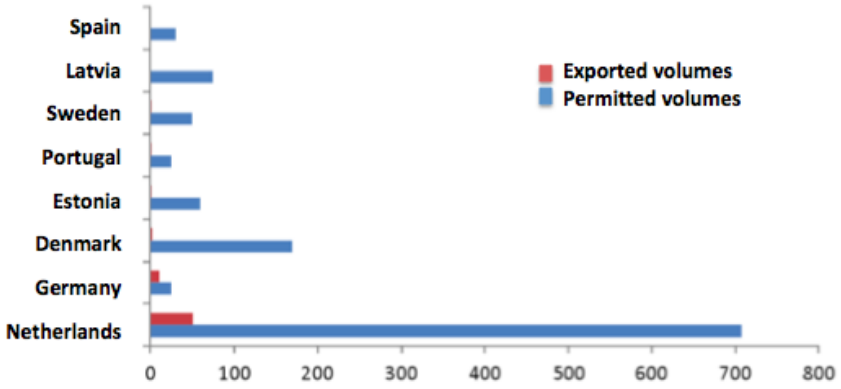


Figure 24: Permitted and actual imported volumes of RDF to the UK *(Source: Avfall Sverige, f2012:03)*

In coming years, the competition between these countries is expected to increase. The reasons are reduced availability of domestic waste due to sustainability issues. Increased recycling and reuse for example will free up incinerator´s capacity. The situation differs between European countries, but in general those countries that almost diverted waste from landfills are characterized by excess capacity and are ready to import. *Figure 25* shows the actual situation and the prognosis of capacity in six countries: Netherlands, Belgium, Germany, Denmark, Sweden and Norway. The red line illustrates the total of domestic waste after recycling and biological treatment. The black line represents the capacity for both actual and planned waste combustion plants. The gap between them, the blue area, is the surplus of capacity, which can be covered by imported waste (Avfall Sverige, f2012:04).

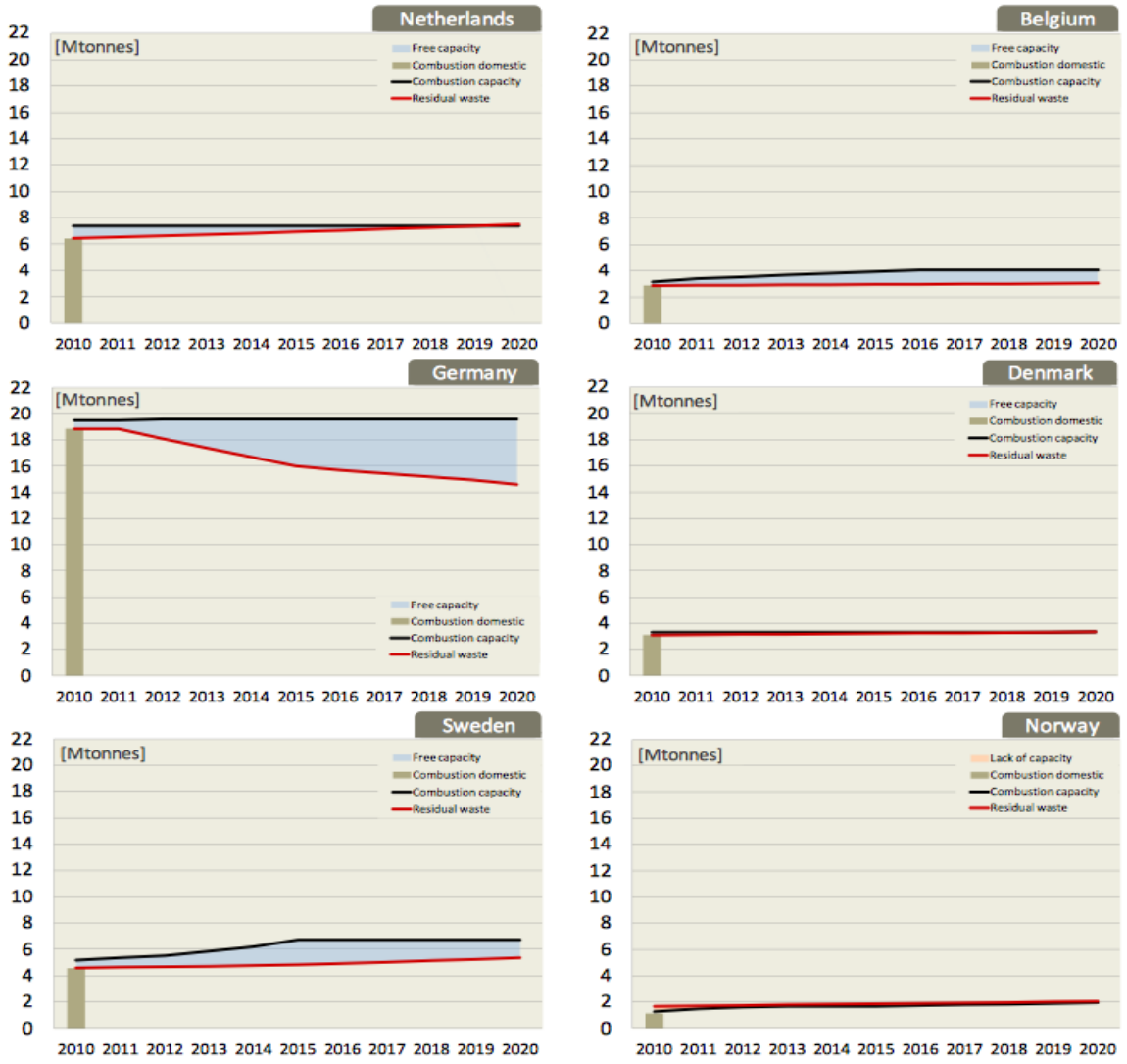


Figure 25: Supply and demand of combustible waste in six countries *(Source: Avfall Sverige, f2012:04)*

The study showed that in 2020 the overcapacity can reach around 7 million tons, depending on if all plans and milestones will be realized. As illustrated in the *figure 25*, Germany is the dominating country that have most energy combustion capacity but also the largest excess capacity in the end of the period. There are no plans on expansion of the plants but the amounts of municipal solid waste is expected to decrease remarkably. Changes in demographics but also increase in recycling and reuse of the products are assumed to be the reasons. This surplus capacity will have a high impact on the competition, which in turn can decrease gate fees (ibid). Regarding regulations Germany have higher requirements on how waste should be transported. Logistic providers are imposed to notify authorities in advance (one week

before) how it will be transported and what units will be used. This fact complicates the planning process for logistic providers (Interviewee 4, 2014).

Further, the situation in the Netherlands is expected to change in the near future. There are no plans on building incinerators while at the same time their domestic waste is increasing. By 2020 the national waste will probably cover all available excess capacity and imports will not be actual any more. In contrast, Belgium is the country that is expanding the energy recovery capacity. Their domestic waste volumes are considered to stay at the same level, which will result in excess capacity. Thus, Belgium is expected to be a new competitor in this industry, especially for UK waste. However, their competitiveness will be measured in terms of gate fees and transportation costs (ibid).

Among Scandinavian countries, Sweden possesses most combustion capacity and at this moment it offers the lowest gate fees for imported waste. This causes challenges for Norwegian incinerators as domestic waste is exported rather than combusted in the country. Even though the country´s total capacity is less than needed for domestic market, Norwegian power and heat plants are imposed to find alternative sources. Even here, UK becomes an important supplier. In Denmark, however, imports have an insignificant share. Their domestic waste volumes almost cover their combustion capacity and there are no plans to expand facility numbers (ibid).

To summarize, the overcapacity in these countries will result in hardened competition for waste volumes. Although, in the long run, there should be a possibility to achieve balance between the volumes and the capacity. In this case, the gate fees should come to a normal level of 100 € ton, making Sweden more competitive from an economical perspective (Sahlin, J., et al 2013). However, environmental aspects need to be taken into consideration. Sweden has access to an alternative fuel such as waste chips if the waste volumes fall. In contrast, if the scarcity will appear in Germany or Netherlands, alternative fuels are only fossil fuels, such as coal and gas (ibid).

Another competitor to the heat and power plants in Sweden is the cement industry. Cementa is a subsidiary of the German company Heidelberg cement and constitute the sole producing actor of the cement in Sweden. Cementa has three production plants in the country, located in Slite, Degerhamn and Skövde (International Cement Review, 2014). These plants are in great need of fuel to produce their product. Although, they require finer waste fractions such as SRF (Specified Recovered Fuel) which needs better sorting equipment before delivery (Interviewee 7, 2014). Historically, municipalities used to send local waste to these plants without paying gate fees. As incinerators have a policy to receive money for disposal of all waste, Cementa emerged as a major competitor. For example, during negotiation

whether to build a new incinerator in Nybro or not, the question was if Cementa would still receive domestic waste. However, it was decided that the new plant was not allowed to use local waste. Instead, a new sorting facility is planned to be built in Kalmarsund´s region and the combustible waste from there will still be sent to Cementa in Degerhamn (Barometern, 2011). These events have imposed managers at the incinerator in Nybro to consider import alternatives (Interviews, 2014).

4.12 Substitutes

The base for Swedish demand for waste import is the district heating. Therefore, the future demand for district heating is decisive for imported quantities. Due to developments in the technology and extended usage of other heating sources in new buildings, the future demand for district heating is forecasted to decline. The *figure 26* below illustrates the forecast for district heating demand from 2007-2025. One of the most important factors contributing to this development are more efficient housewarming methods used by existing customers. The most common substitutes are different kinds of heat pumps. Further, some share of existing buildings that are not connected to the district heating system but also new building will be connected. Yet it will not be enough to retain the level of demand (Waste Refinery, 2013).

