The connection between the issue of food waste and its collection for biogas

A case study of the municipality of Stockholm

My Blomgren
Acknowledgment

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Abstract

Reduction is the best way of handling the issue of food waste, however, considering the difficulties of achieving reduction, a collection of the waste for a potential decrease was established. The thesis consist of an examination between two subjects, the issue of food waste and the waste management system of collecting food waste to produce biogas, where the main focus is upon the municipality of Stockholm. The purpose of the study was to analyze the issue of food waste and connect it to the process of collecting food waste to produce biogas, and examine the potential benefits and conflicts between these two topics. The aim was also to investigate the process possibilities and functionality, and how the procedure is operating in the municipality of Stockholm.

Besides a literature study, four interviews were conducted with respondents from authorities and the municipality. The results show that the process of collecting food waste to produce biogas is a great procedure. It is a good alternative for the environment and generates to a substitute towards fossil fuel. However, whether the process is a benefit for the issue of food waste seems to be rejected. There are also difficulties of apprehending the connection between the two subjects, since they are seen as topics that lie collaterally to each other. In the municipality of Stockholm, the process function within the section of restaurants, however, it is not that fortunate within households. The factors of simplicity, profitability and trust are the main features threatening the success of the process of collecting food waste to produce biogas.

One may presume that the goal/requirement firsthand is to focus upon reduction of food waste. However, there seems to be a shift from consuming less (reduce the waste) to consuming differently (reuse the waste) nowadays, hence, the process of collecting food waste to produce biogas is central.

**Keywords:** food waste, waste management system, biological treatment, biogas production, collection methods, the municipality of Stockholm
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1. Introduction

The global food chain contains major environmental problems. The environmental issues are originated from all the divisions within the food chain, from the primary production to the consumption section. For example there are environmental concerns in the primary production, due to the cultivation that causes an increase of greenhouse gases in the atmosphere and eutrophication. Regarding the level of consumption there are also huge environmental concerns. Rebecka Modin (2011) suggests that the greatest issue is the problem of food waste (Modin, 2011). The issue of food waste is a global problem, since it is estimated that approximately 1.3 billion tons of food is being wasted each year worldwide. The number of 1.3 billion tons of food is included within different factors, such as households, production, manufacture and distributions etc. To add to this number, 1.3 billion tons, is that about one third of the produced food that is wasted at the level of human consumption (Quested et al., 2011). Sweden is also a part of this global problem, because it is a country that throws away a great deal of their food. Approximately 1 010 000 tons of food is being wasted each year in Sweden (Jensen et al., 2011).

Considering the fact that food waste is a problem within all the divisions of the food chain, it leads to huge environmental concern (Modin, 2011). However, while reaching the final destination of households it results in an unnecessary issue, due to the fact that food is being produced without being consumed, which in turn leads to an increase of greenhouse gases in the atmosphere from both the production as well as the consumption level (Modin, 2011). Even though the food waste exists in all parts of the food chain, the households are assumed to be the most significant level for this problem (Modin, 2011).

Seeing it from an environmental perspective, the best way of handling the problem of food waste is to actually reduce the waste itself. However, that is a vision that seems to be failing tremendously and suggestions about alternative procedures have advanced (Modin, 2011). The Swedish waste management system has developed different projects of collecting the waste, which can be seen as a possibility of reducing the waste in the area (Naturvårdsverket, 2008). One project that certain municipalities are working with in Sweden is to collect the food waste in order to produce biogas (Avfall Sverige, 2010). According to Ulrika Franke and Caroline Steinwig, the process of producing biogas out of food waste is seen as a great way of handling the issue of the gigantic food waste worldwide (Franke & Steinwig, 2011) Nevertheless, the municipalities who are working with these sorts of waste management systems are quite few in Sweden (Naturvårdsverket, 2008). Even though there are not that
many municipalities working with the biological treatment of AD (Anaerobic Digestion) to produce biogas out of food waste, the process is actually increasing even further in Sweden nowadays. Since societies where fossil fuel becomes more regulated, food waste is seen as an important material as well as energy source today (Avfall Sverige, 2010). However, it is also linked to the quantitative goals established by the Swedish government, in order to increase the biological treatment of the waste from households. It is important to increase the collection of food waste from households, since the food waste is gigantic within this section. Due to the gigantic problem of food waste in areas, there has been a huge focus upon the biological treatment of AD while operating within waste management (Avfall Sverige, 2010). Even though the process contributes to less environmental impact, there are contradictions that it had been better if the produced food never was thrown into the garbage (Naturvårdsverket, 2012) and whether an actual reduction of the food waste occurred in societies instead (Modin, 2011).

1.1 Aim and research questions

Within this master thesis there are two subjects that are examined. The first topic is about the problem of food waste, where I mainly will have an environmental perspective towards the problem, due to my bachelor degree in environmental science. The second subject is about the waste management system of collecting food waste to produce biogas in municipalities. The study will consist of a connection between these two topics, in order to evaluate whether the waste management system could be beneficial for the issue of food waste, and to distinguish possible contradictions between these two subjects. Regarding the process of collecting food waste to produce biogas, my main focus will be on the municipality of Stockholm. The purpose of the study is to analyze the issue of food waste and connect it to the waste management system of collecting the food waste in order to produce biogas, and examine the potential benefits and conflicts between these two topics. The aim is also to investigate the process of collecting food waste to produce biogas, its possibilities and functionality, and how the process is operating in the municipality of Stockholm.

In order to fulfill the aim, following research questions and sub-questions are addressed:

1. What is the connection between the issue of food waste and the process of collecting the food waste to produce biogas?
   - Why is food waste a significant problem to manage?
   - What are the positive and negative effects with the process of producing biogas out of food waste?
- Are there any contradictions between the two subjects, the issue of food waste and the process of collecting the food waste to produce biogas?
- Can the process of collecting food waste to produce biogas be beneficial for the issue of food waste, for example contributing to a potential reduction of food waste in areas?

2. How has the process of collecting food waste to produce biogas progressed in the municipality of Stockholm?

- How does the municipality of Stockholm operating the process of producing biogas out of food waste? For example what are their collections methods, management control measures and goals etc.?
- Has the process of collecting food waste to produce biogas been functional in the municipality of Stockholm, and, in that case, why?
- What are the lacking factors with the process of producing biogas out of food waste in the municipality of Stockholm?

1.2 Delimitations

There will be a delimitation regarding the research area considering that the problem of food waste is quite extensive and a global problem. The research area is Stockholm, where I will focus upon the municipality of Stockholm while investigating the process of collecting food waste to produce biogas. Considering the thesis time limitation, there was a requirement of choosing one municipality in Stockholm in order to make the thesis feasible, since there are too many municipalities to investigate in Stockholm. The municipalities have also different methods, goals and plans for their areas regarding the process of collecting food waste to produce biogas. Due to these reasons, I decided to choose one municipality, the municipality of Stockholm. Even though there is delimitation within the municipality of Stockholm, there are also discussions about the issue of food waste and the process of producing biogas out of food waste within global context. Discussions towards a global point of view are important in order to contextualize the topic into a broader perspective.

Another limitation for this master thesis is to only focus on the production of biogas out of food waste. Other types of substitutes for biogas production, such as sewage sludge, will not be discussed in this thesis. In other words, it is the collection of food waste to produce biogas that is essential.
1.3 Relation to previous studies

There are a lot of studies regarding the problem of food waste, and the topic has increased in different debates about food related issues worldwide. There is also available information about the subject of using the wasted food to produce biogas. However, reports and studies about connecting these two topics are scarce, which is also the reason why I wanted to investigate this matter. There is a gap of knowledge whether or not it is a good approach to proceed with this type of waste management system, concerning the necessity of reducing the food waste.

There are researches and examples in Sweden about the procedure of collecting food waste to produce biogas. For instance there are studies and good examples in the municipalities of Helsingborg and Uppsala (Franke & Steinwig, 2011). Even though there is research distributed about the approach in certain municipalities, there are scarce studies about the collection of food waste in the municipality of Stockholm. The municipality of Stockholm was chosen due to the reason of the scarce studies in the area.

1.4 Thesis outline

Chapter 1 introduces the reader to the two topics, the issue of food waste and the waste management system of collecting food waste to produce biogas. The aim and research questions are obtained in the chapter, as well as delimitations and relations to previous research.

In Chapter 2 the theoretical framework is identified for the thesis. First, there is a literature review about the issue of food waste. Second, there are literatures regarding waste management in Sweden, where the Swedish environmental objectives, the Swedish waste management and forces within waste management are at focus. At last, the concept of sustainable consumption is included in the chapter.

Chapter 3 is a description of the methodology for the obtained data for the thesis. There are explanations about the technique of semi-structured interviews, the literature study and potential limitations of the methodology.

Chapter 4 is the first part of the findings from the primary data, where the connection between the issue of food waste and the process of collecting food waste is revealed.
In **Chapter 5** the second part of the findings from the primary data is presented. The findings within this chapter are regarding the process of collecting food waste to produce biogas in the municipality of Stockholm.

**Chapter 6** includes the discussion and analysis from the findings in chapter 4 and 5, as well as reflections and connections with the literature study in chapter 2.

Finally, in **Chapter 7** the conclusions of the thesis are confirmed, which is based upon the findings and the analysis within the thesis.

## 2. Theoretical framework

### 2.1 The issue of food waste

Food waste is the biologically biodegradable material within the food chain. Even the liquid form of food that is thrown down the sink is included within the definition (Jensen et al., 2011). The definition of food waste for this thesis is, in other words, food that has been thrown away without being consumed, although it could have been consumed whether it had been handled differently. The assumption refers to the remark that there also exist unavoidable food waste (Naturvårdsverket, 2012), such as banana peel, potato peel and eggshells (Jensen et al., 2011). In other words, the food waste that is seen as an issue is the eatable food that is thrown away (Naturvårdsverket, 2012). Due to this assumption, the food waste discussed within this thesis is referred to as the “unnecessary food waste”. It also exist two different forms of food waste. First, there is the food that is thrown into a mixed fraction together with other types of garbage. Second, there is the part of the food waste that is sorted at the source, such as households and restaurants, and then treated separately, even called biological treatment (Jensen et al., 2011).

According to Rebecka Modin (2011), the issue of food waste is a tremendous problem worldwide, since it contains major problems and different aspects to reconsider. As mentioned in the introduction chapter, there is an environmental aspect towards the issue of food waste. Food waste causes huge increases of greenhouse gases in the atmosphere, both from the production as well as the consumption level, which in turn generates effects of climate change (Modin, 2011). Rebecka Modin (2011) suggests that 1 ton food waste occasions to approximately 2.07 tons of carbon dioxide equivalents. Based upon these estimations, about 1.07 million tons of carbon dioxide equivalents are caused by food waste
from the Swedish households each year. The approximations are grounded upon a previous research suggesting that Sweden throws about 910 000 tons of food each year (Modin, 2011). However, to clarify, it is possible that the estimations may differ, since it depends upon what kind of food that is wasted. In other words, different foods affect the climate in dissimilar ways (Modin, 2011).

Another aspect to reconsider regarding the issue of food waste is the economical feature. Groceries are quite expensive, and it can be seen as a waste of money to throw food for incineration without even consuming it. Besides a waste of money, it also results in a waste of time and effort, due to different factors such as the purchase, transport from the supermarkets and cooking etc. There are estimations, however quite unsure approximations, that the Swedish households with children included are wasting about 8 000 SEK each year. Based upon this estimation, the Swedish households are wasting approximately 20-30 per cent of the purchased food each year (Modin, 2011).

There is also an ethical aspect towards to issue of food waste. The ethical aspect is mainly based upon the assumption that about 1.3 billion tons of food are being wasted each year globally, at the same time as approximately 1 billion people are starving in the world (WFP/FN:s livsmedelsprogram, 2013). According to Tomas Ekvall and Sara Malmheden (2012), there is also an ethical argument that the waste of the unnecessary food is consequential, since it leads to depletion of the earth’s resources (Ekvall & Malmheden, 2012). The overexploitation of resources will also most likely increase even further in the future, due to the current consumption demands and the increase of the human population. There are approximations that the human population will continue to increase in numbers up to about 9 billion people by the year of 2050, which in turn results in even less resources to utilize (Godfray et al., 2010).
Figure 1: An illustrated figure of the total amount of food waste in tons within the different sections in Sweden during the year of 2010. The figure is based on the numbers from Table 1, which also means that the sections of agriculture and hospital kitchens are not included in the estimation (see Table 1).