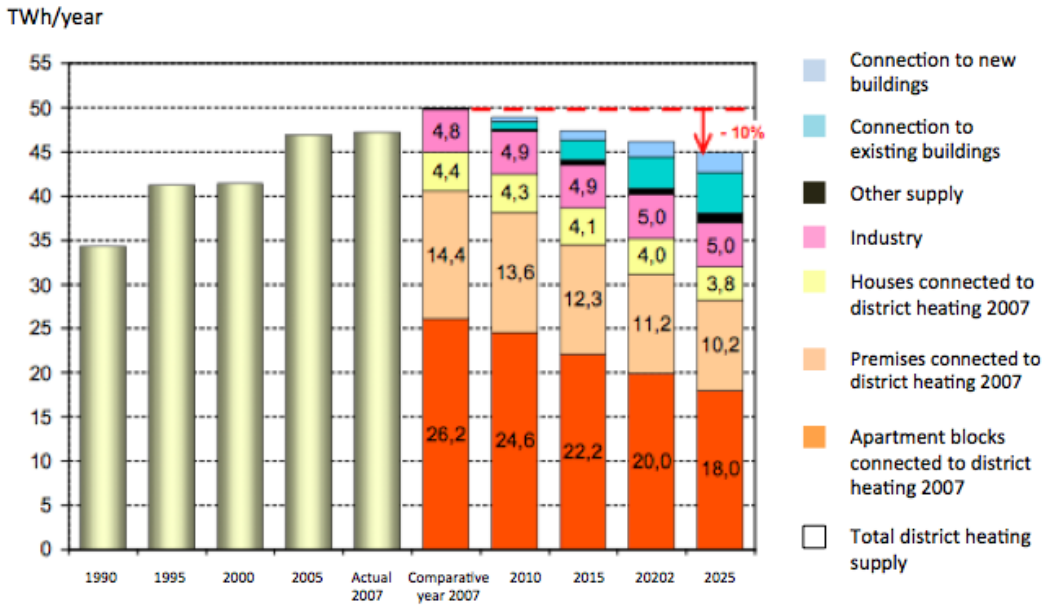
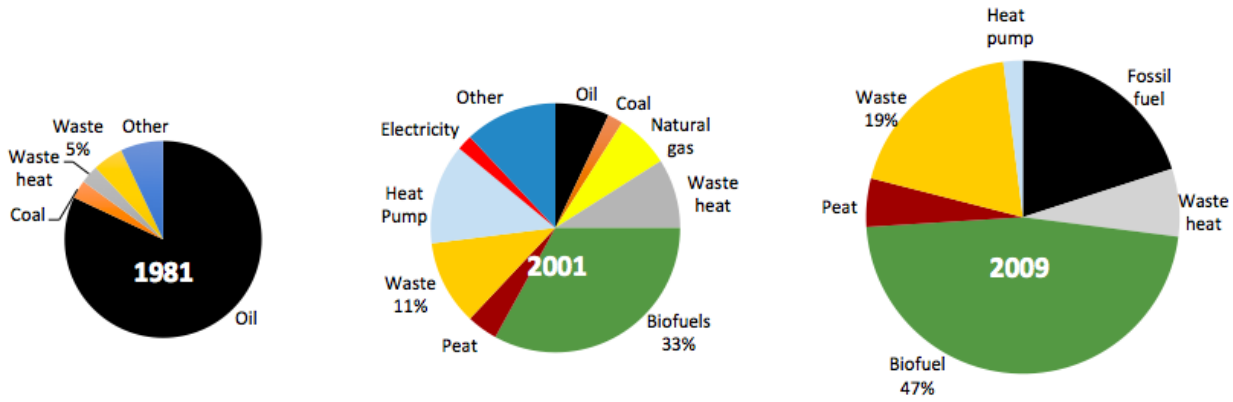


Figure 26: Demand for district heat in Sweden; historic (1990-2007) and future (2007-2025) *(Source: Waste Refinery, 2013)*

Hence, the demand for district heating is expected to decline. Simultaneously, the proportion of waste fuel for this system is increasing. The *figure 27* below demonstrates the development in terms of fuel types for energy recovery since 1981. The size of the circle diagrams visualizes the enhanced use of district heating during this time period. Obviously, the proportion of fossil fuel has declined in favor of mainly biofuels and waste.



27: Changes in proportion of fuel types and growth of district heat system in Sweden 1981-2009 *(Source: Waste Refinery, 2013)*

4.13 Other actors

The waste export/import supply chain involves many other actors, which interact for its completion. These are agents, shipping companies, brokers, municipality representatives, port and terminal authorities, logistic providers etc. In some cases major recycling companies are contracted for a part of or the whole supply chain, where they collect, sort, wrap, storage and are even responsible for transportation of waste to receivers (Avfall Sverige, e2013:06). All these actors play an important role for in the process and they set various requirements on the cargo characteristics. It is not an easy task to satisfy all these actors' preferences. Yet, it is vital to find a common solution so that the entire chain functions properly (Interviewee 3, 4, 5, 2014).

5. Analysis

The structure of this chapter follows scenario development model, which is presented in the second chapter. Through these steps analysis is conducted towards answering the research question. It begins with preparation, where the objectives of scenario planning and its scope are determined. The next part summarizes in short the scanning part, i.e. the empirical investigation presented in chapter four and divides the data into transactional and contextual spheres. Further, the identified certain and uncertain trends are analyzed in deep and two of the most uncertain trends are elaborated. These create four different scenarios for how the future might unfold.

5.1 Preparation

As noticed by Hines and Bishop, 2007, it is vital to decide in an early stage what question the scenario planning process is supposed to answer. In this study the main question is: what changes will the Port of Gothenburg face in five to ten years concerning municipal solid waste imports? Some trends and driving forces are pointing to an expansion of this business, while other aspects advocate decline in the demand. Hence, the objective with this concept is to identify all possible certain and uncertain trends in this industry and identify factors impacting on volumes of imported waste in the future. In addition, the two most uncertain trends that have the most impact on the organization should construct four scenarios representing possible futures. These might include both positive and negative outcomes. The advantage of narrative variations is that they can prepare the Port of Gothenburg with strategies for different situations. In addition, through the scenario maps the company may get more detailed information on possible events and underlying reasons to why these develop in one or the other direction.

Shoemaker (1995), mentions the importance of determination of the scenario´s scope and its time frame. The scope in this report is limited to imported municipal solid waste demanded by heat and energy plants located in Sweden. All other aspects such as other waste kinds or other waste receivers are excluded from the study. Further, time horizon is determined to stretch between five to ten years. Analyses of the industry´s history, but also its volatility are considered to be the main reasons to this (for more information see chapter 4.1).

For the diversity and dissent of the analysis, information had to be collected from different sources. As described in Ogilvy and Schwartz´s report published in 2004, the researchers need to find a group of people with different backgrounds and positions. This procedure is important in order to minimize the risk of missing important aspects in terms of certain and uncertain trends. However, as it was not possible

to gather all these actors, researchers conducted multiple interviews with sales and environmental managers at incinerators, independent companies, authorities at the port, a broker, a shipping company etc. Through these actors the researchers gathered as much information as possible. Questions were constructed in a way to encourage free-thinking (see appendix A, B, C). As respondents were guaranteed anonymity, they had the chance to express their opinions.

5.2 Scanning, and how this will help to develop scenarios

The next step in the scenario development is scanning. The process includes examination of the industry´s transactional and contextual environment (Van der Heijden, K., 2005), which is presented in the empirical part. For the waste industry, the transactional environment consists of actors such as heat and power plants, supplier countries, foreign competitive plants, substitutes, logistic providers, municipalities in both importing and exporting countries, brokers, shipping companies, port and terminal authorities etc. All these actors have high influence on the industry, why identification of their role is important. Situation in the waste industry changes all the time. For this reason, each move of the abovementioned actors needed to be considered.

Contextual environment on the other hand involve actors such as EU, Naturvårdsverket, society, ecology etc. These actors create driving forces that shape the firms environment. The organization does not have the power to effect on these actors but they have a high influence on the organization (Van der Heijden, K., 2005). Through waste regulation review, both EU and domestic, researchers could identify driving forces to the situation and foresee what changes are expected to occur. In addition, sustainability issues derived other aspects. Hence, mapping of these issues were vital, as they constitute the base of the scenarios.

5.3 Trend and uncertainties analysis

Now when all actors in the industry are identified it is vital to conduct trend and uncertainty analysis. According to Van der Heijden, 2005, events that are seen on the surface are often the cause of other events. Thus, in order to understand why the situation develops to one or another direction, these events need to be analyzed in depth so that underlying forces are identified. These forces can be political, environmental, social, technological, legal or industry specific. In this study, researchers divided trends in four groups that are within: *regulations, market and capacity development, logistics* and *environment.*

These are presented in following sections. The trend analysis endeavors to find interrelationships between predetermined forces, so-called “knowledgeable futures” and undetermined trends that are linked to some hesitancy.

5.3.1 Regulation

Any industry´s outer framework is set by the regulation. The same applies on the waste industry where some particularly affecting regulations are identified. First, the EU landfill directive and waste framework directive are known as the drivers to why waste is a subject for transboundary transportation. The objective is to move Europe up in the waste hierarchy and improve the waste management system. Hence, the waste directives have triggered the development so that multiple states are imposed to implement these into their national regulations (Avfall Sverige, e2013:06). Hitherto, the best incentive to decrease waste volumes at landfills have been introduction of progressive landfill tax. The higher the tax is, the more willing are the municipalities to find other solutions, where exports are one of them (Sahlin, J., et al 2013). However, in some countries the introduction of the directives into national regulations have developed at a slow pace (Avfall Sverige, e2013:06). It is unclear if EU will increase the control over these states and introduces penalties. Commission will deliberate if directives need to be strengthened (2008/98/EC). With stricter regulations, however, the exports of waste from these countries may increase.

The proximity principle might also have an impact on the waste flow. Today, the directive is used as an indication within the EU member countries not to transport waste if it is not necessary. The exception concerns the best available technique that is most sustainable (2008/98/EC). Thus, in countries where proper disposal methods are lacking, the waste is handled by either landfill or transportation. This principle then advocates to either build more disposal capacity or transport the waste the shortest path to another incineration plant. The disposal, however, is highly influenced by the market. Hence, the cheapest legal solution is often chosen rather than the shortest distance. The pattern of the flow is thereby still dependent on the cost for shipping and gate fee.

If Norway would implement the proximity principle, it would control the waste that is being exported from the country. Today, Norway´s incineration capacity is close to the domestic demand. Still, both import and export exist due to economic forces. The Swedish incinerator plants have for a long time offered competitive prices to Norway. As waste producers choose the cheapest solution, export volumes have been higher than needed. This fact has led to imports from UK and Ireland in order to fill up the excess capacity (Interviewee 4, 2014). Thus, the implementation of the proximity principle would decrease the export flow to Sweden. As Sweden has a capacity that exceeds the domestic needs this

would increase the need for imports from other countries, which in turn also increases the need for sea transports.

Due to geographical location, the waste flow from UK and Ireland drives a demand for maritime transportation. This flow will be affected by the new SECA limitation, which comes into force in January 1, 2015. The new SECA limit requires fuel with maximum 0,1% sulfur content, which is a considerable difference from the old limit of 1,0% sulfur content (Bunkerworld, 2014). The limit will constitute higher voyage cost for vessels due to raised bunker oil prices. This fact is also correlated to the distance of the maritime transports, why minimized distances can be expected. Thus, more expensive shipping in the area, may affect the competitiveness for Swedish ports, especially those at the east coast. It is difficult to forecast how the operations will be affected by the new limit. One consequence for this could be less shipping traffic around southern Sweden, more traffic to Swedish west coast ports and increased distances for hinterland transports, such as railway and truck.

Further, the cost level can also affect the incinerator plants economy and, ultimately, rise the gate fees. One example of such cost concern allowances within ETS system. The ETS covers all Swedish heat and power plants regardless purpose or fuel used. An exception is made towards plants that are very small or those who only combust biofuel (Sahlin, J., et al 2013). Only in Denmark and Sweden waste incinerators are classified as “co-incinerators” and are therefore considered to pay for emissions. This is a national decision, which could be a subject for reconsideration in the future. An exclusion of WTE plants from ETS would reduce their costs and increase their competitiveness, since lower costs allows lower gate fees. Further, another factor that can increase costs for incinerators is related to the combustion tax, which was implemented in Sweden before, but abolished in 2010. The tax and its effect is still a subject of discussions (Interviewee 2, 2014). Hence, a reintroduction of it would lead to higher costs to WTE plants and possibly a decreased competitive advantage compared to other receiver countries.

Other possible threats that could appear in the future and that would affect the profitability of the Swedish incinerator plants as well as the total waste management in Europe are:

- Political restrictions for import of waste
- Waste import/export embargo
- Stricter regulations regarding transportation of waste
- Stricter regulations regarding waste combustion
- Higher tax for ash from waste combustion

Possible policy measures that could benefit the management and the import of waste:

- Import licenses for three years instead of one year
- Support for developing countries to process waste in a better way according to the waste hierarchy
- Environmental permits for the planned new incinerators in Högbytorp and Högdalen

5.3.2 Market and capacity development

An overall combustion capacity in Sweden and other competing countries is continuously increasing. As already stated, in 2020 the overcapacity can reach 7 million tons, depending on if expansion plans are realized or not (Avfall Sverige, e2014:03). The biggest competitor in this industry with highest freed overcapacity is expected to be Germany. Even if there are no plans on building new incinerators, demographic changes are high and recycling of materials is increasing. In order to fill their pans and supply customers with the electricity, importation of waste will be fundamental (Avfall Sverige, f2012:04). This development can press gate fees down if no stricter regulations on landfilling will be introduced from EU´s side. Compared to Sweden, German incinerator plants are not included in the ETS system giving them more competitive advantages. In addition, transportation cost can be lower from UK. However, one drawback is that Germany has more complicated regulation regarding waste transportation. It hampers the flexibility, as actors need to disclose detailed transportation plans in advance to the environmental authorities. For logistic planners it is not obvious to know which unit that will be available at a special time and at a special place a week ahead. Usually, planners have more “last minute” solutions, utilizing capacity as much as possible (Interviewee 4, 2014). Yet, it is uncertain how freed capacity will effect on this regulation. Probably, as a result of increased demand, it will have more flexible character.

Belgium is assumed to be a new actor competing on RDF volumes from UK. At this point, their plants capacity is under expansion, which is expected to increase even more (Avfall Sverige, f2012:04). From a geographical perspective, the country is closely located to UK. This fact makes transportation cost less expensive in comparison to Sweden. In addition, emissions from the incinerator plants are not regulated by ETS system giving them less operating costs. However, even if Belgium is considered to be a severe rival in coming five years, from 2020 and onwards, it will probably take over waste volumes going to their neighboring country, Netherlands. In Netherlands, domestic waste is continuously increasing filling the existed overcapacity. As there are no plans on further capacity expansion (ibid), the country may not be as big competitor in the future as it has been before.

As illustrated before, the situation differs in European countries regarding landfills. For some members, like Poland, Lithuania, Bulgaria, etc., landfill is still the most common way to handle all kinds of waste (Avfall Sverige, e2013:08). EU directives have not been implemented into their regulation and it is uncertain if any incinerators will be built. In contrast, for other members like UK and Italy environmental issues are becoming important and EU directives are slowly implemented into their regulation. There are some plans of using waste as an energy resource and provide citizens with the electricity (EEA, 2013). However, even if there is an intention to decrease volumes going to landfills, building plants requires resources in terms of both assets and time (Avfall Sverige, e2013:06). Incentives in some countries are still very small to trigger the development. It can take many years until these members can take care of their own waste (EEA, 2013). In addition, even if governments try to hasten the development by introducing taxes, low gate fees in receiving countries promotes exports. In many cases this way is more profitable than building own facilities.

Even if the development of better waste disposal techniques is slow, the picture may change in the future. There are some example countries where introduction of high taxes on landfills changed the situation. In Norway for example, when landfill ban was introduced in 2009 rapid expansion of own combustion capacity took place. After five years their domestic waste could almost be handled in-house with only minor needs for exports (Avfall Sverige, f2012:03). Hitherto, due to high investment costs gate fees for Norwegian incinerators have been higher compared to Sweden. This was one of the reasons to why some volumes were still exported to Sweden, causing surplus capacity at domestic plants. Nowadays, Norwegian incinerators are trying to adjust prices to Swedish gate fee level so that most of domestic waste can be handled within the borders. This development will decrease waste exports in the future (Interviewee 4, 2014). Probably, one of the biggest suppliers to Swedish incinerators will have only small share in the future.

The consequence of this development is that Swedish incinerators are investigating possibility to import from other countries. UK with its high quality RDF has been most interesting among those. The country still landfills a large proportion of its municipal waste and with the increased taxes, municipalities try to find cheaper alternatives. Exporting to other countries has been beneficial both for actors involved and the environment. As the taxes level has increased over time, UK´s willingness to pay has also expanded (Sahlin, J., et al 2013). However, it is not certain how long time it will take until situation changes. Even if today expansion of combustion plants is still very slow, taxes can reach a break-even point where it will be more profitable to hasten the process than export. Norway is a good example to illustrate this situation.

Hence, it is uncertain how much time it will take for UK to come to the same level. Moreover, this development is also dependent on price levels at receiving countries. Prices include both transportation and gate fees.

Another interesting waste exporting country for Swedish combustion plants is Ireland. Yet, the fuel quality is not as good compared to UK. Food waste for example still remains in the content, which in turn decreases heating value (Interviewee 4, 2014). If fuel quality will improve in the future, Swedish incinerators may not need to import as many tons of waste to fill the capacity (Avfall Sverige, e2014:03). However, it is uncertain if this country will be willing to build sorting facilities similar to those they have in UK. It depends on what requirements will EU set on them. Further, Italy is the country that have already tried to export municipal waste Sweden. However, there have been some problems to fulfill the requirements. For example bad fuel quality and mafia involvement into this business has forced some receiving plants to refuse imports (Interviewee 1 & 2, 2014). Transportation of waste is already associated with negativity in the society why bad publicity needs to be avoided. It is uncertain when will Italy be able to solve this problem but if they do, imports to Sweden may increase in the future. Yet, the waste fuel quality should comply with the requirements. It should be dried and do not contain hazardous substances.

One of the certain trends in Sweden is that interest of imported waste is steadily increasing. This interest is a consequence of increased domestic overcapacity but also it is a reaction on energy market with its high prices on fossil fuels (Avfall Sverige, f2012:04). The usage of oil products is expected to decrease in the future due to cheaper fuel alternatives. If gate fees for waste imports will remain at the same level or increase, waste will be the cheapest alternative, even more affordable than biofuels. This is the reason to why waste has increased commercial interest for different actors. However, if the market situation changes and gate fees will decrease, biofuels will have more competitive advantages in terms of less handling costs. These substitutes leave less ash after combustion, are not covered by ETS and do not require complex purification systems (Interviewee 34, 2014). Volumes of Swedish municipal waste are expected to increase. This fact is driven by population growth and increase in GDP. Yet, new recycling milestones set by Naturvårdsverket will most likely decrease the volumes going to combustion plants in the future (Avfall Sverige, e2014:03). This authority has been earnest with their suggestions and the probability that they will reach their goals is quite high. This development in combination with new expanded capacity will increase competition between incinerators. New plants will take away municipal waste from older ones, forcing them to find alternative sources. However, even if imports are seem to increase in the future, it is uncertain how much volumes the incinerators will need to receive. The demand for district heating in Sweden is decreasing through technological innovation and usage of other heating

techniques (Waste Refinery, 2013). Even if drastic changes are not expected for the next five years, in the long term expansion of new incinerators will probably cease. Moreover, after 2020 some incinerators will need to be renovated. From an economic point of view, some can be shut down.

Further, it is uncertain if cement industry will still receive waste without gate fees. If Cementa will demand payment for receiving volumes, it can be more financially feasible for municipalities to send local waste to combustion plants instead. This development can decrease the need of imports, even if the volumes are not so large. On the other hand a recession can increase imported volumes significantly, as it was the case in 2008. Right now, there are no signs that it would happen within five years, but this issue cannot be certain.

To conclude, Sweden will probably continue to be best at energy recovery from waste. As already stated, the country has large district heating network (Avfall Sverige, 2012:04). Other countries like Germany would need to invest large amounts in order to come to the same level, which in turn can increase gate fees. Today, Sweden offers lowest gate fees (Interviewee 1 & 2, 2014). However, it is uncertain how regulations in Sweden will effect on the development. Increased prices for emission allowances or higher ash tax can change the situation. To stay competitive, Sweden would need to keep prices lower than for example Belgium.