As mentioned above, food waste is a problem within all the divisions of the food chain, such as in the primary production, wholesaler, restaurants, stores, large-scale caterings and households (Naturvårdsverket, 2012). Although, it is a major issue within all the divisions, households are the ones that cause the biggest concern of the total amount of the food waste in Sweden (see Figure 1) (Jensen et al., 2011). Naturvårdsverket (2012) suggests that consumption patterns, knowledge, attitudes and behaviors are the main factors that cause the greatest amount of food waste within the section of households. The high amount of food waste can be a consequence of time limitations of prioritizing the purchase of groceries (Naturvårdsverket, 2012), forgotten leftovers, wrongly stored food or that the best before date has expired and so forth (Modin, 2011).

Carl Jensen et al. (2011) suggests that within a total number of 1 010 000 tons of food waste, about 674 000 tons of the food waste was represented by the households within Sweden in the year of 2010 (see Table 1). This is estimated to an average number of approximately 76 kilos of food waste per person each year, or about 0.8 kilos of food waste within a family of four.
people each day. The food processing industries lies in second place, with approximately 171 000 tons of food, followed by supermarkets, restaurants and school kitchens (Jensen et al., 2011). However, it can be worth mentioning that the amount of food waste is not estimated within the sections of agriculture and hospital kitchens (see Table 1).

Table 1: Shows the approximated total amount of food waste and the separated food waste in tons, within all the different sections in Sweden during the year of 2010 (adapted from Jensen et al., 2011).

<table>
<thead>
<tr>
<th>Section</th>
<th>The excited amount (tons)</th>
<th>The portion of the excited amount (%)</th>
<th>The amount of the separate collection (tons)</th>
<th>Collection rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>?</td>
<td>?</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Food Industries</td>
<td>171 000</td>
<td>17</td>
<td>?</td>
<td>?</td>
</tr>
<tr>
<td>Supermarkets</td>
<td>39 000</td>
<td>4</td>
<td>8 400</td>
<td>22</td>
</tr>
<tr>
<td>Restaurants</td>
<td>99 000</td>
<td>10</td>
<td>9 500</td>
<td>10</td>
</tr>
<tr>
<td>School kitchens</td>
<td>26 000</td>
<td>3</td>
<td>17 000</td>
<td>65</td>
</tr>
<tr>
<td>Hospital kitchens</td>
<td>?</td>
<td>?</td>
<td>3 500</td>
<td></td>
</tr>
<tr>
<td>Households</td>
<td>674 000</td>
<td>67</td>
<td>134 000</td>
<td>20</td>
</tr>
<tr>
<td><strong>unavoidable</strong></td>
<td>435 000 (65%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>unnecessary</strong></td>
<td>239 000 (35%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1 010 000</strong></td>
<td></td>
<td><strong>169 000</strong></td>
<td></td>
</tr>
</tbody>
</table>

According to Carl Jensen et al. (2011), in comparison to the total amount of the food waste, the collected amount of the food waste was quite modest in the year of 2010 (see Table 1). For example in the section of households, the total amount of the food waste was about 674 000 tons, however, only 134 000 tons of the food waste was collected (Jensen et al., 2011). Nevertheless, while studying the numbers in Table 1 there is a requirement to reconsider the case of the unavoidable food waste from households. Even though the households represented the greater amount of the food waste during the year of 2010, about 435 000 tons was unavoidable food waste, which was approximately 65 per cent of the households food waste (see Table 1). About 35 per cent of the food waste was counted as the unnecessary food waste from households, which was approximately 239 000 tons. (Jensen et al., 2011)
2.2 The Swedish environmental objectives regarding waste management

About ten years ago the Swedish government established 16 environmental objectives, in order to create structure within the environmental development in Sweden (Regeringskansliet, 2013). However, according to Naturvårdsverket (2012), the environmental objectives turned out as a failure (Naturvårdsverket, 2012). A few of these environmental objectives are connected to the issues regarding waste in Sweden. For example there is a sub target within the environmental objective called “Good built environment” (God bebyggd miljö), where the goals were to not increase the amount of waste and to recycle about half of the waste from households within the year of 2010. The biological treatment of the food waste was also included in the goal (Modin, 2011). Due to the failure of the environmental objectives, the Swedish government advanced the goals and established thirteen stage goals instead during the year of 2012. Specific themes were prioritized within the stage goals, such as waste, biological diversity, air pollution and hazardous substances. The stage goals are supposed to elucidate the necessary shifts and reforms within societies, in order to achieve the previous environmental objectives (Regeringskansliet, 2013). Within the theme of waste, the stage goal included for example that 50 per cent of the total waste from schools, households, restaurants and stores should be biologically treated in order to produce plant nutriment. The goal also refers to that approximately 40 per cent of the waste should be used as an energy contribution by the year of 2018 (Regeringskansliet, 2012). To add to this per cent is that the stage goal is placed upon a national level, hence, it is not necessarily a requirement that all the municipalities are supposed to collect 40 per cent each, but rather for them to be able to collect 40 per cent of the food waste all together (Sundström, 2011). However, within this stage goal, it is also included that about 20 per cent of the total food waste should be reduced by the year of 2015. In order to accomplish the goal, there is a requirement of further management control measures as well as reliable data and statistics regarding food waste within the level of consumption (SMED, 2011).

2.2.1 The Swedish waste management

Caroline Steinwig (2011) suggests that in connection to the Swedish environmental objectives and its failure, in order to reduce the waste there are debates about alternatives and developments within the waste management system in Sweden. There are three systems of disposing food waste, which are incineration, landfiling and biological treatment (Steinwig, 2011). In the system of incineration it is possible to utilize the generated heat and power, such as district heating (Avfall Sverige, 2012). However, there are no nutrients from the waste that...
is recuperated within this system (Avfall Sverige, 2012). While using the process of landfilling, it takes place inside the landfill. Within these landfills there is a situation of lack of oxygen, even called anaerobic conditions, which results in the food waste breaking down and creates methane gas. A dilemma with landfilling is that a few of them are lacking a proper gas collecting system, which in turn can cause major leaks of methane gas into the atmosphere, hence, an effect of climate change (Steinwig, 2011). There are mainly two approaches of conducting the biological treatment of the food waste. The first way is by composting the food, and the second approach is by AD (anaerobic digestion). Within both these approaches of biological treatment, a recovery of the nutriment from the food waste occurs (Avfall Sverige, 2012). On the contrary, the energy produced from the methane gas is also being recuperated within the method of AD. The gas produced with the method of AD is also the contribution to a production of biogas in the end (Avfall Sverige, 2012).

The products for biogas production in the biological treatment of AD can be divided into two categories. One of the categories are decay products, which is for example food waste, sewage sludge, cultivated crops for biogas production and waste from agricultural products. The second category is waste and decay products from industries, such as cultivated crops for biogas production (Sundström, 2011). However, it is primary sewage sludge and food wastes that are the most utilized categories for biogas production (Sundström, 2011). The biological treatment of AD is also the only process that leads to recycle of nutrients, which in turn makes it an environmentally friendly system (Avfall Sverige, 2012). An increase of the biological treatment of AD is connected to the Swedish environmental objective, due to the requirement of reducing the waste and the demand of fossil fuel. A reduce in waste and fossil fuel also decreases the impact of an accelerating greenhouse effect (Naturvårdsverket, 2012).

According to Avfall Sverige (2012), Sweden is a developed country, with a history of working with sustainable waste management and an interest of treating the waste in a reasonable manner. Sweden has more or less stepped away from landfilling nowadays, hence, there is a focus upon the processes of biological treatment and incineration (Steinwig, 2011). The number of municipalities working with the waste management system of collecting the food waste to produce biogas is increasing each year (Avfall Sverige, 2010). Ulrika Franke and Caroline Steinwig (2011) suggest that there are a few municipalities that have been quite successful with this type of process of producing biogas out food waste. These municipalities are for example Uppsala, Enköping, Helsingborg and Heby, as well as a few council companies, such as Nårab and Vafab (Franke & Steinwig, 2011).
In the municipality of Uppsala for example, there is a compulsory collection of the food waste. The municipality of Uppsala introduced the waste management system in the year of 1996, however, it was not until the year of 2000 that the process became mandatory for households and companies. There are many students living in Uppsala, which resulted in certain complications of establishing the waste management system at first, since students tend to live in an area during a short period of time of their study. Due to these assumptions, there was a requirement of reaching out to the citizens more frequently with information regarding the waste management system in the municipality of Uppsala (Franke & Steinwig, 2011). Even though certain complications occurred, the municipality of Uppsala became quite successful within their community, since approximately 40 per cent of the food waste was collected in the year of 2010 (Franke & Steinwig, 2011). Regarding the case of Stockholm, Södertälje was the municipality that separated the most of their food waste during the year of 2011. The municipality of Södertälje collected about 39 kilos of food waste per person during this year. How these municipalities succeeded with their collection has partly to do with whether it is mandatory or not to separate the food waste. Another important factor of the successfulness in these municipalities is the variety of collection methods within the procedure (Sundström, 2011).

2.3 Forces within the waste management

Waste management is one of the most important services distributed by the urban authorities. In order to create a sustainable system within the waste management, it is important to reconsider the factor of functionality. While discussing the waste management system of the biological treatment of AD, it is also important to reconsider the forces and factors within the system, since we are living in a competitive world of business. These factors are for example the development in a country, the quantity of waste and what type of waste the area generates (Chandrappa & Bhusan Das, 2012). However, while framing waste management systems within urban areas it also depends on the population of the area. The transportation and the collection of the waste become more complex when urban areas increases in size, especially without a suitable planning. In order to achieve sustainable waste management (SWM) there is a prerequisite of an influence of six different factors. These factors are; 1) law, policy and planning, 2) waste handling, 3) training, 4) consciousness, 5) safeguard livelihood inducements and 6) emergency readiness. The first factor, law, policy and planning, has a significant role within the SWM. Without rules and laws, confusion will appear regarding responsibilities etc. (Chandrappa & Bhusan Das, 2012). However, there is also a requirement
of a suitable waste handling as well as training to be able to implement the laws. Besides waste handling and training, the waste generators require a change in their behaviors, hence, a raise in consciousness is of significance. It is also important to reconsider that many countries depends upon their waste for livelihood, especially while framing new policies. Finally, emergency readiness is the most mistreated factor in SWM programs, which causes death and injuries among the staff in the waste management systems as well as the public (Chandrappa & Bhusan Das, 2012).

![Waste Management Hierarchy](image.png)

Figure 2: An illustration of the waste management hierarchy (adapted from Chandrappa & Bhusan Das, 2012).

The waste management has a hierarchy of achievements, called the “waste management hierarchy”. The waste management hierarchy refers to the fundamental intentions while developing waste management schemes (see Figure 2). Many developed countries have adopted the waste management hierarchy while implementing waste management systems. The implementations are focusing on the disposal on land, minimization, transformation and recovery (Chandrappa & Bhusan Das, 2012). However, it is not until the society is at the top of the pyramid, which is to avoid the waste, that it generates the greater fortune for the society (Chandrappa & Bhusan Das, 2012). Although avoidance is the main objective within waste
management, there are also several challenges with this achievement. Waste avoidance can for example take place while banning certain products in a country, such as the case of the ban of alcohol in the Gujarat state in India (Chandrappa & Bhusan Das, 2012). Nevertheless, it may not be a good method to prohibit products in regions for either the society or for the environment, since it often leads to potential substitutes towards the banned product. The choice of the alternative product depends on the country’s population density, transportation, topographic and environmental and socioeconomic rules (Chandrappa & Bhusan Das, 2012).

As mentioned in the previous section, there are a few successful municipalities working with the waste management system of collecting food waste to produce biogas. According to Ulrika Franke and Caroline Steinwig (2011), the successfulness has to do with influences from different factors in the waste management system. These factors are for example dedicated officials, clear political decisions, making plans together with other collections from households, to move slowly and systematically during the introduction of new waste management systems and to have central focus on receiving information about other factors and previous successful stories in other municipalities (Franke & Steinwig, 2011).