5.3.3 Logistics

As waste transportation over long distances is a relatively new phenomenon there is still no standardization in the flow. Today, transportation is performed by different cargo carriers, including baled waste shipped by bulk carriers, on cassette and trailer via Roro ships, or in container. In some cases the waste is transported as non-baled by truck, loaded either in a trailer or container (Interviewee 31, 37, 41, 2014). In addition to sea transport and truck, railway has been used occasionally. Although it seems more economical for longer distances, the railway has not become a popular transport mode for this cargo. The problem with the railway solution is that many incinerators do not have their own industrial tracks; hence it requires an extra transshipment to truck (Avfall Sverige, u2011:01). Other problems are the unsatisfying frequency and delays. As waste is a specific type of cargo with risks of polluting environment, it demands a logistic chain with little or no storage. In order to utilize the railway, a standardized system needs to be developed and organized according to some level of JIT requirements. Due to the abovementioned facts, the development of better logistics solutions will continue in the future. The pressure will be higher if volumes will increase.

Investments in railway capacity, equipment and logistics for more viable waste transports seem defendable for a medium and long-term perspective (Avfall Sverige, u2011:01). However it presumes that the demand of this transport mode increases during this period. The new SECA limit that will come into force January 1st 2015 might be the source of such development, steering more traffic from sea transport around Sweden to road and railway. Increased hinterland traffic in turn, will demand for the adaptation of transport options and standardization. Raised efficiency and availability for this mode of transport in combination with optimal container and bale dimensions and either baled or non-baled material could be a solution for the future. Streamlining the chain and removing the elements that do not add value might create costs in the initial startup phase but later result in lower management costs. A reduced number of vertical movements would also improve efficiency and economy of the logistic chain. One logical solution seems to be a uniform cargo carrier that could be used from the producer to the incinerator regardless transport mode. In addition, loading the train directly from the ship would reduce the amount of handling. However, these kind of lean chains need very precise planning and reliable resources. Train stops or crane machine breakdowns can cause significant problems if the flow is big and storage possibilities are reduced. Therefore, this concept might also require comprehensive investments in proactive maintenance of all-important equipment in order to function optimally. Yet, if waste volumes will decrease after 2017, no such investments will be needed.

From an economic perspective but also in order to increase the utilization, the possibility to use cargo carriers for other types of cargo is important. The containers/trailers become contaminated by the waste and must be effectively cleaned in order to use them for some other types of loads. That means there must be facilities for such activity in proximity to the destinations. Today, only a few incinerator plants have access to facilities for washing containers. The issue is thus expected to be emphasized in the future. This may also foster better cleaning alternatives. As it is today, even after thorough cleaning waste cargo carriers are limited to rougher types of goods (Interviewee 4, 2014).

5.3.4 Environment

One certain trend is that public interest for environment is increasing in many European countries including Sweden. In many places protection of surrounding has become a common issue, which is an outcome of increased education. Hence, it is not surprising that transportation of waste over long distances has become a sensitive issue. A widespread opinion is that waste should be handled locally, do not transported or combusted in other countries (Interviewee 3, 2014). Therefore, there is a high probability that non-governmental organizations (NGOs) will try to effect on this industry and try to decrease imported volumes. Accidents that can occur during the transportation or during handling in ports

and other terminals may increase the dissatisfaction even more. Bad publicity will have a major impact on the industry and introduction of some additional regulations can be actualized.

With increased competition between states, but also with increased proportion of recycling, there might be scarcity of waste supply. This development is naturally dependent on the level of regulations from EU´s side. If shortage of waste supply will occur in Sweden, incinerators can use biofuels as alternatives and do not increase impact on the environment. Yet, the situation is different in Germany. If German plants will experience the scarcity, their alternative fuel will be fossil fuels such as coal and oil. Hence, from an environmental perspective, it is better that waste volumes go to Germany instead (Interviewee 4, 2014).

One additional aspect to the ETS that only applies to Swedish and Danish incinerators (Interviewee 2, 2014) is that it may affect the development of the waste hierarchy process in EU. The extra cost that the system leads to may drive up the gate fees. As many members have introduced the landfill tax in their regulation, it encouraged municipalities to find alternative disposal methods, where exports have been one of them. However, if exports become more expensive and if tax levels will remain to be high, it may trigger expansion of incinerators. Consequently, the exported quantities may be reduced.

5.4 Scenario development

After analyzing different driving forces, these were put on impact/uncertainty grid as described in step three of the scenario model. Through this grid some key trends were identified (see the list in appendix I). These trends have most impact on the organization and are most uncertain. Some of them could be categorized under regulations while others under market development. For the scenario development, these two were used, i.e. level of gate fees, (which is affected by market development) and EU regulations. The choice is based on the number of aspects that can be linked to these factors. EU regulations for example have very high impact on how the situation will develop in the future. Stricter directives including increased requirement on landfill tax, higher prices on permits for carbon dioxide, increased recycling and higher focus on proximity principle by using best possible technology, will have high effect on other trends and factors in the industry. On the other hand, the market development can have a decisive role in the development. High or low gate fees can affect imports making them either profitable or not economically viable. These two trends are used to build four different scenarios when combining their high or low levels *(see figure 28).* As earlier stated, the perspective for the scenarios presented below is approximately five to ten years.

In order to better understand scenarios, storylines on what will happen should be developed. Construction of story-maps will allow the reader to oversee the events and understand what causes the other (Van der Heijden, K., 2005). Further, to ensure both high quality and utility of scenarios, these need to fulfill some requirements. According to Van der Heijden, 2005, scenarios need to be relevant, i.e. they should coincide with the research question, plausible, which means that stories needs to be possible, and challenging.

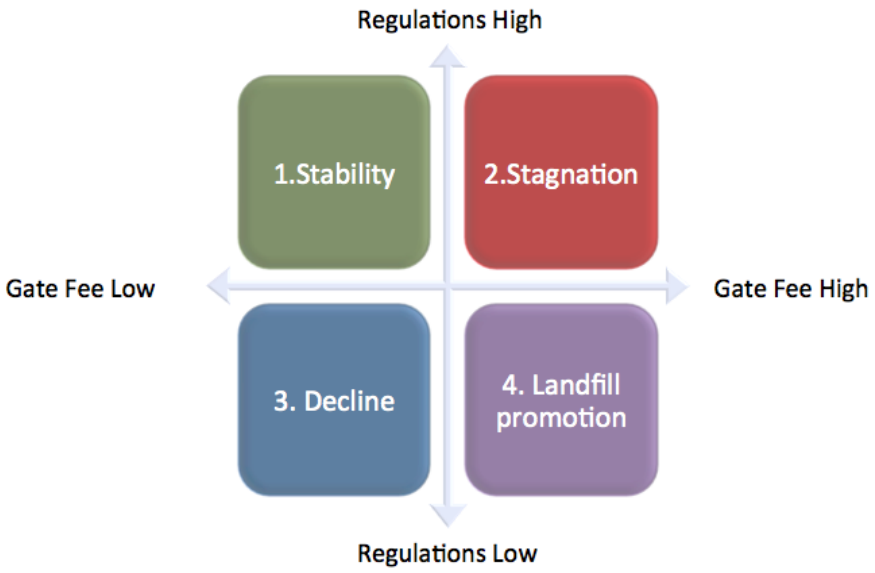


Figure 28: Scenario development from most uncertain trends with most impacts *(Source: adapted from Lindgren, M. & Bandhold, H. 2003)*

5.4.1 Scenario 1. Stability

This scenario is based on high level of regulation and low level of receiver fees. Since regulations are high, EU is assumed to introduce stronger incentives to reach their goals regarding waste management. This will result in fees for landfilling countries in order to enforce development. The incentives add more focus on building domestic capacity for waste treatment, but economically viable export solutions will exert a dampening effect. Hence generally, exports will increase to countries like Germany, Belgium and Sweden. However, the ETS price development will play a role for the Swedish competitive position.

The new SECA limit might derive some changes in the market, possibly a larger share of volumes will go through western ports. The port fees and infrastructure availability are decisive factors in the choice of port. Hence, with less maritime transportation, hinterland transport modes such as railway and truck will

get the attention. Container might be the new standard cargo carrier, which increases the possibility for smooth transportation and adjusted equipment at every transshipment station. This also includes facilities for cleaning.

Caused by excess waste supply, trading interest will be high. Waste becomes an interesting commodity that constitutes an opportunity for business. Increased interest in trading will also awaken plans of extending the incinerator capacity even further. However, the demand for district heating will set limits. In addition, this development will rise more concern from authorities, NGO´s and society regarding environmental issues. This can lead to introduction of more regulations. For example, it can include no environmental permits for new or expanding incinerator plants, combustion tax and restrictions on imports. The proximity principle could also be more stringent. Due to stricter regulation imports may stagnate. This in turn will impose waste export countries to speed up capacity expansion process.

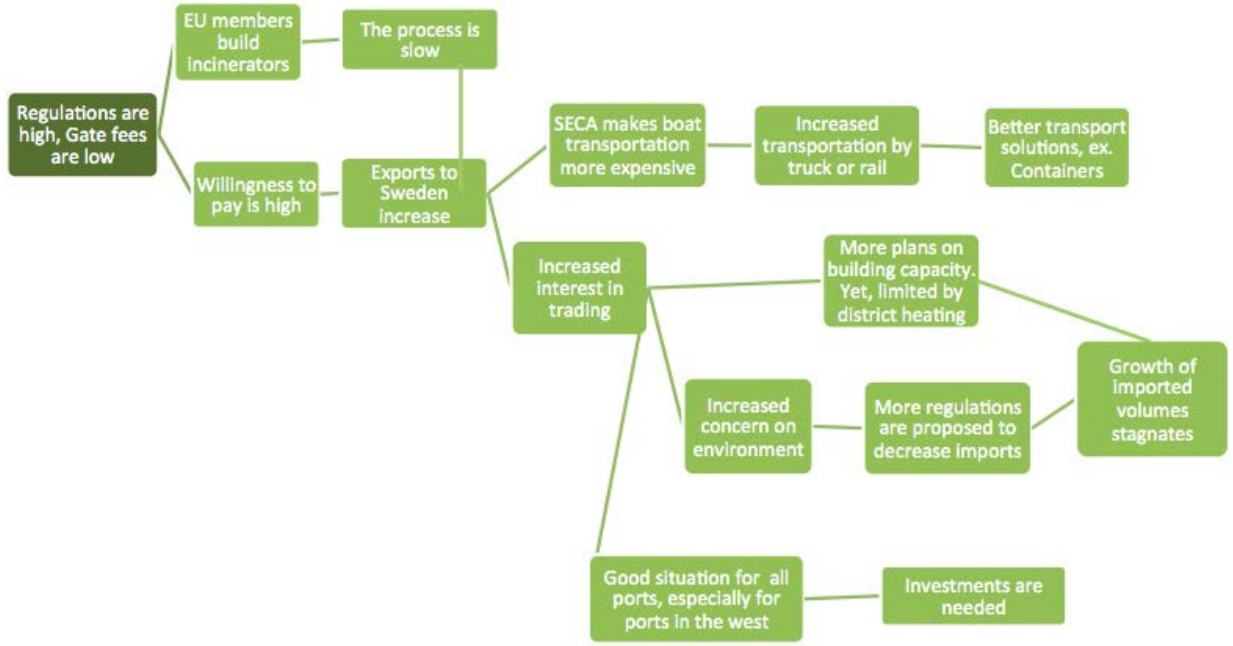


Figure 29: Story map of the first scenario *(Source: own construction)*

5.4.2 Scenario 2. Stagnation

In the second scenario a starting point is strict EU regulations combined with high gate fees. As in the first scenario, EU will put stronger incentives on improved waste management. This will impose countries to find other waste disposal solutions instead for landfilling. Export will be a solution in the short term. However, high gate fees in receiving countries will give incentives for rapid domestic capacity

expansion. In EU states where the reluctance to incinerators are high, emphasis will be on finding alternative technology solutions.

Hence, in the short run, as willingness to pay increases, large waste volumes will be exported to countries like Sweden, Germany and Belgium. Again, SECA restriction may make boat transportation more expensive steering volumes to hinterland transport modes. This limit may also increase quantities to western Swedish ports, which in turn will demand for better handling solutions. Thus investments in port will be needed, but not for a long term.

High gate fees in a combination with high regulations will evoke great commercial interest in waste management. It will also increase interest to building new incinerator capacity. However, this issue will be limited by the reduced district heating demand, but also by the future waste fuel supply. Yet, as imported quantities will reach the high number, Swedish NGOs and authorities may strengthen regulations, introduce tax, limit permits, imports etc. Regulations together with increased capacity in exporting countries will lead to stagnation phase. In the long run this may also result in decrease in volumes.

Figure 30: Story map of the second scenario *(Source: own construction)*

5.4.3 Scenario 3. Decline

In this scenario both regulations from EU´s side and gate fees in receiving countries are low. Low gate fees can be caused by increased competition between EU countries as they can face challenges with excess capacity. While there are no major incentives from EU´s side to decrease waste volumes going to landfills, member states´ willingness to pay for exports does not increase. This development does not trigger expansion of new incinerators either, making landfilling to be the most common way of handling municipal waste. However, this situation does not characterize all state members. Some countries are more concerned about the environment and have their own regulations to decrease negative impact. They will probably continue exports to Sweden until their own capacity is build. Depending on tax level development, expansion of incinerators and volumes going to exports will be different.

From a total perspective waste volumes going to Sweden will be low. Waste coming from tex. UK will likely be transported to western ports as SECA restrictions can make boat transportation less competitive to truck and rail transportation. In addition, the scarcity of supply might drive down prices on transportation, as actors will require low cost logistic solutions. For this reason no major investments will be made to enhance the flow or design special units. Hence, no major investments will be needed in the Port of Gothenburg. These volumes can be handled without having special facilities and equipment.

Low gate fees will also effect on interest on trading. This business will become less profitable postponing plans on realization of new capacity. Old incinerators will experience the scarcity of imported fuel and the competition in price level will be high. As the surplus capacity needs to be filled, incinerators will try to find alternative fuels. Biofuels will probably be the most attractive as they are not covered by ETS and they do not require complicated purification systems. Further, due to decreased imported waste volumes concern on environmental damage from this issue will be less from the society. Swedish governments will not introduce new regulations that can complicate situation to the actors involved. However, these actors will question participation in ETS as Sweden´s involvement in this benefits competitors in other waste receiving countries.

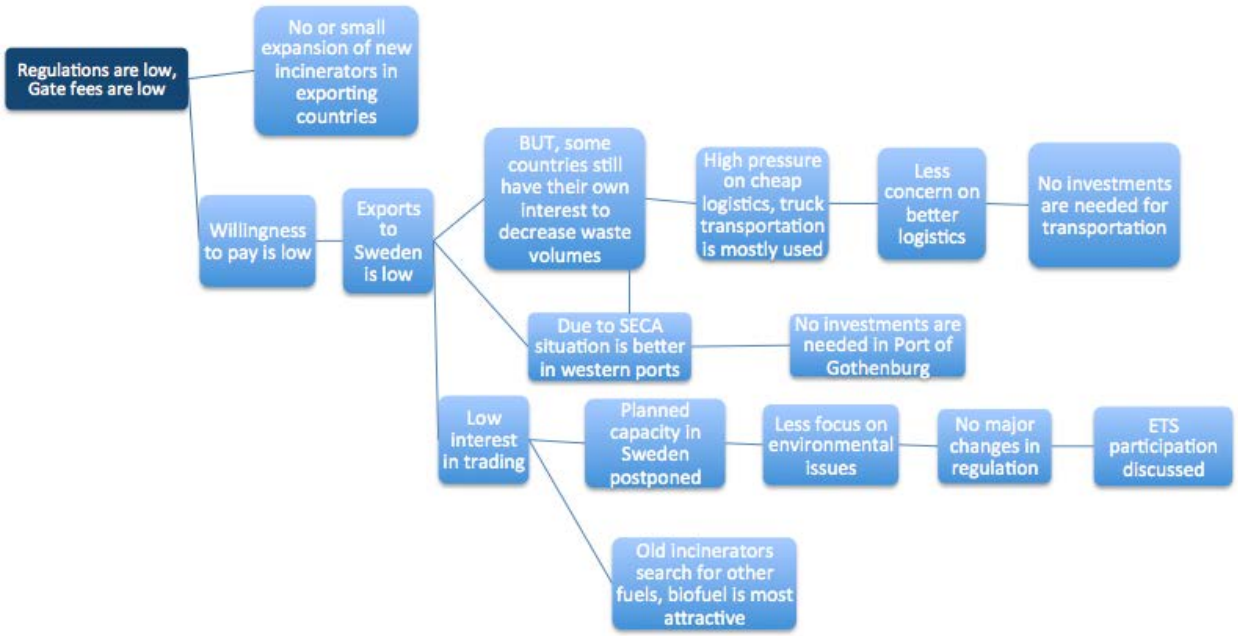


Figure 31: Story map of the third scenario *(Source: own construction)*

5.4.4 Scenario 4. Landfill promotion

In this scenario gate fees are high, which can for example be caused by increased price on permits for carbon dioxide emissions, while regulations are low. As in the third scenario, low level of regulations from EU does not give incentives to landfilling countries build incinerators. Moreover, willingness to pay for exports will be low as no taxes will be introduced. Still, there will be some countries with own regulations that will try to decrease waste volumes going to landfills. However, due to high gate fees in receiver states, exports will be weighted towards landfilling. The latter may prove be more economically viable. Hence, if some volumes are exported, there will be high price pressure on logistics. No major changes regarding cargo carriers will be expected. Even if SECA restrictions may promote deliveries to western ports from for example UK or Ireland, situation will likely be the same in all Swedish ports. There might only be small quantities, so that Port of Gothenburg does not need to invest.

Regardless high interest in trading, waste exports to Swedish incinerators will be low and the plants will search for alternative fuels. Again, biofuels will be the most attractive as the price on fossil fuels will be high. Scarcity of supply will also postpone plans on new waste combustion plants. Society will be less critical to incinerators´ fuels and there will be no major changes in regulations. Yet, there might be a strong reluctance towards participation in ETS system. Actors may show their dissatisfaction of being one of few countries covered by this regulation.

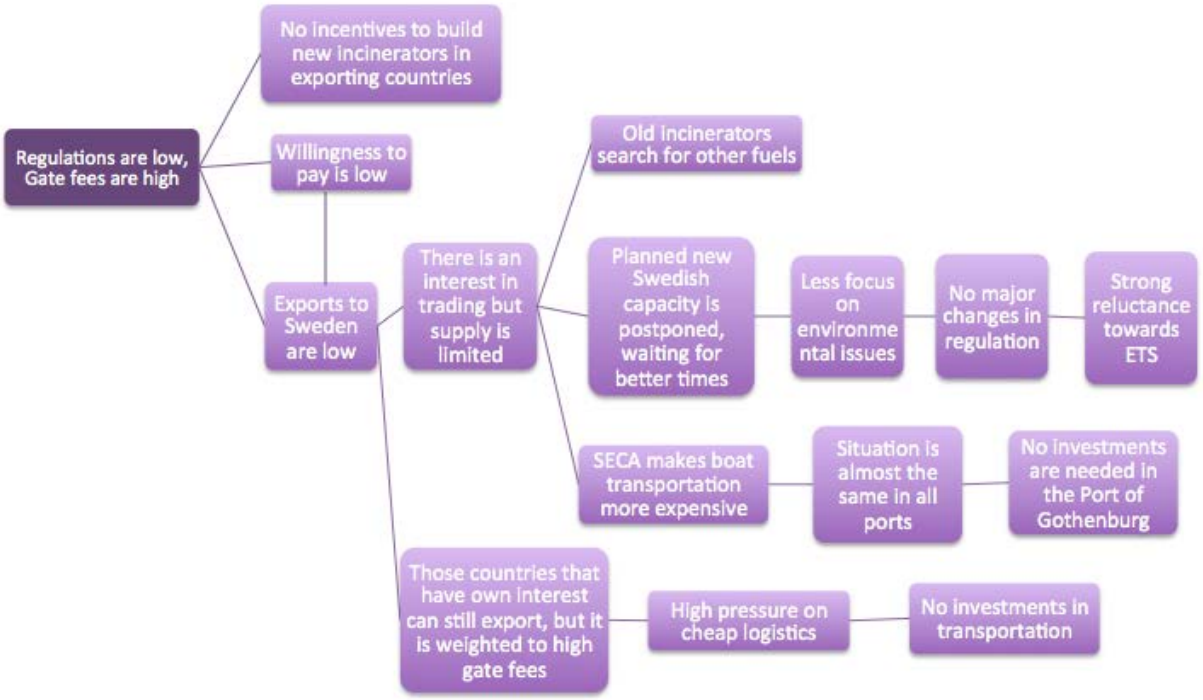


Figure 32: Story map of the fourth scenario *(Source: own construction)*

6. Conclusion

The research question that this report is expected to answer is: *What changes will the Port of Gothenburg face in five to ten years concerning imported municipal solid waste?* Which is supported by the two sub questions *"What is the current situation today regarding this import flow?"* and *"What future scenarios may be the most relevant for this import flow?"*