2.4. Forces within food and consumption patterns

We are living in a world today which puts a gigantic pressure upon our global natural resources. It mainly has to do with the human population increase, a rise in welfare and the increase in the consumption. The human population growth has its largest increase in developing countries, however, the growth in welfare and consumption is more extensive within industrialized countries, which in turn results in environmental consequences (Europeiska miljöbyrån, 2013). Even though Sweden is a relatively small country, Sweden causes huge environmental impacts due to its enormous trade system. The environmental issues caused by the Swedish consumption patterns also affect other parts of the world, since Sweden is dependent upon their imports of products (Naturvårdsverket, 2012). In practice there are rules about trading, where political and powerful international forces are framing the trade policies of food (Lang & Heasman, 2004). Although market forces are a fact, there is also an existence of the consumer power. Tim Lang and Michael Heasman (2004) suggest that within these market forces there are modern arguments regarding the theory of the “consumer choice”. The concept of the consumer choice refers to that the consumers have the power as well as the vote of their own food in their society. Depending on what sorts of food the consumers want in an area, it is also what the society will receive. In other words, the consumers have the luxury in the range of choices, which in turn creates consumption patterns
within a region (Lang & Heasman, 2004). Even though it exist a wide range of choices, it does not necessarily mean that the consumers receive labels of information about their choice of food (Lang & Heasman, 2004). The consumer choice can be referred to the increased quality standards of food. The increase of quality standards is mostly based upon the standards from the higher income countries, and has partly to do with the raise in new scientific discoveries, technologies and information about diet and health (Caswell & Mojduszka, 1996). The consumption patterns are endorsed by globalization and a number of general trends (Morgan, Marsden & Murdoch, 2006), which in turn shapes taste and style with specified products (Southgate, Graham & Tweeten, 2007). The food producers are responding to these quality standards by transforming and extending the products according to the consumer’s demand, which also results in a variety of food products (Caswell & Mojduszka, 1996).

Considering the market forces, the consumer choice and the extensive consumption, there is a risk of “the tragedy of the commons”. The tragedy of the commons denotes to rational thinking of trying to maximize as much as possible, which in turn causes the consequence of overexploitation of resources. The theory of the tragedy of the commons refers to a picture of a pastureland that everyone can access, which results in that every herdsman keeps as many cattle as possible within the pasture. It is a way of thinking rationally, however, the carrying capacity of the land becomes neglected (Hardin, 1968). The tragedy of the commons is a possible scenario regarding the issue of food and agriculture. Countries and regions are trying to maximize their own requirements of food and only reconsider their consumer choice (Lang & Heasman, 2004), and not about its possible environmental damages in the long run (Europeiska miljöbyrán, 2013). As long as the pressure from the market forces and our consumption patterns continue, there is a risk of overexploitation of resources, especially while reconsider the human population increase in the future (Europeiska miljöbyrán, 2013).

2.5 The concept of Sustainable Consumption

While discussing the contradiction between the requirement of a reduction in food waste and the process of collecting food waste to produce biogas, there is a concept worth mentioning. The notion is “sustainable consumption”, which first was founded as a global-political agreement in the Agenda 21 during the UN conference on Environment and Development report established in Rio de Janero (1992). In the European Environment Agency’s (EEA) report (2005), sustainable consumption is defined as the use of services and goods which results in basic requirements and better quality of life. The concept of sustainable
consumption also contributes to a reduction of the use of toxic materials, natural resources and emissions from waste, which in turn decreases the threat for future generations (EEA, 2005).

However, there are different definitions of the concept of sustainable consumption, which has resulted in a variety of significance and problems of applying the notion (Jackson & Michaelis, 2003). According to Tim Jackson and Laurie Michaelis (2003), assumptions are added within the concept, such as it does not necessarily mean that there is a need of a reduction in the consumption pattern, but rather to consume in a more responsible and efficient way. In other words, there are different definitions where sustainable consumption can be referred to consuming differently, consuming responsibly or consuming less (Jackson & Michaelis, 2003). Due to these assumptions, the process of collecting food waste to produce biogas can be seen as “sustainable consumption”. It is a process where the food waste consumes in a different and a more efficient way, since it is a better alternative for the environment (Avfall Sverige, 2012) that may lead to a potential reduction in food waste (Franke & Steinwig, 2011). However, the notion of sustainable consumption is also linked to the contradiction discussed in the thesis. What is most important, to consume less in order to reduce the food waste, or that we are supposed to consume it in a different way, by for example using the food waste to produce biogas?

There is often an institutional consensus of consuming differently rather than consuming less nowadays, for example to produce and sell more sustainable products (Jackson & Michaelis, 2003). However, the perspective of consuming differently has led to an issue of potential collapse regarding the distinctness between sustainable production and sustainable consumption. There are also disputes about consuming differently, since it fails while addressing essential factors, such as the relevance of lifestyle change, the scale of consumption and the nature of consumer behavior (Jackson & Michaelis, 2003). Conversely, there are strong reasons of adding consumption within national policies today. The reasons are for example environmental impacts from our consumption patterns, the question whether the consumption generates to human well-being and the inequality in the distribution of consumption goods etc. Due to these reasons, it obligates the requirement of not overlooking the issues of consumption (Jackson & Michaelis, 2003). Even though, it might be impossible to generate consensus about an overall definition of sustainable consumption, there is a need of questioning the problems of consumption to be able to add consumer behavior and lifestyle as well as to establish sustainable developments etc. The concept of sustainable consumption
can, in other words, only be understood by including the context of consumption, consumerism and consumer behavior (Jackson & Michaelis, 2003).

The government has a major role while framing sustainable consumption policies. There are two specific assignments that need to be conducted by the government. First, the government needs to seek and comprehend the consumer’s behavior. Since the government is seen as a manager of the system and the consumer’s as units that can impose unpredictable behaviors. Secondly, the government needs to influence the consumers and act like an expert advisor, in order for individuals to consume differently. The influence can for example be executed by generating information, performing physiological measures and conduct further education within societies etc. (Jackson & Michaelis, 2003).

However, there are a few challenges of achieving sustainable consumption. In order to develop a sustainable consumption it is required to involve different stakeholders from all the levels in the system. Why this is a problem has partly to do with the complexity of the system. There are many people involved in the process, both from the food chain and the production of biogas out of the food waste, which results in many aspects to reconsider regarding responsibilities and best efficient actions etc. Besides a variety of actors, there is also a complexity of consumption patterns, since people have different consumption behaviors and so forth (EEA, 2005).

3. Method

The thesis has partly been performed as a case study within the municipality of Stockholm, due to an examination about the operation of collecting food waste to produce biogas in the area. A case study refers to an investigation in detail of a specific area, where the methods of the examination can vary. The main goal of conducting a case study is to generate an understanding towards the examined subject in the area. In other words, within a case study it is all about being descriptive. However, in order to make the thesis feasible, it is also important to have clear boundaries within the case study (Silverman, 2010). One of my boundaries is to only focus upon the municipality of Stockholm. Another boundary for this case study is to only focus on the production of biogas out of food waste and not on other types of substitutes, such as biogas production out of sewage sludge etc. In other words, it is the collection of food waste to produce biogas that is essential in this case study. Besides the case study of the municipality of Stockholm, I will also investigate the connection between
the two themes, the issue of food waste and the process of collecting food waste to produce biogas. Even though the interaction is quite obvious between these two topics, it is of interest due to its lack of research. In other words, even though there will be a case study of the municipality of Stockholm, I will also contextualize the two subjects with support from previous literature, in order to create an understandable perspective towards the issue of food waste and its connection to the process of collecting food waste to produce biogas.

In order to gather necessary information about the problem of food waste and the process of producing biogas out of food waste, the thesis will consist of qualitative methods. In qualitative methods there is a general belief of contributing to a deeper understanding of a social phenomenon (Silverman, 2001), which is of interest since the thesis has an interpretative and understandable departure point. Qualitative research methods are also an attempt to generate personal and subjective experience, and aims to that quantitative method are lacking the significant dimension of social reality. Reality is seen as something emergent that is in continuous fluctuation, which is created by the exchange of social interaction (Sullivan, 2001). Although social reality is of occurrence, there might be a problem of validity within qualitative methods, due to their in-depth approach in specific cases (Silverman, 2010).

The method chapter is divided into three sections. The first part is about the collection of primary data, which has been gathered through semi-structured interviews. The second part is a section regarding the secondary data received from a literature study. Finally, the third part is about arisen limitations regarding the choice of methodology.

### 3.1 Primary data

The collection of primary data has been conducted through semi-structured interviews. Semi-structured interviews are resembled to a conversation rather than an interrogation, which often leads to a variety of interviews. The interviews differ, since the respondents deliberate opinions about what they think is worth mentioning (Valentine, 2005). There is a possibility that different actors have varied sentiments about food waste and the process of producing biogas out of food waste, hence, it was of interest to have interviewees from different units. It was of concern to examine the respondent’s thoughts about the connection between the two topics. To be able to gather necessary information about the first research question, regarding issue of food waste and its connection to the process of producing biogas out of food waste, there was a requirement of interviews. However, besides information about the connection, the semi-structured interviews was also performed in order to answer the second research
question of this thesis, regarding the process of producing biogas out of food waste in the municipality of Stockholm. The semi-structured interviews have been essential for both of my research questions, due to the lack of previous research about the subjects.

The respondents consisted of actors connected to and working on the issue of food waste as well as the process of collecting food waste to produce biogas. In other words, there have mainly been interviews with selected stakeholders from authorities and the municipality of Stockholm. Even though the interviews have been essential for this thesis, the interviews turned out to be quite few. I conducted four interviews, which were with the Swedish Environmental Protection Agency (Naturvårdsverket), the Swedish Waste Management (Avfall Sverige), the Traffic Agency in Stockholm (Trafikkontoret i Stockholm) and the County Administration in Stockholm (Länsstyrelsen i Stockholms län). Although the interviews were quite few, it has not been an issue. I received an enormous amount of information from these four interviews and decided that the obtained information from the respondents were enough in order to answer my research questions.

The semi-structured interviews are divided into two parts, one for each research question. The first section was mainly about the first research question, regarding the connection between the two subjects, and the second part was about the second research question, regarding the case of the municipality of Stockholm. Within the first section of interviews, the interviews with the Swedish Environmental Protection Agency and the Swedish Waste Management were included. The first conducted interview was with a civil servant from the Swedish Environmental Protection Agency. The agency was of interest, due to their work on the issue of food waste in Sweden. However, the agency also received information about the process of collecting food waste to produce biogas, since they are a part of the collaboration for the process in Sweden. The second interview was with a civil servant from the Swedish Waste Management. The interview with the Swedish Waste Management was important for this thesis, because they are a fundamental actor within the process of collecting food waste to produce biogas. The first section of the interviews focused more on the connection between the two subjects and they were concentrated to a national level, which was important to be able to contextualize the issue. However, in the second part of the interviews, the focus was mainly upon the case study of the municipality of Stockholm. In the second part of the interviews, the interviews with the Traffic Agency in Stockholm and the County Administration in Stockholm were included. These two interviews were of significance for this thesis, since they are actors related to the process of producing biogas out of food waste.
in the municipality of Stockholm. Since the second part of the interviews were focused upon the case of the municipality of Stockholm, it became fundamental for the second research question in this thesis.

I selected the respondents from the chosen authorities and the municipality of Stockholm as I was searching for information about the two topics in matter. I contacted the interviewees myself. Even though I got in contact with the respondents myself, the interviewees suggested other selected respondents which were interviewed later on, due to their collaboration with each other regarding this issue. For example, there were situations where certain questions were unknown for the respondents, resulting in them referring to one another. In other words, the interviews were based upon the method of snowball sampling, since the respondents were directed me with occasional questions to other contacts. Snowball sampling refers to a method of receiving new contacts with help from previous interviewees or other contacts. Afterwards, a reference to another interviewee with interesting information might be obtained from the new contact and so forth. This interview method is worthwhile, since there is a possibility of getting in contact with interviewees who may have great knowledge about the subject in matter. Snowball sampling is also a positive method, because it might be easier to get an interview with an important respondent, since they have received information about me as a researcher from my previous contact beforehand. In that sense, the respondent might reconsider me as trustful (Valentine, 2005).

There were two different ways of conducting the interviews, by telephone or by visiting the respondent’s office. I visited the Swedish Environmental Protection Agency and the County Administration in Stockholm. These two interviews were fortunate, since it is easier to discuss more freely while sitting together in the same room. The other two interviews with the Swedish Waste Management and the Traffic Agency in Stockholm were performed by telephone. The interview with the Swedish Waste Management was conducted by telephone, since their office lies in Malmö and it is located rather far away from Stockholm. The Traffic Agency, on the other hand, is placed in Stockholm, however, the respondent wished for the interview to be done by telephone. Considering that the interview with the Traffic Agency in Stockholm was fundamental for my case study of the municipality of Stockholm, I confirmed the interview by telephone. Before the interviews I prepared a few main questions with related sub-questions about specific points of interest. Regarding the first research question about the connection between the two subjects, questions such as “What is most important to have focus upon, a reduction in the food waste or to reuse the food waste for biogas production?”
and “Is it possible that the biological treatment of AD could contribute to a reduction of the food waste in societies?” etc… were questioned. Questions for my second research question, regarding the process of collecting food waste to produce biogas in the municipality of Stockholm, were for example “What are the collection methods in the municipality of Stockholm?”, “Has the municipality of Stockholm any management control measures?” and “Has the process of collecting food waste to produce biogas functioned in the municipality of Stockholm?” and so forth… Two of the respondents were able to prepare for the interview, since they wanted the questions beforehand, and the questions were sent by email. My computer was the only material during the interviews, where I also kept my prepared questions. Notes were written down directly on the computer during the interviews. The interviews were not recorded. I asked the respondents attendant questions regarding specific points that were unclear or that I wanted to know more about.