Exports of municipal solid waste to Sweden have increased in recent years. This fact is mainly driven by EU Landfill directive and Waste Framework directive. These regulations impose member states to improve their position at the waste hierarchy where landfilling should be avoided. The development of better waste disposal techniques has been visible in many states. However, some EU members have not yet implemented directives into their national regulations and still landfill a large proportion of generated municipal waste. Sweden is one of the countries with highly developed waste management due to landfill ban, high share of recycling and efficient incinerator techniques. The comprehensive district-heating network provides the possibility to utilize recovered heat. Waste fuel for this purpose has become a more essential part in recent years. This fuel fraction replaces dependability on fossil based fuels such as oil and coal.

Import of waste has increased in recent years. The driving force for this development has been the excess capacity at incinerator plants. This is caused by decreasing volumes of Swedish domestic combustible waste, but also due to the capacity expansion. If all plans will be realized, the excess number can reach 2,4 million tons. Today, the main supplier to Swedish incinerators is Norway. However, the situation is changing as they have expanded their own capacity. For this reason the interest has turned to countries such as UK and Ireland. Still, Sweden is not the only state receiving waste. The major competitors are Netherlands, Germany and Belgium. These countries have a geographically more available position in relation to UK. This fact strengthens their competitive advantage.

The logistics concerning the waste import industry is currently under a development phase, where actors are experimenting with different solutions. There is not yet a standardized solution for the transportation of waste and every setup involves handling issues. The challenge with this particular commodity is that it contaminates cargo carriers resulting in limited usability afterwards. From Norway, most imports are performed by truck using either trailer or container, while transport from UK and Ireland require maritime transports. Hinterland movements of this commodity are still conducted by trucks. Railway is not considered to be a competitive transport mode due to its delays and low frequency. Also, it requires extra handling for the last part of the distance between the railway station and the plant.

Further, waste imports are expected to increase to at least 2017. This conclusion is mostly based on the capacity expansion that is already under construction. However, it is uncertain how the situation develops after 2017 as the industry is depending on different factors. Some important aspects were identified in this study. Strengthened regulations for countries that have failed to meet established targets are perceived as the most vital element. This have the most impact on the willingness to pay for better disposal services. Another factor concerns the surplus capacity that will increase even in other countries. This will contribute to increased competition among receiving countries. The profitability of the industry will thereby be negatively affected, which can cause a transition to alternative fuels. In addition, some other aspects affecting the market are:

- Decreasing demand for district heating in Sweden will decrease imported quantities
- New countries may start exporting
- Higher price on ETS allowances will lead to increased costs for Swedish incinerators.

Increased volumes put extended pressure on the logistics. The need for cheap, frequent and effective transport is increasing. A sustainable logistics chain needs standardization, reduced handling and JIT solutions. Container together with appropriate equipment at terminals and plants could be more commonly used in the future, as it facilitates handling. Further, the introduction of SECA may influence on the logistics flow. West coast ports can receive more volumes leading to increased hinterland transport. Therefore, railway solutions might become advantageous. However, the competitiveness depends on its efficiency, frequency, reduced delays and costs.

Environmental issues are important in this industry. The general public opinion regarding waste import is negative today and this trend may continue in the future. Controlling all the risks that is connected to waste transport is identified as the key to manage the image of the industry. In addition, society needs to be informed of the environmental benefits arising from transboundary transportation of waste.

6.1 Developed scenarios

The level of trading interest depends on the market situation (i.e. profitability), where regulations play a very important role. For this reason, the level of regulation was chosen as one key uncertainty for scenario development. The other key uncertainty concerned the level of gate fees at incinerator plants. These two important factors are used to build and develop scenarios for how the future may unfold. By putting these aspect into the scenario matrix, four possible future scenarios could be developed. These are stability, stagnation, decline and landfill promotion as illustrated below:

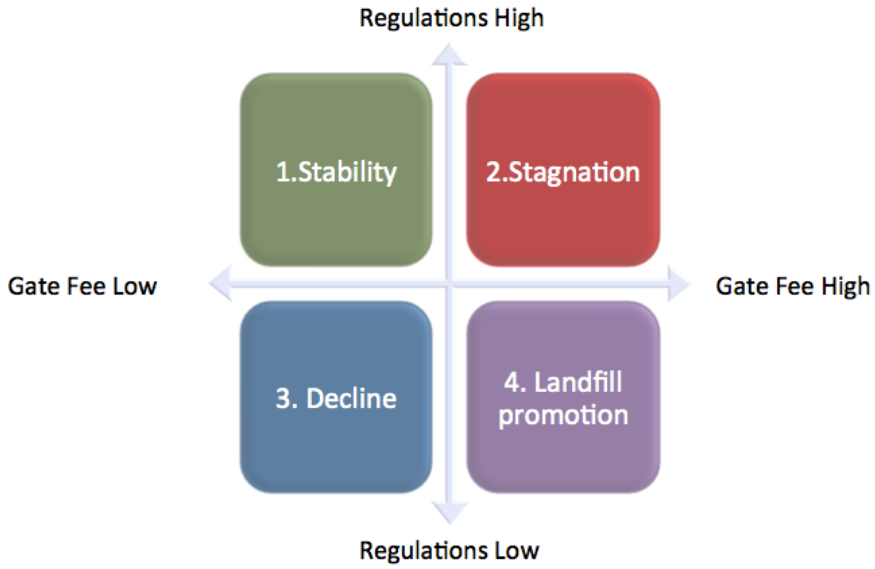


Figure 33: Scenario development from most uncertain trends with most impacts *(Source: adapted from Lindgren, M. & Bandhold, H. 2003)*

The stability scenario is explained by effective and long term oriented EU incentives for minimization of landfilling in all EU member states. In combination with low gate fees the import level is expected to increase. The trading interest is triggered and insinuates an opportunity to develop attractive logistics solutions in order to ensure a future role in the chain.

The second picture "Stagnation" insinuates a stagnating level of imports. Due to high regulations that encourage export for concerned countries and high gate fees, the import level is expected to increase in the short run. However, caused by high gate fees a rapid capacity expansion will be noticeable in waste exporting countries. This fact will lead to stagnation at some point. Hence, this scenario advocates high trade interest in the short run.

The third scenario demonstrates a decline in import flows, due to a lack of incentives for exports. The profitability is affected by low willingness to pay for the incinerator service, which leads to increased usage of alternative fuels such as biofuels. This also leads to postponed or cancelled expansion of capacity.

The last scenario is characterized by the combination of low regulations and high gate fees, making export less attractive. The import level will therefore be low, and incinerator plants will switch to use more alternative fuels. In this scenario landfilling will continue to be a convenient alternative.

6.2 Recommendations

Scenario planning model was used as a basis of this study in order to map the current situation and speculate how future may unfold. This concept has many benefits that is the reason why it is included in the recommendation part. It allows freethinking in identification of all possible trends, both certain and uncertain, which minimizes the risk of overlooking some major factors. Out of these trends, the method concentrates on two crucial aspects that are highly uncertain and have high impact on the organization. Through the process, possible outcomes, i.e. scenarios are mapped. Hence, scenarios provide not only one picture of the future as it is shown in a forecast, but multiple futures on how the situation might be. The main objective of this method is to increase company´s preparedness to changes. Instead of having one single strategy that may not always work depending on situation, this technique promotes having various strategies to choose between. Hence, the recommendation from us is to use this method as a standard for strategy creation. This theory model can be applied to other cases. It has been fully tested in this study and proven to be effective. However, challenges with this approach needs to be considered in the process in order to work properly. The list of these can be found in 2.5. Hence, it is important to interview a diverse group of people before developing scenarios. These contribute with various ideas and help to see things from different angles. The researchers of this study had got a lot of help from them.

Another recommendation concerns investments in the port. Current situation indicates to an increase of waste volumes, at least until 2017. To cope with this development, the port will be imposed to find solutions for better waste handling. This can include building a temporary facility with a roof that still can be open but wind protected, have better equipment for handling etc. However, this strategy is dependent on different factors. The first is that actors in the industry are testing waste transportation by containers. If this transport mode will prove suitable, the port will not need to invest in transshipment facility. Instead, handling will be facilitated. Yet, shipping companies might offer cheap prices on cassette transportations, which may prove more economically viable. In this case, the port will be needed to provide better solutions. In addition, if scenario one or two occurs, waste volumes will increase considerably. In this case, a combination of different transport modes might be used, why investments will be needed as. In the last two scenarios, however, there is no need to enhance the flow due to low volumes. Plans on investments can be postponed if not abandoned.

Regardless on which scenario occurs, the port will need to promote itself. Different actors can be involved in determination of logistics flow in this industry but most common are brokers, incinerators and agents. Through close collaboration with these actors, the port can get more customers. However, this requires that the port offer seamless logistic solutions. Further, the price is often decisive when choosing the port

during the transportation. Some interviewees considering waste imports from UK or Ireland claimed that prices were higher in Port of Gothenburg in comparison to other smaller ports on the west coast. This fact makes other ports more competitive. Hence, Port of Gothenburg needs to choose between low prices but gaining economies of scale or high prices but less waste volumes.

Further, through collaboration with other logistic providers such as railway companies, freight forwarders etc., the port will gain competitive advantages. For example it can encourage railway companies to increase their services and provide more frequent and scheduled departures. Such solutions are needed, as incinerators require JIT deliveries. Yet, this strategy is applicable in the first and the second scenario. The fact with increased waste volumes will arise interest from these actors who will be more willing to fulfill incinerator´s requirements. Though, if the interest in trading is low in waste industry, as it is the case in the third and the fourth scenario, these actors will not be as responsive.

To conclude, in order to minimize the risk at the port, such as leakage or other disorders, port can set their own requirements on waste fuel quality. This can include enhanced wrapping, better-dried content so that smell is minimized, proper dimensions on the bales etc. However, this strategy is quite venturous as it decreases competitiveness. This strategy can be beneficial in the first two scenarios when ports can get bargaining power. However, it should not be used during inferior times like in the last two scenarios.

6.3 Further research

In this study, a six-step scenario planning model was constructed through combination of previous research data. Different scholars and organizations have developed concepts in this field, which in general follow the same process. To adapt these techniques to the actual research question, the model was customized. Some steps were excluded, while others were put together. Hence, for this particular case, this model proved effective. However, it is not certain if it will be applicable on all other cases. To heighten the models validity, each step can be analyzed in deep and examined if they measure what they are supposed to measure.

Due to time constraints in this report, it was not possible to examine the situation in other countries regarding municipal waste volumes and the disposal methods. Interesting countries in this field could be all European Union members with high share of landfills, but also USA, China and India. Even if probability of imports from these states is low, the changes in their regulation may affect the industry. Hence, in order to improve reliability of the developed scenarios, more detailed information is required.

To conclude, the focus in this study was on mapping the current situation and identifying certain and uncertain trends, rather than looking at logistic solutions. As stated in this paper, this type of cargo implies high pressure on transportation. The chain must be cheap and frequent, while at the same time it requires return transports. However, due to contamination issues not all kind of goods can be loaded in the same unit, which complicates the planning. For these reasons, a thorough investigation of both existing and possible future logistic solutions could facilitate strategy decisions at the Port of Gothenburg.

Sources

Bishop, P., Hines, A., Collins, T., (2007) ***The current state of scenario development: an overview of techniques,*** vol. 9 no. 1, pp. 5-25, Emerald Group Publishing Ltd, ISSN 1463-6689

Bisaillon, M., Johansson,I., Jones, F. & Sahlin, J. (2013) **Fuel Quality - Composition and properties of waste fuel to waste-to-energy plants.** Project nr WR-57, Waste refinery, SP Sveriges Tekniska Forskningsinstitut, Borås, Sweden

Blumberg, B., Cooper, D. R., Schindler, P. S., (2011) ***Business research methods.*** Mc Graw-Hill Education, third edition, Maidenhead, UK. pp 266-267

Bryman, A. & Bell, E., (2011) ***Business research methods***. Third Edition, Oxford University Press, Oxford, UK. pp 475-476

C. A. Velis, P.J. Longhurst, G.H. Drew, R. Smith, & S. J. T. Pollard (2010) ***Production and Quality Assurance of Solid Recovered Fuels Using Mechanical–Biological Treatment (MBT) of Waste: A Comprehensive Assessment.*** Centre for Resource Management and Efficiency, Sustainable Systems Department, School of Applied Sciences, Cranfield University, Cranfield, Bedfordshire, 40:979–1105, UK

Collis, J. & Hussey, R. (2009) ***Business research, a practical guide for undergraduate & postgraduate students.*** Third edition, Plagrave Macmillan, UK, US. pp 55-61

Cachia, M & Millward, L. (2011) ***The telephone medium and semi-structured interviews: a complementary fit.*** Emerald Group Publishing Limited, Qualitative Researchin Organizations and Management: An International Journal Vol. 6 No. 3, 2011 pp. 265-277

Hines, A. & Bishop, P. (2007) ***Thinking about the future: Guidelines for strategic foresight.*** Social Technologies

Konno, N., Nonaka, I., Ogilvy, J., (2014) ***Scenario planning: The basics,*** World Futures, vol. 70, pp 28-43

Lindgren, M. & Bandhold, H. (2003) ***Scenario Planning: the link between future and strategy.*** Plagrave Macmillan, New York

Norrman, R., (2001) ***Reframing business -when the map changes the landscape***, John Wiley and Sons Ltd, Chichester, England

Ogilvy, J. & Schwartz, P., (2004) ***Plotting Your Scenarios***, Global Business Network, California, USA

Postma, T., Liebl, F., (2005) ***How to improve scenario analysis as a strategic management tool?*** Technological Forecasting and Social Change: Vol. 72, No. 2, 2005, pp 161–173

Quinlan. C., (2011) ***Business research methods***, Cengage Learning EMEA, United Kingdom, pp 289-291

Schoemaker, P., (1995) ***Scenario planning: a tool for strategic thinking,*** Sloan Management Review, Vol. 36, No. 2, Cambridge. pp 25-40.

Schwartz, P. (1998) ***The art of the long view: planning for the future in an uncertain world.*** John Wiley and Sons. Chichester, England

Schwenker, B. & Wulf, T., (2013). ***Scenario based strategic planning. Developing strategies in an uncertain world.*** Springer Gabler, Wiesbaden, Germany

Van der Heijden, K., (2005) ***Scenarios -The art of strategic conversation***, Second edition, John Wiley & sons ltd, West Sussex, England

Van der Merwe, L., (2008), ***Scenario-Based Strategy in Practice: A Framework,*** SAGE Publications, Advances in Developing Human Resources May 2008 vol. 10 no. 2216-239

Wiltback, Robert et al, (2006), ***What to do next? The case for non-predictive strategy.*** Strategic management journal, 27; 981-998

Electronic sources

Avfall Sverige, 2008:13
http://www.avfallsverige.se/fileadmin/uploads/Rapporter/Utveckling/2008_13.pdf
Accessed 2014 03 03

Avfall Sverige, u2009:06
http://www.avfallsverige.se/fileadmin/uploads/Rapporter/Utveckling/U2009-06.pdf
Accessed: 2014 04 09

Avfall Sverige, u2011:01
http://www.avfallsverige.se/fileadmin/uploads/Rapporter/Utveckling/Rapporter_2011/U2011-01.pdf
Accessed 2014 04 10

Avfall Sverige, f2012:03
http://www.avfallsverige.se/fileadmin/uploads/Rapporter/Förbränning/F2012-03.pdf
Accessed 2014 04 13

Avfall Sverige, f2012:04
http://www.avfallsverige.se/fileadmin/uploads/Rapporter/Förbränning/F2012-04.pdf
Accessed 2014 04 10

Avfall Sverige, e2013:04
http://www.avfallsverige.se/fileadmin/uploads/Rapporter/Förbränning/E2013-04.pdf
Accessed 2014 03 01

Avfall Sverige, e2013:06
http://www.avfallsverige.se/fileadmin/uploads/Rapporter/F%C3%B6rbr%C3%A4nning/E2013-06.pdf
Accessed 2014 03 01

Avfall Sverige, e2013:08
http://www.avfallsverige.se/fileadmin/uploads/Rapporter/F%C3%B6rbr%C3%A4nning/E2013-08_ny.pdf
Accessed 2014 04 09

Avfall Sverige, e2014:03
http://www.avfallsverige.se/fileadmin/uploads/Rapporter/E2014-03.pdf
Accessed: 2014 05 02

Barometern, Oskarshamns tidningen (2011)
http://www.barometern.se/nyheter/nybro/sopavtal-pa-gang-for-nybro-energi(2922452).gm?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+bot-nyheter+%28BOT+Nyheter%29
Accessed: 2014 04 13

Bunkerworld, Rotterdam (2014)
http://www.bunkerworld.com/prices/port/nl/rtm/
Accessed: 2014 04 18

EEA (European Environmental Agency; Ireland) (2013)
http://www.eea.europa.eu/publications/managing-municipal-solid-waste
Accessed: 2014 04 25

EEA (European Environmental Agency; Italy) (2013)
http://www.eea.europa.eu/publications/managing-municipal-solid-waste
Accessed: 2014 04 25

EEA (European Environmental Agency; Finland) (2013)
http://www.eea.europa.eu/publications/managing-municipal-solid-waste
Accessed: 2014 04 25

Energimyndigheten, Handel med utsläppsrätter
http://www.energimyndigheten.se/Foretag/Utslappshandel/
Accessed: 2014 04 23

European Union, 2010
Being wise with waste: the EU's approach to waste management
http://ec.europa.eu/environment/waste/pdf/WASTE%20BROCHURE.pdf
Accessed: 2014 04 14
2008/98/EC, Waste Framework Directive
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:312:0003:0030:en:PDF
Accessed: 2014 04 05

1999/31/EC, Landfill Directive
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:01999L0031-20111213&qid=1398691681968&from=EN
Accessed: 2014 04 05

2006/1013/EC, Regulation on Shipments of waste
http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R1013&from=EN
Accessed: 2014 04 05

Greentech, 2014 – The Swedish Experience & Expertise
http://swedishcleantech.se/download/18.5fc5e021144967050486a7/1394468235072/cts-greentech-report.pdf
Accessed: 2014 04 08

Handelskammaren, 2009
http://www.handelskammaren.com/uploads/media/Rapport_4_09_final_01.pdf
Accessed: 2014 04 10

International Cement Review - news events and trading (2014)
http://www.cemnet.com/members/gcr/intros/189.pdf
Accessed: 2014 04 13

Legislative Council Secretariat, 2013
http://www.legco.gov.hk/yr13-14/english/sec/library/1314in05-e.pdf
Accessed: 2014 04 14

Naturvårdsverket, 2012:6520
http://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6520-1.pdf
Accessed: 2014 04 10

Naturvårdsverket, 2012:6560
http://www.naturvardsverket.se/Documents/publikationer6400/978-91-620-6560-7.pdf
Accessed: 2014 05 02

Naturvårdsverket, 2013, Avfall
http://www.naturvardsverket.se/Miljoarbete-i-samhallet/Miljoarbete-i-Sverige/Uppdelat-efter-omrade/Avfall/
Accessed: 2014 05 02

Shell International. 2008. Scenarios: An Explorer's Guide. London: Shell
http://s05.static-shell.com/content/dam/shell/static/public/downloads/brochures/corporate-pkg/scenarios/explorers-guide.pdf
Accessed:

Sahlin, J., Holmström D. & Bisaillon M. 2013. Import av avfall till energiutvining i Sverige. Delprojekt 1 inom projektet perspektiv på framtida avfallsbehandling, Waste Refinery.
http://www.wasterefinery.se/sv/project/projects/perspektivpaframtidaavfallsbehandling/Documents/WR35%20Delproj%201_Import%20av%20avfall_till%20AI.pdf
Accessed: 2014 04 10

Tolvik Consulting 2011
http://www.tolvik.com/markets-and-data/reports/UK_Waste_Exports.pdf
Accessed: 2014 03 02

Waste Refinery 2013
Perspectives on future waste treatment, waste management in Sweden from 2013 onwards
http://www.wasterefinery.se/sv/project/projects/perspektivpaframtidaavfallsbehandling/Documents/PFA_eng_130703.pdf
Accessed: 2014 04 10

Appendix

Appendix A

Interview template for representatives at incinerators, translated from Swedish.