To use the technique of semi-structured interviews to collect the primary data for this master thesis was most likely the right choice of method. There are scarce information and reports about the connection between the two topics, the issue of food waste and the process and collecting food waste to produce biogas. There are also only a few studies about how the procedure is operating in the municipality of Stockholm. Due to the scarce data, the interviews turned out essential for this master thesis.

Even though the respondents were civil servants from different authorities and the municipality of Stockholm, who also is familiar with each other’s work and what they advocates for, I decided to keep them anonymous out of ethical reasons. Considering that the thesis is about a relatively contradicted theme, about the connection between the issue of food waste and the process of producing biogas out of food waste, there is a possibility of clash of interests. To avoid or cause any social harm for the respondents, the interviewees were kept anonymous.

3.2 Secondary data
To be able to contextualize and connect the two subjects, the issue of food waste and the process of producing biogas out of food waste, a literature study was conducted. The literature study is also of importance since, together with the semi-structured interviews, it contributes to an interpretative departure point. The studied literature was mostly reports and evaluations written by authorities, such as the Swedish Environmental Protection Agency and the Swedish Waste Management. These types of reports are of interest, since the authorities are working
with these topics in Sweden. Reports that has been of interest are for example “Biogas ur gödsel, avfall och restprodukter – goda svenska exempel” (Naturvårdsverket, 2012), ”Svinn i livsmedelskedjan – möjligheter till minskade mängder” (Naturvårdsverket, 2008) and “Utvärdering och optimering av metod för förbehandling av källsorterat hushållsavfall till biogasproduktion” (Avfall Sverige, 2010). In addition, another source of significance was the report called “Biogasstrategi för Stockholms stad – en rapport från Miljöförvaltningen” (Sundström, 2011) written by the Environmental Department. The report was especially important for the second research question, regarding the process of collecting food waste to produce biogas in the municipality of Stockholm.

3.3 Limits of methodology

A minor criticism towards the methodology may be a certain part of the work before the interviews. The respondents from the Traffic Agency in Stockholm and the County Administration in Stockholm wanted the questions in advance. They wanted to prepare for the interviews beforehand, and they obtained the questions by email. It is possible that it might have led to a consequence of embellished answers to the questions during the interview, since the respondents had time to figure out appropriate answers for the questions in advance. Even though it might be embellished answers, it may on the other hand be beneficial, since the respondents knew my specific points of interest before the interview. Another possible outcome may be that the interviewees did not know or remember the prepared answers to the given questions, which might have led to additional amounts of information. Due to these assumptions, it might have been better to email all the respondents in advance, since it may have resulted in superior interviews. A further consideration of embellished answers is that it might always be a risk of biased responses, since respondents may have incentives to show how good the work is within their workplace. In that sense, it was probably only beneficial to send the questions in advance.

As mentioned in the previous section, two of the interviews were conducted by telephone. The interview with the Swedish Waste Management was quite compelling to perform by telephone, due to its location in Malmö. However, the interview with the Traffic Agency in Stockholm was also conducted by telephone, even though their office lies in Stockholm. It is assumed that it might have been better to visit the respondent at their office instead, since the interview was rather intense with a lot of detailed information about the process of collecting food waste to produce biogas in the municipality of Stockholm. The interview was quite intense, since there were deliberations about the municipality’s collection methods, goals and
management control measurement etc. Due to the detailed information, it was occasionally quite stressful to follow the respondent, hence, a visit would have been preferable to better comprehend the information. Although a visit might have been a better choice, the interview went well. I acquired a great deal of material, which also turned out central for this master thesis. There was also a discussion after the interview about the issue of the massive and detailed information with the civil servant. As a result of the discussion, we decided that I could contact the respondent later on, if I had any further questions or did not comprehend any of the given answers.

Due to the translation, there is a possibility that the answers from the interviews have become slightly skewed. Considering that the interviews were made in Swedish and then translated into English, there is possibility that the answers have not turned out as precise in the thesis as before. Even though it is plausible of skewed answers, a lot of effort has been to make it as clear and correct as possible. The respondents have been offered to read and comment on their parts of the result chapters (chapter 4 and 5), to avoid any major mistakes regarding this potential issue.

Although these assumptions are conceivable, the method of semi-structured interviews was essential for this thesis. The interviews contributed to a large amount of knowledge about the issue of food waste and the process of producing biogas out of food waste.

4. The connection between the issue of food waste and the biological treatment of AD for biogas production

4.1 The issue of food waste

There is a general agreement among the respondents that the problem of food waste has developed to a serious problem nowadays. The agreement aims mainly to the problem of depletion of resources worldwide (Civil servant from the Swedish Environmental Protection Agency, 2013). The depletion of resources are also considered to increase even further in the future, since the human population is escalating in number each year, which results in even less resources to utilize (Godfray et al., 2010). Food waste is a significant issue to reconsider, because it is of everyone’s concern. Everyone needs nutriment in order to survive. Since food is vital for survival, the depletion of resources has turned out to be an indirect affect for humans to gain their requirement of nutriments. Finally, that humans in turn throw a great
deal of their food makes the issue of food waste an unnecessary problem (Civil servant from the Swedish Environmental Protection Agency, 2013).

However, regarding the problem of food waste, the debates mainly refers to the issue of respect, hence, making it an ethical dilemma. It is estimated that humans are producing food for approximately 12 billion people globally, even though we are about 7 billion people in the world today. In other words, the production of food is twice as much as actually required in the world, and in turn humans throw every fourth bag of groceries into the garbage, which makes it unnecessary and an ethical dispute (Civil servant from the Swedish Environmental Protection Agency, 2013). Especially while reconsidering that there are about 1 billion people starving in the world today (WFP/FN:s livsmedelsprogram, 2013). Due to these assumptions, the issue of food waste is seen as a controversial subject, since it is in contrary to the moral aspect as well as to the political and societal norms (Civil servant from the Swedish Environmental Protection Agency, 2013).

Besides the factors of respect and depletion of resources, there are other factors that increase the consciousness regarding the issue of food waste. For example there is a factor of economics. We are living in a world where the economical aspect is of significance. As mentioned above, humans nowadays are throwing away every fourth bag of groceries, which is not sustainable for our economy. In other words, while throwing away food, it also results in a waste of money (Modin, 2011). Another important factor is imports. Sweden is importing a great deal of the food from other countries (Jordbruksverket, 2010). The consumption patterns in Europe, as well as other countries in the Western world, are causing environmental impacts in other areas in the world, due to production, resource extraction, processing and transports. Approximately one third of the household’s impact towards the environment comes from the consumption of food and drinks (EEA, 2005). It is not enough that food is being transported long distances, which causes environmental degradation due to its pollution of greenhouse gases in the atmosphere, since it is also due to our consumption behavior of demanding good quality of food. Countries in the Western world, such as Sweden, are a bit spoiled of requiring specific food products. The demanding quality of food has for example to do with wanting the products in specified sizes and colors etc. Due to the requirement of high quality, there are several food products that become unnecessarily wasted, since the food does not meet the quality of standards (Civil servant from the Traffic Agency in Stockholm, 2013). On top of it all, the food products that are thrown because of its low quality is often completely eatable. The problem of food quality exists within all the consumer categories,
such as households, restaurants and supermarkets (Civil servant from the Traffic Agency in Stockholm, 2013). The consumption demand in Europe is driven by demographic transformations, increasing incomes and shifts in lifestyle. For example the focus is partly about luxury nowadays, such as good quality of products etc. Predictions exist that the environmental impacts from our consumption patterns will continue to increase, as long as no further actions are being made (EEA, 2005).

The main goal is to reduce the food waste and, at the same time, exploit its byproducts for biological treatment and sell it as animal food or incineration (Naturvårdsverket, 2012). Even though the exploitation of its byproducts contributes to less environmental impact, the greatest profit would be to not produce the food that is thrown for incineration. It is also assumed that one of the greatest profits for a society is to decrease the food waste within the section of households. The statement is mainly based upon the assumption that households cause the biggest amount of the total food waste in comparison to the other sectors. Besides the statement that households are causing the greater amount of food waste in societies, the cost per kilo food waste becomes superior further down the grocery chain. Since households are the final destination of the chain, the expenses are the highest within this consumer category (Naturvårdsverket, 2012).

To be able to reduce the food waste in different areas, there is a prerequisite of collaboration between different stakeholders in the process. As in the case of Sweden, there is cooperation between organizations, actors, municipalities and researchers. The collaboration is functioning as a network and it is called “Collaboration towards reduction of food waste” (Samverkan för minskat matavfall). The network creates the possibility of exchanging knowledge and experiences, which is of major importance in order to develop more sustainable processes and establishing new laws etc. The exchange in knowledge starts with the networks pushing towards modification in communities, where the networks are operating the municipalities. Secondly, the municipalities are coaching the individuals to reduce the food waste within households. In other words, it contributes to a cycle of knowledge for change. The contribution of knowledge is of major significance, since it confirms where the food waste originates and what types of measures that are required in the society (Civil servant from the Swedish Environmental Protection Agency, 2013). As mentioned, the issue of food waste is a problem within all the consumer categories (Civil servant from the Swedish Environmental Protection Agency, 2013). Controversially, the different consumer categories can support each other to combat the problem of food waste. For example the supermarkets
can help their costumers/individuals by not offering deals, such as “take 3 and pay for 2”. Contributions like these can be powerful, since many households are buying these sorts of deals, due to its beneficial profit (Civil servant from the Swedish Environmental Protection Agency, 2013). Although these deals gain profit for the households, it often results in a non-profit at the end. The price worthy food often starts to rot before the households even had time to eat it. In other words, the deals from supermarkets leads to even further food waste within households (Civil servant from the Swedish Environmental Protection Agency, 2013).

### 4.2 The process of collecting food waste to produce biogas

The main aim of the biological treatment of AD is to contribute to a substitute and an upgrade in automotive fuel. Besides the requirement of an upgrade in fossil fuel (Avfall Sverige, 2013), the aim is also connected to the prohibition of depositing, where the organic material was removed within landfills since the year of 2002 (Naturvårdsverket, 2005). Afterwards, the idea was developed by utilizing the nutriment within the organic material, which resulted in a production of biogas. In other words, the purpose of the biological treatment of AD is to contribute to a substitute towards fossil fuel, by utilizing the nutriment from food waste. The production of biogas leads to a decrease in fossil fuel, which is a better alternative for the environment, since it reduces the greenhouse gases in the atmosphere (Avfall Sverige, 2010).

Municipalities establishing the waste management system of producing biogas out of food waste today are increasing in numbers. The municipalities have the responsibility of collecting the food waste from households, restaurants and large-scale caterings in the area. In other words, the biological treatment of AD for biogas production is self-determining for municipalities (Franke & Steinwig, 2011). The municipality makes all the decisions for the area, such as which collection methods to use, management control measurements and whether the collection should be mandatory or not. However, the planning of the collection of food waste is then re-addressed to the housing associations, tenancy compounds and houses etc. For example, to make it obtainable of separating the food waste in properties belonging to housing associations, the housing associations needs to plan for the collection of their food wastes afterwards. Otherwise it is up to the individuals/households themselves to manage the possibility of separating the food waste within their property. What is meant by operating the possibilities on your own is to make phone calls to the housing association, and potentially the municipality, and suggest that there is an interest of collecting the food waste within their property etc. (Civil servant from the County Administration in Stockholm, 2013). Although it is optional for the households of managing the operation, it is sometimes a complicated task
that often requires a lot of effort to establish (Civil servant from the County Administration in Stockholm, 2013).