This project is conducted in collaboration with the Port of Gothenburg. The purpose is to map the current and future waste import flow.

1. Is municipal waste incinerated at your facility?
2. What is the capacity of your incinerator? (tons/year)
3. How much are you permitted to combust?
4. What quantity is incinerated at the facility annually? (tons/year)
5. Do you have excess capacity?
6. Do you have plans on expanding the capacity?
7. Do you import combustible waste?
7.1. If no:
a) Why?
b) Are there plans for import?
c) Have you received inquiries from foreign producers?
7) If yes:
a) How much do you import? From which countries?
b) How is the import performed? (Which actors are involved, mode, route, cargo carrier, frequency, sorting etc.)
8. Are you satisfied with the current logistic chain?
a) If no, what is it specifically that does not work?
b) How do you perceive the risk for damaged wrapping?
9. Are you planning on expanding the imports? If yes, how much?
10. Which trends in this industry do you perceive as certain?
11. Please mention the four most important factors that implies uncertainty
12. Please describe your best and worst scenario for this industry

Appendix B

Interview template for representatives at new incinerators

This project is conducted in collaboration with the Port of Gothenburg. The purpose is to map the current and future waste import flow.

1. Is municipal waste incinerated at your facility?
2. What is the capacity of your incinerator? (Tons/year)
3. How much are you permitted to combust?
4. What quantity is expected to be incinerated at the facility annually? (Tons/year)
5. Do you have excess capacity?
6. Do you import combustible waste?
6.1 If no:
a) Why?
b) Are you planning to import in the future?
c) Have you received inquiries from foreign producers?
6.2. If yes:
a) What quantities do you import? Which export countries?
b) How is the import performed? (Which actors are involved, mode, route, cargo carrier, frequency, sorting etc.)
7. Are you satisfied with the current logistic chain?
a) If no, what is it specifically that does not work?
b) How do you perceive the risk for damaged wrapping?
8. Are you planning on expanding the imports? If yes, how much?
9. Which export countries are you interested in? a) How do you perceive the future regarding interesting export countries?
10. Which trends in this industry do you perceive as certain?
11. How do you perceive the competitive position for Sweden as an import country?
12. Please mention the four most important factors that implies uncertainty
13. Please describe your best and worst scenario for this industry

Appendix C

Interview template for representatives at Profu and Avfall Sverige.

This project is conducted in collaboration with the Port of Gothenburg. The purpose is to map the current and future waste import flow. Scenario development will be used for this study, why the questions are open and supposed to encourage multiple reflections.

1. The first question considers the current situation. Please give your reflections regarding:

- Volumes imported waste
- Actors
- Suppliers
- Incinerators
- Capacity
- Logistics chain
- Competition between receiving countries
- Regulations (EU and national)
- Regulations regarding transportation
- Political aspects
- Environment and society issues
- Substitutes
- Different fees

2. What driving forces can you identify in waste imports?
3. Which trends in this industry do you perceive as certain?
4. Which trends do you perceive as uncertain? Please mention the four most important
5. Please describe your best and worst scenario for this industry
6. What main decisions do you perceive as important regarding sustainability connected to the phenomena of waste import at this point?
7. What limitations do you perceive regarding waste import?
8. Is there something you would like to add to this issue?

Appendix D

Incinerators	Capacity	Export Countries	Modes of transportation
Avesta	55	N/A	N/A
Boden	100	Norway	Truck
Bollnäs	70	-	-
Borlänge	88	-	-
Borås	98	Norway	Truck
Eda	75	Norway	Truck
Eksjö	55	N/A	N/A
Finspång	30	N/A	N/A
Göteborg	540	England	Roro boat + truck
Halmstad	185	England, Ireland, Scotland	Bulk boat + truck
Helsingborg	160	Norway, Great Britain	Roro boat + truck
Hässleholm	50	-	-
Jönköping	165	Norway	Truck
Karlskoga	42	-	-
Karlstad	55	-	-
Kil	15	-	-
Kiruna	73	Norway	Truck
Kumla	160	-	-
Köping	30	-	-
Lidköping	130	Norway, Scotland	Truck, Bulk boat + truck
Linköping	400	England	Bulk boat + truck
Ljungby	58	-	-
Malmö	630	England, Norway	Bulk boat + truck
Mora	17	N/A	N/A
Norrköping	505	Norway, North Europe	Truck, Bulk boat + truck
Skövde	55	Norway	Truck
Stockholm	760	Norway, Scotland, Ireland	Truck, Bulk boat + truck
Sundsvall	185	Norway, Netherlands	Truck, Bulk boat + truck
Tidaholm	10	N/A	N/A
Uddevalla	130	-	-
Umeå	160	Norway	Truck, Bulk boat + truck
Uppsala	375	N/A	Truck, Bulk boat + truck
Västervik	85	N/A	N/A
Sigtuna (See Stockholm)	-	-	-
Västerås	360	Great Britain, Ireland	Bulk boat + truck
Nybro	50	-	-
Upplands-Bro	250	-	-

Source: (Avfall Sverige, e2014:03), (Interviews, 2014)

Appendix E

Trends concerning regulations

Certain trends	**Uncertain trends**
● EU directives leads to more waste prevention, reuse and recycling ● EC leads to less landfill ● SECA new limits for sulfur content in bunker fuel	● Reconsideration of Swedish plants being categorized as co-incinerators ● Strengthened EU incentives for countries that fail reaching the goals ● Naturvårdsverket strengthen regulations ● Stricter use of the proximity principle ● Norway implementing proximity principle ● Stricter regulations/sanctions regarding waste transportation ● Stricter regulations/sanctions regarding waste combustion ● Licenses uncertain, wanted for three year period for better planning of capacity, logistics and supply contracts ● Political restrictions against import trade (commercial interest) ● Import/export embargo ● Support to developing countries to take better care of waste ● Reintroduction of combustion tax ● Level of tax for ashes increases ● Environmental permits for new capacity (Högbytorp, Högdalen)

Appendix F

Trends concerning market development

Certain trends	**Uncertain trends**
* Better waste fuel quality * Biofuels and fossil based fuels will decrease due to waste fuels * Receiver competition increasing * Belgium new competitor * Swedish combustible waste volumes decreasing * Energy recovery will increase in EU * District heating demand decreasing in Sweden * Other heating techniques will increase * UK landfill tax increase: alternatives solution like export increase, willingness to pay increase * Commercial interest for waste as a trade commodity * Norway landfill ban in 2009 led to increased capacity, decreased exportation, adapting to Swedish price level * Import increase * Swedish waste volumes increase * GDP increases in Sweden * Population increases in Sweden * Cement industry will continue not having gate fees * Interest in new export countries will increase * Germany becomes large competitor * The Netherland´s demand is stagnated, excess capacity is decreasing * Sweden stays on top in terms of energy recovery technique	* Eastern Europe export * Gate fees steady or decreasing (Germany might dump prices) * Sweden offering best price * Willingness to pay * Improved waste management in Italy (mafia involvement) * Overcapacity 7,2 million tons in 2020 * Recession * Next big exporting countries: Italy, Poland, Spain * New incinerators can guide away waste from other plants * Other countries building up capacity * Better fuel quality leads to decrease in importation demand * ETS price increase * Planned capacity realization

* Energy market (oil price) drives interest for waste * Capacity expansion very slow in export countries * Surplus capacity increasing * Older plants will be shut down after 2020	

Appendix G

Trends concerning logistics

Certain trends	**Uncertain trends**
* Developing transport solutions, continued demand * Traffic increase on ports, roads and railways * Increased possibility to wash containers	* Investments in railway solutions and capacity seem viable if the flow is stable in a medium and long term perspective * Container transportation * Railway might be more economically viable for transport to northern/eastern Sweden which earlier used maritime transport, after SECA new limit * Solution baled/non-baled * Transport cost development * New technology breakthroughs in handling waste

Appendix H

Trends concerning environment

Certain trends	**Uncertain trends**
* Public environmental interest increasing	* NGO organization will complicate imports * Political/public opinion affected by accidents, knowledge, public information * Environmental aspects making e.g. Germany a reasonable receiver country (alt fuel is oil, in Sweden alt fuel is woodchips)

Appendix I

Key uncertain trends

Key uncertainties regarding regulations	**Other key uncertainties**
* Changed laws on imports * Environmental permits * Reintroduction of combustion tax * Political restrictions against waste as a trade commodity * Support to developing countries to export waste * Strict regulation regarding combustion * Swedish incinerators excluded from ETS * Strengthened EU regulations on landfills	* Level of gate fees (market development) * The level of ETS increase (market development) * New technology for waste handling * Transportation cost development * Recession

Appendix J

List of interviewees

Incinerators	Other organizations/Actors
Boden	Avfall Sverige
Bollnäs	Profu
Borlänge	Port of Gothenburg
Borås	Gemonor
Eda	DFDS
Göteborg	Gothenburg Roro Terminal
Halmstad	Cementa
Helsingborg	Driver of waste cargo
Hässleholm	
Jönköping	
Karlskoga	
Karlstad	
Kil	
Kiruna	
Kumla	
Köping	
Lidköping	
Linköping	
Ljungby	
Malmö (I)	
Malmö (II)	
Norrköping	
Skövde	
Stockholm	
Sundsvall	
Uddevalla	
Umeå	
Uppsala	
Västerås	
Nybro	
Upplands-Bro	