There are about 290 municipalities in Sweden, and approximately 163 of them are separating their food waste today (Franke & Steinwig, 2011). There are in other words about 53 per cent of the municipalities that have a system of collecting their food waste in Sweden (Avfall Sverige, 2012). In addition, certain municipalities have a system of collection, were only a small amount of the households, restaurants and schools might separates their food from other types of garbage. In other words, even though the municipalities have established a collection of their food waste, it does not necessarily mean that everyone in the area separates their food waste from other types of garbage. The remaining 47 per cent are the municipalities that do not have a system of collection. Instead of separating their food waste, these municipalities have a mixed and incendiary waste disposal (Avfall Sverige, 2012).

The most common collection method while collecting the food waste from households is to have two separated containers, one for the organic waste and one for the incendiary waste. There are approximately 65 per cent of the municipalities that are using this common method in Sweden. Other regular collection methods are multiple bin containers and the optic separation. Within the collection method of an optic separation, the households are sorting their waste in bags that have different colors and place them into the same container. In order to acquire the right treatment for the waste, the bags become automatically separated at the waste disposal plant afterwards (Avfall Sverige, 2012). Controversially, within the collection method of multiple bin containers, the different fractions are separated in dissimilar containers at the place in households, restaurants and schools etc. (Avfall Sverige, 2012).

There is an existence of a large amount of food waste to use for a production of biogas from all the different consumer categories. However, to produce biogas out of food waste is a quite complicated process (Franke & Steinwig, 2011). Within the waste management system of the biological treatment of AD, a screw press is used to separate any potential waste that has been sorted wrongly in the collected food waste, such as plastics. Most of the collected waste contains only of food waste, however, occasionally people sort their waste wrong and other types of garbage ends up within the collected food waste. Afterwards, a second separation occurs, where the food waste becomes squashed. The second separation is divided into two fractions, a liquid and a dry fraction. The liquid fraction is used to produce biogas within the biological treatment of AD, and the dry fraction becomes rejected for incineration or
composting (Avfall Sverige, 2010). The produced biogas mostly consists of carbon dioxide and methane gas, and it is of major importance since it is a substitute for automotive fuel (Avfall Sverige, 2012). Nevertheless, the produced biogas is also effective within other fields of applications, such as energy and electricity as well as organic manure in the agricultural sector (Avfall Sverige, 2012). However, the second separation is not entirely profound. A few biodegradable materials that should be separated into the liquid fraction sometimes occur within the dry fraction for incineration instead. It is about 63 per cent of the food waste that separates as liquid fraction and approximately 37 per cent of the food waste that separates as dry fraction. There are estimations that about 1 ton of food waste contributes to approximately 1.5 tons of liquid fraction and 0.2 tons of dry fraction (Avfall Sverige, 2010).

4.2.1 Positive and negative effect of the biological treatment of AD

According to all the respondents, the process of collecting food waste to produce biogas is a positive waste management system (Civil servants, 2013). The positive view has mainly to do with the contribution to a substitute towards fossil fuel. Besides a potential reduction in fossil fuel, the biological treatment of AD has a positive effect of promoting pre-separation at the source. It has been shown that households who are separating their food waste often also separate other sorts of packages. A pre-separation at the source is of significance, since it causes less impact towards the environment (Avfall Sverige, 2011).

Although the waste management system of collecting food waste to produce biogas is seen as a positive process (Civil servants, 2013), the technique has a few shortcomings. The biggest issue with the technique is that it is based upon anaerobic conditions of methane gas (Avfall Sverige, 2012). If the treatment plants are not properly sealed, there is a risk of pollution of methane gas into the atmosphere (Civil servant from the Swedish Environmental Protection Agency, 2013). The pollution of methane gas causes environmental impacts, generating in a climate change (Naturvårdsverket, 2012). The leakage of methane gas can also proceed from both the stage of the pretreatment and/or within the phase of the potential upgrade. Besides the different stages of the treatment, the leakage can also originate within dissimilar zones in the biological treatment plant, such as the ventilators (Civil servant from the Swedish Environmental Protection Agency, 2013). Other environmental consequences caused by the biological treatment of AD are acidification and eutrophication, due to its increase of ammonia. There are also studies suggesting that composting generates to less greenhouse gas emissions in the atmosphere, in comparison to the production of biogas out of food waste. In
other words, it is more environmentally friendly to compost the food waste rather than use it for biogas production (Naturvårdsverket, 2012).

Another problem with the process of collecting food waste to produce biogas is the choice of collection methods. Depending on which collection methods the municipalities use, it causes different obstacles due to their requirement of dissimilar factors. For example there is a consequence with the method of the optic separation, because it occasionally leads to the waste being separated wrongly. As mentioned above, within this collection method the waste is separated into different plastic bags, which sometimes leads to small components of plastics within the collected food waste. Since the plastic bags are ripped during the separation, it occasionally leads to small parts of plastics being mixed up with the food waste (Civil servant from the Swedish Environmental Protection Agency, 2013).

There are also a number of negative impacts within the performance of the biological treatment of AD. The process of producing biogas out of food waste is a quite new method that is still being tested within municipalities. The process is within a developing phase, since the first biological treatment plants were not built until the beginning of the 90s. Yet, there are also treatment plants being built at this moment in different areas. In other words, there are many plants that still lack experiences within the management. The lack in experience causes shortcomings (Avfall Sverige, 2013), such as the security aspect in the procedure. For example the employees are in fact working with bio aerosols during the collection of the food waste, which might be health threatening (Avfall Sverige, 2011). There has also been a problem with odor due to emission of methane gas, ammonia and nitrous oxide from the process (Naturvårdsverket, 2003).

Due to these potential shortcomings of methane gas, the cause of wrongly separation, the security aspect and odor, there are several inspections within all the treatment plants (Civil servant from the Swedish Environmental Protection Agency, 2013). Since these shortcomings occurs in the procedure (Civil servant from the Swedish Environmental Protection Agency, 2013), there is a need of having these inspections in order to make the process more quality efficient. Due to the inspections, new and more efficient techniques has developed in the process, which also has its focus upon decreasing potential shortcomings, such as the issue of odor (Avfall Sverige, 2013). Regarding the security aspect, it is also managed with support from different technical measures during the discharge of the waste, which also creates better work environments for the employees (Avfall Sverige, 2011).
As mentioned in the previous section, about 53 per cent of the municipalities are using the waste management system of collecting food waste to produce biogas in Sweden. Yet, the quantity of the municipalities using the process are quite few (Avfall Sverige, 2012), since the procedure is a relatively young technique so far (Avfall Sverige, 2013). Another significant factor affecting the number of municipalities that are using the process of collecting food waste to produce biogas is the economical factor. The process is an expensive procedure that requires large amounts of resources for municipalities. For example it is expensive to build and maintain the biological treatment plants (Avfall Sverige, 2013). Besides the economical aspect, the process also requires a lot of planning. The municipalities using the technique must make a variety of choices, such as collection method, where to deliver the food waste and transports etc. Planning this procedure can take up to about 5 years until it receives penetrating power within a municipality. In other words, decisions and transactions of this type of waste management system is a slow process that requires a lot of time and effort before it launches in a municipality (Civil servant from the Swedish Waste Management, 2013). Although it is a slow process, it is also required in order to make it functional. A slow progress creates trust among actors and the public. A hastily planned procedure can cause irritation among clients, especially if the process fails. Lack of trust among clients is not beneficial for the process, since it might lead to negative perceptions towards biogas, which is not a desirable outcome (Civil servant from the Swedish Waste Management, 2013). Even though there are relatively few municipalities using the technique and that it requires a lot of time and effort of establishing it in an area, the number of municipalities is increasing today. There is a possibility of making the process of collecting food waste to produce biogas mandatory for the municipalities in Sweden in the future. There is a suggestion regarding a decision of compulsory in Sweden that is under investigation today. Whether the procedure will be mandatory in the future or not, it will most likely apply to all the different sectors, such as households, restaurants, supermarkets and schools (Civil servant from the Swedish Environmental Protection Agency, 2013).

As already mentioned, there is a possibility for households to managing the operation by themself, such as making phone calls to the housing association and the municipality, if a collection of food waste has not been established within the property (Civil servant from the County Administration in Stockholm, 2013). However, to manage the operation by yourself might be a complicated task that requires a lot of effort of launching. It might be a complicated task of conducting, and it may result in individuals/households not even trying
(Civil servant from the County Administration in Stockholm, 2013). In order to increase the number of households separating their food waste from other types of garbage, there is of significance to simplify the collection methods of the waste management system. If the method and the system are simplified, more households will follow the process in the future. One example is the collection method of garbage grinders that has made it easier for households to separate their food waste. The collection method of waste grinders seems to have increased within apartments and flats today (Civil servant from the County Administration in Stockholm, 2013).

Due to the aspect that the process of collecting food waste to produce biogas is an expensive technique, the factor of profitability is of significance. Whether the process contributes to adequate biogas to fulfill the investment of money within buildings and establishments is unknown. There are also scarce studies about the process profitability, since the procedure is a relatively young technique (Avfall Sverige, 2013). However, the subject is under examination. For example there have been notifications regarding the collection method of an optic separation. Due to the issue that the food waste occasionally gets stuck into the plastic bags it may threaten the profitability, since it results in an incineration of the food waste instead. These potential drop-outs could have been used for biogas production, hence, giving a better profitability for the process (Civil servant from the Swedish Environmental Protection Agency, 2013).

4.3 A contradicted theme – The requirement of reduction

There are certain features that connect the topics, the issue of food waste and the process of collecting food waste to produce biogas, into a contradicted theme. To see the problem of food waste within a climatic perspective it is approximately ten times more efficient to reduce the waste than reuse it for biogas production. This statement is mainly based upon the assumption that biogas is seen as a substitute (Franke & Steinwig, 2011). In other words, there is a positive aspect that the process contributes to a substitute towards fossil fuel. Yet there is a conflict regarding the requirement of reduction in food waste rather than the need of biogas production out of food waste. The respondents claim that there is of most importance to reduce the food waste firsthand. The issue of food waste is a gigantic problem and a reduction of food waste is of significance, since it is a better alternative for the environment in comparison to the biological treatment of AD (Civil servant from the Swedish Environmental Protection Agency, 2013). The necessity of a reduction is also what societies are striving for today. As the case of the waste management hierarchy, the main goal is to avoid and reduce
the waste firsthand, and afterwards focus upon processes concerning recycle and reuse (Civil servant from the County Administration in Stockholm, 2013).

Another consideration is that it might be more cost efficient to reduce the food waste rather than reuse it for biogas production. Since the process of collecting food waste to produce biogas results in certain costs for the municipalities, such as expenses regarding waste management etc. (Naturvårdsverket, 2012). Nevertheless, further research about these assumptions is required. To be able to estimate what is most socioeconomically optimal for a society, there is a requirement of knowing the socioeconomically profit of reducing the food waste and convert it to the processes of the biological treatment, incineration or selling it as animal food. Later there is also a need of opposing it to the eventual socioeconomically costs for each arrangement (Naturvårdsverket, 2012).

There is a general agreement among all the respondents that the process of producing biogas out of food waste is a proper waste management system (Civil servants, 2013). The positive view is mainly based upon the requirement of an upgrade and a reduction in fossil fuel (Avfall Sverige, 2013), which in turn diminish the greenhouse gases in the atmosphere (Naturvårdsverket, 2012). In other words, the procedure is seen as an environmentally friendly technique (Avfall Sverige, 2012). Controversially, there is also a risk with the positive view about the process of collecting food waste to produce biogas. There is a possibility of causing an optimistic view among households, due to its few negative opinions. Even reports and articles are generally positive towards the process. It might be possible that individuals are encouraged to throw their food rather than reduce the food waste. Individuals may presume that it might be “okay” to throw the food, because of its recycle knowledge and utilization into biogas. Due to this reason, the perspective of the requirement of reduction might be omitted (Civil servant from the Swedish Environmental Protection Agency, 2013). Even though it is better to reuse the food waste for biogas production rather than throw it for incineration, it is of most importance to reduce the food waste firsthand (Civil servant from the Swedish Environmental Protection Agency, 2013).

However, even though a reduction is the best alternative for the environment (Civil servant from the Swedish Environmental Protection Agency, 2013), there is also a requirement of having a functional waste management system. A functional waste management is to required (Civil servant from the Swedish Waste Management, 2013), especially while reconsidering the assumption that there always will be unavoidable food waste (Naturvårdsverket, 2012).
Considering this statement, the process of producing biogas out of food waste can be seen as a necessary and a good procedure (Civil servants, 2013). Since unavoidable food waste always will exist (Naturvårdsverket, 2012), it is better to reuse the food waste rather than throw it for incineration (Civil servant from the Swedish Environmental Protection Agency, 2013). In other words, in order to create prevention, there are requirements of both reducing the food waste as well as having a functional waste management system. To be able to create a successful approach towards the issue of food waste, there is a need of adding both parts of a reduction and a functional waste management (Civil servant from the Swedish Waste Management, 2013).

4.4 Possibilities and difficulties regarding the connection

The connection between the two subjects, the issue of food waste and the process of collecting food waste to produce biogas, is related to each other in an obvious way. Food waste is a great substitute for biogas production (Avfall Sverige, 2013). Due to the reuse of the food waste, the process of producing biogas out of food waste can be seen as a great way of managing the problem of the gigantic food waste worldwide. Although the connection has a quite positive correlation (Franke & Steinwig, 2011), the impression among the interviewees is that these two topics should be observed and handled separately, since they are seen as two subjects that lie collateral with each other (Civil servants, 2013). As already mentioned, the aim of the process of collecting food waste to produce biogas was to establish a substitute towards fossil fuel and to utilize the nutrient from the food waste, rather than contribute to a reduction of food waste in areas. There is not a connection between the necessity of a reduction in food waste and the establishment of the process of collecting food waste to produce biogas. The assumption that the process might reduce the food waste in municipalities is seen as a positive contribution rather than an aim for the procedure (Civil servant from the Swedish Environmental Protection Agency, 2013). In other words, the respondents suggest that it is unknown whether the process of producing biogas out of food waste might be a possible solution for a reduction in food waste in areas (Civil servants, 2013). Even though there are suggestions that the process of producing biogas out of food waste is a great way of managing the issue of the gigantic waste worldwide (Franke & Steinwig, 2011). The respondents suggested that the subjects are not correlated to each other and that the process probably is not a potential solution for the gigantic food waste in the future. It is hard to predict if it may lead to an actual reduction of food waste in societies (Civil servants, 2013). Considering future aspects, the process is not enough to combat the
issue of food waste, especially not since the human population is increasing in numbers each year. In order to diminish the food waste, other factors are required. For example there is presumably a need of hiring people within municipalities who can maintain great knowledge about the subject and contribute to further education in schools and restaurants etc. (Civil servant from the Swedish Environmental Protection Agency, 2013). Even though the procedure may not lead to a decrease in food waste, there is a possibility that the process might result in a greater consciousness regarding the problem of food waste among individuals (Civil servant from the Traffic Agency in Stockholm, 2013).

5. The case of the municipality of Stockholm

5.1 The goals regarding waste management within the municipality

Stockholm is an active region for biogas production, where the biological treatment plants are fundamental for the manufacture. From the start, the production of biogas has mainly been performed by sewage sludge, however, substitutes for biogas production has evolved. Within the waste management system of the biological treatment of AD, substitutes such as food waste and related agricultural products is also of significance today (Sundström, 2011).

There is a development scheme that concerns the biogas production in the region of Stockholm. The scheme is called the regional development plan for Stockholm County (RUFS), which partly has its focus on the waste management in the region. Within waste management, the main goal of the scheme is to reduce the waste and reuse the waste as a resource. Food waste is seen as an important feature for this goal, since it is a great and massive resource in Stockholm. To achieve the goal, pre-separation at the source is encouraged in order to collect and reuse the food waste for biological treatment and biogas production in the region (Sundström, 2011). It also exist a proposal of a biogas strategy that the Environmental Department has established in Stockholm. There are certain factors that are central within the biogas strategy, such as briefings of different techniques regarding the collection of the food waste, to increase the collection of food waste, to find other substitutes besides food waste for biogas production, to confirm a time plan of securing the production of biogas and to create collaboration between different actors. Even though the biogas strategy is implemented on a regional level, the municipality of Stockholm, as well as the other municipalities, has its boundaries towards the municipality’s resource potential (Sundström, 2011).
In regard to the national goal of collecting at least 40 per cent of the food waste by the year of 2015, the municipality of Stockholm has the ambition of achieving it and to increase the supply of biogas in the area (Sundström, 2011). Due to this reason, the process of producing biogas out of food waste has expanded in the municipality of Stockholm today. For the process in the municipality, a goal has been established, which aims to collect at least 50 per cent of the food waste by the year of 2018. The goal previously had its focus upon the section of restaurants, however, the households are also on the agenda today. The goal is quite enormous for the municipality of Stockholm, since the collection of the food waste was about 8 per cent during the year of 2010 (Sundström, 2011) and it is approximately 9 per cent today (Civil servant from the Traffic Agency in Stockholm, 2013). Even though it might be difficult of achieve the goal, the municipality has self-confidence. The number of households, apartments and restaurants signing up for separating their food waste increases every day (Civil servant from the Traffic Agency in Stockholm, 2013).

5.2 The process of collecting food waste to produce biogas

The municipality started their collection of food waste to produce biogas in the beginning of the 90s, where the focus was to collect food waste from restaurants. The decision was made by the government in Sweden, which then became executed by the municipality. The collection from the restaurants was successful, which resulted in a development of the process with collections from households as well (Civil servant from the Traffic Agency in Stockholm, 2013). The households are of major importance for the process in the municipality of Stockholm, especially due to the scarcity of biogas and the requirement of substitutes for biogas production (Civil servant from the County Administration in Stockholm, 2013). The issue of scarcity of biogas will be further discussed in the next section of this chapter.

To separate the food waste is not mandatory in the municipality of Stockholm today. It is optional in almost entire Stockholm County to separate the food waste. The aspects of trust and respect for the individual’s right to choose is perhaps the reason why it is not mandatory for the municipality. There is a possibility that constrains will cause troubles, such as irritation. There is of avoidance to cause these sorts of troubles in the municipality (Civil servant from the County Administration in Stockholm, 2013). Instead of making the process of separating the food waste mandatory in the municipality, there is an establishment of a management control measure called subsidized rate. The subsidized rate refers to that it is a cheaper alternative to separate the food waste, rather than placing the waste into the same container for incineration. The subsidized rates are established to promote pre-separation at
the source. For example the houses in the municipality of Stockholm have a subsidized rate that is based on a fixed price per kilo wasted food (Civil servant from the Traffic Agency in Stockholm, 2013). If the houses separate their food waste, they receive a discount for their waste disposal on the basic charge for approximately 300 SEK (Stockholms Stad, 2013).

There are four main biological treatment plants, where the larger amount of the total food waste is transported. These plants are Bromma, Henriksdal, Himmerfjärden (Syvab) and Käppala. There is also a plant called Loudden, where certain flour products are transported. Out of these treatment plants, Bromma, Henriksdal and Loudden are located in the municipality of Stockholm (Sundström, 2011). Himmerfjärden, on the other hand, is located in Grödinge (Syvab). However, in addition there are two other biological treatment plants and one pre-treatment plant that are under construction today. The pre-treatment plant is located in Huddinge, and the other two treatment plants, called Skarpnäck and Högbytorp, are placed within the municipality of Upplands Bro. There are also discussions about constructing a biological treatment plant in Brista. If the decision will be implemented, this plant will be located in the municipality of Sigtuna (Sundström, 2011). The collected food waste from the municipality of Stockholm is transported to two biological treatment plants today. One of these treatment plants lies in Uppsala. The produced biogas of the treatment plant is used and remains in Uppsala. In other words, the collected food waste from the municipality of Stockholm that is transported to Uppsala for biogas production is not for Stockholm to consume. Whether it leads to an excess, there is an idea of sending the biogas back to Stockholm (Civil servant from the Traffic Agency in Stockholm, 2013). Yet, there have not been any excess in order to send biogas back to Stockholm. The reason why food waste is transported to other municipalities, such as the case of Stockholm transporting food waste to Uppsala, depends on no available pre-treatment plants and/or treatment plants in the area. In cases when there are no plants in the area, the food waste, besides the collected food waste from waste grinders, often requires transports to other municipalities where pre-treatment plants and treatment plants exist (Civil servant from the Traffic Agency in Stockholm, 2013). However, the ongoing construction of the pre-treatment plant in Huddinge will contribute to a conditioning treatment of a certain amount of the food waste in Stockholm. There are estimations that approximately 25 000 tons of the food waste collected in Stockholm will be treated within this new pre-treatment plant. Due to the long distance transports to Uppsala, it is also a better alternative for the environment to have the pre-treatment plant in the same area (Sundström, 2011). Nevertheless, the other biological treatment plant where the municipality
of Stockholm is transporting their food waste for biogas production is Himmerfjärden in Grödinge (Civil servant from the Traffic Agency in Stockholm, 2013). Even though Himmerfjärden is located in Grödinge (Syvab), the produced biogas within this treatment plant is for the municipality of Stockholm to utilize. The biogas produced in Himmerfjärden is mainly transported and used within petrol filling stations in the municipality of Stockholm (Civil servant from the Traffic Agency in Stockholm, 2013).

5.2.1 The different collection methods

The process of collecting food waste to produce biogas is quite complex in the municipality of Stockholm, since there are several collection methods to reconsider within the different sections (Civil servant from the Traffic Agency in Stockholm, 2013). Even though the collection methods are many, the diverse set of methods is also required to make it functional in the municipality. There is of consideration to have a variety of methods, due to the huge number of inhabitants living in the area, which results in dissimilar accessibilities for the different properties (Civil servant from the Traffic Agency in Stockholm, 2013). Different methods and techniques are increasing the collection of food waste. To use only one method when collecting from all the sectors is not reasonable. For example specific collection methods within certain sectors or properties may cause complications with the techniques or work environments etc. (Sundström, 2011). In other words, there is a need for several collection methods to be able to extend the process of separating the food waste in all the different consumer categories (Civil servant from the Traffic Agency in Stockholm, 2013).

For starters, the flats and houses in the municipality of Stockholm are separating their food waste (it is not mandatory) using the most common method of separation. As mentioned in chapter four, the general method is to have two separate containers. One container is for the organic waste and another for the incendiary waste. The majority of restaurants in the municipality are also using this general collection method (Civil servant from the Traffic Agency in Stockholm, 2013). Even though numerous flats in the municipality are using the general collection method of two separated containers, there are also certain flats using the method of bottom discharge containers. The method of bottom discharge containers refers to a common and a buried container (Civil servant from the Traffic Agency in Stockholm, 2013) that is mechanically evacuated with a crane lorry (Nacka kommun, 2013). However, to use regular containers is the most common collection method within the section of supermarkets (Civil servant from the Traffic Agency in Stockholm, 2013). Nevertheless, the collection from apartments in the municipality of Stockholm differs slightly from the other sections. There are
certain apartments that have the possibility of using the collection method of waste grinders, which contributes to another outcome. The food waste collected from waste grinders does not account as a collection, since the food waste goes directly to the treatment plant, which in this case is Henriksdal. The food waste collected from waste grinders and treated in the treatment plant of Henriksdal, contributes to biogas that is used within public transports in Stockholm, called Storstockholms Lokaltrafik (SL) (Civil servant from the Traffic Agency in Stockholm, 2013). However, since waste grinders are connected to sewage discharges, the method generates to less biogas production in comparison to other methods, such as collections in separated containers or within a closed tank. Yet, there is of importance to include the method of waste grinders, since it might be the only solution of a collection within certain real estates (Sundström, 2011).

There is a decision about testing the collection method of optic separation in the municipality of Stockholm today. It is called “The green bag project” (Gröna påsen) by the municipality. “The green bag project” is collaboration between the Traffic Agency in Stockholm and the housing corporations called Familjebostäder and Stockholmshem. The method of an optic separation is conducted in many municipalities in Sweden today, however, this is the first time the collection method is tested in Stockholm. The project is tested at this moment during nine months in the year of 2013, involving about 3 000 households from the areas of Östermalm, Kungsholmen, Farsta, Bagarmossen, Älvsjö, Hägersten-Liljeholmen, Södermalm and Skarpnäck. In other words, there are certain areas within the municipality of Stockholm, as well as other municipalities in Stockholm County, that are participating in the project. The selection of households is mainly apartments and flats, and the project is scheduled to finish the test period in November (Stockholm stad, 2013). The collection method of an optic separation is a relatively simple method of performing that might increase the collection of the food waste within households in the municipality (Civil servant from the Traffic Agency in Stockholm, 2013). As mentioned in chapter four, it is only a requirement to place the food waste into a green bag and throw it into the same container as other types of garbage bags. It is the biological treatment plant that makes the separation. It is also possible that the method of an optic separation might be beneficial for the municipality of Stockholm. There is often a lack of space to place different containers, which makes it difficult for households to pre-separate at the source (Stockholm stad, 2013).
5.3 The challenges with the process in the municipality

The request for biogas has increased each year, which has resulted in a lack of biogas in the region of Stockholm. The lack of biogas occurs since the demand is higher than the existed supply within the region. Due to these reasons, substitutes are of major importance for biogas production. The municipality of Stockholm has tried combating the scarcity of biogas by developing substitutes and implementing better production processes for the environment (Sundström, 2011). However, in order to increase the biogas production with the process of collecting food waste to produce biogas, there is a necessity for the municipality to focus upon the section of households as well. Yet, the priority in the municipality of Stockholm is still the collection within restaurants. There is a security to prioritize the restaurants, since they are contributing to a large amount of food waste. Due to this assumption, it is also most effective to focus on this section (Civil servant from the County Administration in Stockholm, 2013). Nevertheless, considering the requirement of substitutes for biogas production, the collection of food waste from households has increased today. It is difficult to confirm whether the scarcity of biogas has diminished or increased today, due to the lack of research about the subject (Civil servant from the County Administration in Stockholm, 2013). Although, studies are scarce, discussions concerning the scarcity of biogas seem to have decreased in general in Stockholm, which may indicate that the scarcity is not as severe as before (Civil servant from the County Administration in Stockholm, 2013). However, further studies are required to assure the present situation of the scarcity in the area (Civil servant from the County Administration in Stockholm, 2013). Controversially, there are concerns that the lack of biogas will continue to increase, since the risk of the planned constructions of the new treatment plants will be delayed. Due to the requirement of planning, it will take time for the plants to be able to start their production of biogas (Sundström, 2011). In other words, it is important to start concentrate and increase the collection of food waste from the section of households in the municipality of Stockholm (Civil servant from the County Administration, 2013).

The process of collecting food waste to produce biogas in Stockholm has been challenging in the beginning. There were consultations whether the procedure were reasonable and effective enough in comparison to the regular waste management system of incineration (Civil servant from the Swedish Environmental Protection Agency, 2013). The reason to why the process has been challenging, mostly depends on the question of profitability. It is commonly more profitable to perform the system of incineration in comparison to the biological treatment of
AD, since many incinerating plants in Stockholm are overcapacity cited in Stockholm nowadays. In other words, the plants for incineration have a possibility to obtain even more garbage bags than actually exists in the area. There have been times where the over-capacity resulted in garbage bags being imported from other areas in order to make it profitable. On top of it all, further contradictions exist that it is expensive to construct and maintain the biological treatment plants for biogas production (Civil servant from the County Administration in Stockholm, 2013). Although it might be more effective to use incineration rather than the biological treatment of AD, it also depends on what the municipality wants to achieve. The process of collecting food waste to produce biogas contributes to an upgrade in automotive fuel, which cannot be received from the waste management system of incineration. Incineration generates heat, however, not the possibility to produce biogas, which is required to be able to decrease the demand of fossil fuel in societies. Within this perspective, it might be more profitable to use the biological treatment of AD rather than incineration, since it contributes to renewable fuel which also is an environmentally friendly technique. In other words, by using the process of collecting food waste to produce biogas, it may lead to profitability in the future (Civil servant from the County Administration in Stockholm, 2013). However, to gain profitability and a stable market, there are requirements of an increased biogas production within all treatment plants in Stockholm, an expansion in constructions of more treatment plants and further developments of other substitutes for biogas production. Besides these three significant factors, there is also a need for further encouragements for biogas production rather than fossil fuel, better and functional distributions of biogas, an increase of larger petrol filling stations and a reduction of technical issues within gas stations (Sundstöm, 2011).

5.4 The functionality of the process in the municipality

Whether the process of collecting food waste to produce biogas in the municipality of Stockholm has function or not varies, since it depends upon dissimilar factors and the variation within the different consumer categories. Different municipalities have dissimilar conditions, which in turn results in variations. It partly has to do with the knowledge regarding the municipality’s capacities, which is received by gained experience (Civil servant from the Traffic Agency in Stockholm, 2013). Yet, the municipality of Stockholm has not attained that much experience, since the municipality is still within a phase of collecting the experience (Civil servant from the Traffic Agency in Stockholm, 2013). As mentioned in
chapter four, the process of collecting food waste to produce biogas is a relatively new technique and is still within a developing phase (Avfall Sverige, 2011).

Nevertheless, the functionality of the process also depends on which section is observed. Regarding the section of restaurants in the municipality of Stockholm, the collection of the food waste is quite successful. The reason why the collection functions within this section in the municipality of Stockholm is because of the high number of restaurants, and many of them separates their food waste from other types of garbage. However, it may depend on the restaurants early start and focus of separating their food waste for biogas production. As mentioned above, the main focus of the process was from the beginning on the section of restaurants in the municipality of Stockholm (Civil servant from the Traffic Agency in Stockholm, 2013). However, the collection of food waste in the section of households is not totally adequate while studying the amount of collected kilo per individual. In other words, the collection in the procedure within the section of households can be improved. The reason why the process has not been more successful within this section has partly to do with the large number of people living in the municipality (Civil servant from the Traffic Agency in Stockholm, 2013). Nevertheless, there are also contradictions towards this assumption. Since there are many people living in the municipality, it may also indicate a great deal of resources and an ability to collect additional amounts of food waste in the area (Länsstyrelsen i Stockholm, 2011). Another reason to why the section of households is not totally adequate is that the section has not been a priority from the start. Focus on the section of households in the municipality of Stockholm started ten years later, after the process was launched (Civil servant from the Traffic Agency in Stockholm, 2013).

There is existing evaluations about how much food waste the municipality of Stockholm has collected each year. There are estimations that approximately 8 500 tons of food waste were collected within the municipality during the year of 2012. Out of theses 8 500 tons, about 1 000 tons were collected from the section of households (Civil servant from the Traffic Agency in Stockholm, 2013). On the other hand, the evaluation is only a speculation made by the municipality. In order to ensure the result, further studies and statistics about the topic are required (Civil servant from the Traffic Agency in Stockholm, 2013). To add to this estimation, analyses are showing that about one quarter of the food waste was collected in Stockholm during the year of 2009. The analyses also refers to that approximately 122 000 tons of food waste was thrown for incineration in Stockholm County. These 122 000 tons of food waste corresponds to about 200 million SEK (Länsstyrelsen i Stockholm, 2011).
words, there is a necessity for Stockholm to improve the collection of food waste within the section of households (Civil servant from the Country Administration, 2013). Nevertheless, a particular requirement is to reduce the food waste in the area firsthand (Civil servant from the County Administration in Stockholm, 2013). However, the municipality knows that there is a prerequisite of improving the process within the section of households, which is also what the municipality of Stockholm is striving for today (Civil servant from the Traffic Agency in Stockholm, 2013).

5.4.1 Lacking factors affecting the process successfulness
The process of collecting food waste to produce biogas in the municipality of Stockholm could function better, especially within the section of households. However, regarding the process successfulness there are certain factors to reconsider. Stockholm is often observed as a city of royalty, since it is the capital of Sweden. Due to this assumption, procedures such as the process of collecting food waste to produce biogas are often tested in Stockholm firsthand (Civil servant from the County Administration in Stockholm, 2013). Even though processes often are tested in Stockholm first, there are certain problems that can occur during the implementation of the procedures. Problems of implementation may perhaps depend on the large number of people living in Stockholm, which also results in many individuals being involved in the processes. It is possible that it might be difficult for the residents to take part in all the different opinions from all the actors within the procedure. A potential risk is that it may fallout in conflict of interests (Civil servant from the County Administration, 2013).

Another potential factor is the issue of trust that may have affected the functionality of the process. There seems to be a positive interpretation about the process of collecting food waste to produce biogas among the public in the municipality of Stockholm. However, there might be problems of trust of knowing whether the procedure will be worthwhile at the end. There is a requirement of knowing its profitability, since processes like these often costs a lot of money and investments (Civil servant from the County Administration in Stockholm, 2013). The problem of trust may also be linked to the developed issue towards the acceptance of having and constructing the treatment plants in the areas. In other words, the process functionality might also struggle with the problem of land-use. For example there have been discussions about the planned treatment plant in Skarpnäck, where the plant has been appealed and the construction of the building is postponed (Civil servant from the County Administration in Stockholm, 2013).
6. Discussion and analysis

The first research question, about the connection between the issue of food waste and the process to produce biogas out of food waste, has notified certain disputes. The connection between the two subjects is quite clear, however, doubtful considerations about their interaction exist (Civil servants, 2013). Nevertheless, it might be understandable why there is an occurrence of a dispute, while reflecting the problem in reference to the concept of sustainable consumption (Jackson & Michaelis, 2003). As mentioned in the theoretical chapter, the concept of sustainable consumptions has a variety of definitions focusing on different approaches (Jackson & Michaelis, 2003). Complexity occurs whether the focus should be on consuming differently, consuming responsibly or consuming less within the notion of sustainable consumption (Jackson & Michaelis, 2003). The complexity about its focus might generate certain confusion on what may be the right procedure to follow, which in turn might result in a clash of interest regarding the approach.

Due to the assumptions from the respondents who advocates for the requirement of a reduction in food waste firsthand (Civil servant from the Swedish Environmental Protection Agency, 2013), it seems to be convincible that it is fundamental to focus upon consuming less (to reduce the food waste). In an environmental perspective, the best alternative is to focus upon consuming less, since it leads to a decrease of greenhouse gases in the atmosphere (Modin, 2011). As the waste management hierarchy is representing, there should be an avoidance of waste firsthand (Chandrappa & Bhusan Das, 2012). By considering the waste management hierarchy, it is possible that a striving goal is to decrease the amount of food waste in all the municipalities in Sweden. However, it seems to be problematical to have a striving goal towards avoidance of food waste. Consuming less is a complicated task, since it always will be unavoidable food waste in communities (Naturvårdsverket, 2012). Even though unavoidable food waste is a fact, there is still a necessity of reducing the amount of the unnecessary food waste in societies. National goals exist to reduce the food waste in societies (Modin, 2011), as well as uncertainties how to achieve them. Due to the uncertainty of accomplishing the goals of reduction, new and simpler processes are established, hence, consuming differently (to reuse the food waste) is considered central. In other words, it might be assumed that the focus is to consume less in societies, however, the attention seems to be shifting towards consuming differently instead, such as the process of collecting food waste to produce biogas. The shift towards processes of consuming differently occurs since it might be an easier technique of managing the issue of food waste in comparison to consuming less.
The difficulties regarding the connection between the two topics, the issue of food waste and the process of producing biogas out of food waste (Civil servants, 2013), is perhaps an effect of the goals within the biological treatment of AD. The main goal is to contribute to a substitute towards fossil fuel (Avfall Sverige, 2013). In order to produce biogas as a substitute, there is a requirement of throwing food in the garbage. The assumption can also be linked to the potential optimistic view among individuals. Due to its recycle benefits (Civil servant from the Swedish Environmental Protection Agency, 2013), it might be seen as “okay” to throw away food. In other words, the connection between the two subjects becomes problematic, since the food waste is seen as a positive resource rather than an environmental concern. Since food waste generates to renewable fuel in societies (Avfall Sverige, 2013), there might be perceptions considering that it is more beneficial to throw the food rather than trying to decrease the food waste. This perspective is perhaps what the public is corresponding to and also another reason why the focus seems to have shifted from consuming less to consuming differently. The goals of reduction in food waste might become omitted in societies. There is a possible consequence that the biological treatment of AD can be seen as a competitor towards the requirement of reduction. A requirement of throwing away food for biogas production may lead to an increase in food waste instead. However, considering its recycle benefits (Avfall Sverige, 2012) the process of collecting food waste to produce biogas is relatively a better alternative for the environment in comparison to the regular process of incineration. The potential collision between the two subjects is also particularly problematic within the process of incineration. This assumption is partly based on the example where garbage bags were imported from other areas to make it efficient in the incineration plants during certain periods (Civil servant from the Traffic Agency in Stockholm, 2013). One may assume from this example that it is more cost efficient to have larger amounts of food waste within the plants. This may result in a distressing clash between the requirement of imported garbage bags for incineration and the need of reduction in food waste. It is especially distressing since the waste will not be biologically treated and it is a superior threat on the environment. Nevertheless, there is a possibility that the process of collecting food waste to produce biogas results in an increase in consciousness (Civil servant from the Traffic Agency in Stockholm, 2013), which may lead to a realization that individuals are throwing substantial amounts of food in societies. In order to develop further sustainable processes and to combat the issue of food waste in areas, a raised consciousness is fundamental among individuals.
Regarding the second research question about the process of collecting food waste in the municipality of Stockholm to produce biogas, the municipality is striving towards great goals within their waste management. However, perhaps it might be difficult to achieve the goal of collecting at least 50 per cent of the food waste by the year of 2018. The assumption is mainly based upon the minor collection amount of approximately 9 per cent of the food waste in the municipality today (Civil servant from the Traffic Agency in Stockholm, 2013). To be able to accomplish this goal, it is a requirement that more households will sign up for separating their food waste. To increase the number of households to separate food waste, the municipality is probably obligated to try and influence the households towards a collection. Encouragement is presumably significant in order to gain an actual interest about the procedure. The municipality of Stockholm is convinced that they will achieve their goals (Civil servant from the Traffic Agency in Stockholm, 2013), however, certain pensiveness appears regarding the goal of reducing the waste. As mentioned in chapter five, the municipality of Stockholm is a part of the regional development plan for Stockholm County (RUFS), where the scheme is also focused upon a reduction in waste within Stockholm (Sundström, 2011). There seems to be a lot of focus on the waste management system of the biological treatment of AD. However, considering the scarce explanations of functional procedures and approaches concerning a reduction in food waste, the focus seems to be slightly less on the action of reduction. Due to these assumptions, there is a requirement of developing new approaches towards the goal of reducing the waste in Stockholm. Otherwise, there is a risk that the goal will not be achieved.

Depending on the observed consumer category, the process of collecting food waste to produce biogas has not been totally successful in the municipality of Stockholm. Yet, there is a requirement of improving the collection within the section of households (Civil servant from the Traffic Agency in Stockholm, 2013). There is a prerequisite of placing the issue of food waste on the agenda among the households. In order to secure the municipality’s goals of collection, there is a need to influence a separation of the food waste within households. Considering the huge number of inhabitants within the municipality of Stockholm, it is especially required to improve the collection within the section of households (Civil servant from the Traffic Agency in Stockholm, 2013). However, the necessity is also based upon the fact that the households are causing the highest amount of food waste in societies (Jensen et al., 2011). Due to the household’s major impact of food waste, there is a requirement of reducing the food waste within this sector. There is also a necessity of shifting the focus
towards this consumer category and not only prioritize the section of restaurants. The theory of the consumer choice (Lang & Heasman, 2004) might be linked to the reason why the municipality of Stockholm has not been able to establish a better collection of food waste within the section of households. It is possible that the households in the municipality of Stockholm have generated awareness of the consumer’s right to select their own food (Lang & Heasman, 2004). As long as the market and the requirement of specific food is an exciting force, it is possible that the production of food exaggerates, hence, the problem of food waste will proceed in areas.

The notion of the consumer choice can also be linked to the ethical aspect towards the issue of food waste. The ethical dilemma is mainly based upon the fact that huge amounts of unnecessary food is thrown away for incineration globally (Quested et al., 2011), at the same time as superior amount of people are starving in the world (WFP/FN:s livsmedelsprogram, 2013). Questions are raised whether it is fair that the Western world, Sweden included, overexploit the resources (Ekvall & Malmheden, 2012) and throws away food that is not consumed, at the same time as humans in other parts of the world are starving. This conjecture is perhaps a consequence of the consumer choice (Lang & Heasman, 2004). The food producers are responding to certain quality standards compiled by the consumers (Caswell & Mojduszka, 1996). Due to the consumer’s knowledge of having the power of controlling their own food patterns, it might become consequential that the Western world will continue this norm (Lang & Heasman, 2004). As long as the consumer choice continues together with the gigantic issue of food waste, the ethical aspect will particularly be confirmed. In other words, there is a huge requirement to focus upon the theory of the waste management hierarchy to reduce the food waste in societies firsthand (Chandrappa & Bhusan Das, 2012).

There are certain requirements in order to create a successful collection of food waste for biogas production in the municipality of Stockholm. The necessity of having several collection methods seems to be obtained in the municipality (Civil servant from the Traffic Agency in Stockholm, 2013). It is especially obtained after the collection method of an optic separation is finalized (Stockholm stad, 2013). However, my assumption is that there are mainly three factors causing certain complexity of the successfulness of the procedure of collecting food waste to produce biogas in the municipality of Stockholm. These are the factors of trust, simplicity and profitability. As Ulrika Franke and Caroline Steinwig (2011) are suggesting, there is a need of moving slowly and systematically during an introduction of
a new waste management system. This assumption might be linked to the potential issue of trust in the municipality within the process of collecting food waste to produce biogas (Civil servant from the County Administration in Stockholm, 2013). It is possible that actors occasionally are rushing procedures and forget the need of fitting the process and its construction with the society. The conceivable rush might result in a threat towards the acceptance of the procedure, such as potential disputes regarding the construction of treatment plants (Civil servant from the Traffic Agency in Stockholm, 2013). The concept of NIMBY (not in my back yard) may be compared to the arguments against constructions of treatment plants. NIMBY refers to a protectionist point of view, where community groups have unwelcome attitudes towards adopted developments within their society. Even though there are unwelcome attitudes towards the process, a cognizance exist about the necessity of having the development in the area (Dear, 1992). Considering the process contribution to renewable fuel (Avfall Sverige, 2011), there seems to be a positive view towards the process of collecting food waste to produce biogas in the municipality of Stockholm. However, it might raise typical land-use problems between actors and individuals, such as disputes about where to build the treatment plants for the procedure (Civil servant from the County Administration in Stockholm, 2013). It is not desirable to cause threats towards the acceptance of the procedure, since it may result in disapproval towards biogas in the end. The factor of trust is also important within the biological treatment of AD, because it reduces the risk of complications and encourages the households to separate their food waste. Ulrika Franke and Caroline Steinwig (2011) suggest that a requirement of making plans together with other collections from households will construct a successful waste management system. Trust and acceptance are possible central notions to receive anticipation from the households in the collection process.

Besides the issue of trust, the factors of simplicity and profitability (Civil servant from the County Administration in Stockholm, 2013) seem to be of significance to achieve a successful waste management system in the municipality of Stockholm. The factor of simplicity is mainly linked to the necessity of increasing the number of households to separate their food waste. To increase the number households there is a requirement of simplicity, such as having simple collection methods (Civil servant from the County Administration in Stockholm, 2013). It is preferable that the procedure is simple and introduced with precautions. Humans often have certain requirements as well as determinations, and to be compelled to separate the food waste for biogas production is not optional. As simple as possible, the municipality
needs to fit the waste management system within the private sector, without threatening the individual’s lifestyles. Otherwise there is a risk of causing disapproval towards the process among the households. The factor of profitability mainly refers to the requirement of acknowledging whether the process is worthwhile and generates certain profits (Civil servant from the County Administration in Stockholm, 2013). This assumption can be linked to the example of the challenging issue in the municipality of Stockholm as the biological treatment of AD first started. The dispute was based upon the assumption that the process of incineration is more cost efficient than the biological treatment of AD (Civil servant from the County Administration, 2013). These considerations about profitability are perhaps related to the need of acting realistic and rational. In order to investigate whether the procedure is an efficient method to conduct, there is a requirement of first testing the process in a society first. However, while adding specific factors there are different definitions of what is efficient within a procedure. For example while adding the feature of environmental damage, the biological treatment of AD is by far a more efficient method of conducting in comparison to the process of incineration.

While establishing waste management systems there are requirements to involve all the actors in the system (EEA, 2005). Although the assumption is idealistic, it might be problematic to involve everyone in the procedure of collecting food waste to produce biogas. Since there are many people living in the municipality of Stockholm, it also results in many individuals being involved in the process (Civil servant from the Traffic Agency in Stockholm, 2013). If there are too many opinions to reconsider, a typical clash of interest may follow. Even though it is important to acquire all the different opinions, it is also of significance that the government is operating their assignments to make it functional (Jackson & Michaelis, 2003). According to Tim Jackson and Laurie Michaelis (2003), the government needs to influence and act like an expert advisor within the system. The governments are required to contribute to the education and information about the behavior of the individuals and their consumption patterns etc. (Jackson & Michaelis, 2003). Knowledge and information may result in a greater interest about the issue of food waste and the waste management among the public.

Due to the debates about finding procedures that both reduces the food waste and the demand of fossil fuel (Avfall Sverige, 2010), the waste management system of producing biogas out of food waste might be a potential idea as well as a win-win solution. However, it seems to be rejected whether the process of collecting food waste to produce biogas could be beneficial towards a reduction in food waste. The procedure is a better alternative for the environment in
comparison to incineration, due to the contribution of less greenhouse gases in the atmosphere (Avfall Sverige, 2012). The food waste becomes reused (Avfall Sverige, 2012) and it is also a good way of managing the issue of food waste, rather than throwing away the food for incineration. Even though the process might be a great way of managing the problem of food waste, it is not a management to rely upon in the future. In the short-term point of view, the procedure can be seen as a potential support in an environmental perspective. However, the process will not be fundamental in a long-term perspective. This assumption is mainly based upon the potential situation within the year of 2050, where the human population most likely increases to 9 billion people (Godfray et al., 2010). Within this possible situation there will be a requirement of further food production, which most likely will result in an increase of food waste in the future. There is a possibility that the requirement of an increased food production together with the forces of the consumer choice (Lang & Heasman, 2004) will result in a circumstance of the tragedy of the commons (Hardin, 1968). In other words, further overexploitation of resources will presumably be a fact. Due to these assumptions, the process of producing biogas out of food waste is not enough to rely upon regarding the issue of food waste. As the waste management hierarchy refers to, there is also a need to reduce the food waste firsthand (Chandrappa & Bhusan Das, 2012).

To clarify, the process of producing biogas out of food waste might be a good system of managing the food waste. The assumption is mainly based upon the conjectures of the requirement of producing substitutes for automotive fuel (Avfall Sverige, 2010) and because there always will be unavoidable food waste (Naturvårdsverket, 2012). However, there is still a need of reducing the food waste in societies as well, since it also exist large amounts of unnecessary food waste (Jensen et al., 2011). To be able to reduce the food waste in societies, there is also a need for further developments within the waste management system. Otherwise food waste will probably always be a problem. There is a requirement of further studies about the issue of food waste and the process of collecting food waste to produce biogas. The necessity of research is both required in general and within the case of the municipality in Stockholm. Concerning the problem of food waste, further research is especially necessary in order to put the problem on the agenda as well as to create awareness that it is of everyone’s concern (Civil servant from the Swedish Environmental Protection Agency, 2013). Since food is essential for all life on earth, it should not be thrown away if not necessary. There is also a requirement of further studies about the process of collecting food waste to produce biogas. Yet, the process is a relatively young technique (Avfall Sverige, 2013), which perhaps
indicates that there is still information to learn about the process. For example there might be information to learn about new developments contributing to better profitability, simpler methods and less greenhouse gas emissions etc. Advanced research about the process is probably also required to increase the number of households to separate their food waste, which is also a goal for the municipality of Stockholm (Civil servant from the Traffic Agency in Stockholm, 2013). Since the process is a young technique (Avfall Sverige, 2013), it is likely that the households do not have adequate knowledge about the procedure. Due to the potential inadequate knowledge, it may have led to a lack of interest about the process among the households. Finally, there is also a huge requirement for further research about the connection between the two topics. Due to the difficulties of apprehending the connection (Civil servants, 2013) and since the studies are scarce about the connection, further research is especially required. For example there seems to be a necessity of additional studies about their interactions, possibilities and further future requirements and so forth.

After reading this master thesis, one might assume that the connection between the two subjects is a dysfunctional connection. However, the dysfunctional connection probably occurs because of the difficulty of apprehending the connection. Due to this assumption, it is quite revealing that this master thesis is relatively important, since it shows a knowledge gap regarding the linkages between the two topics. The knowledge gap advocates for a huge requirement of further research to be able to understand their interactions. It is desirable to create prevention and develop the waste management systems (Civil servant from the Swedish Waste Management, 2013). In that sense, it is essential to grasp the factors and processes interactions to one another. Otherwise it may be difficult to comprehend the issue of food waste as well as the requirements to establish sustainable developments within the process. While obtaining both a reduction in food waste and a functional waste management system, it will most likely contribute to several necessary factors. For example it can contribute to less greenhouse gas emissions, fewer ethical disputes about throwing unnecessary food, a raised awareness about food waste and the process, a secure profitability and an increased collaboration between all the different consumer categories. In other words, the connection is a complex matter, which makes it obligational of apprehending the connection. The world is a complex system, which also causes complexity in factors and developments within the systems. As a result, to understand the problems around, it is required to see the connection as an overlapped context.
7. Conclusion

There is a general agreement among the respondents that the issue of food waste is a gigantic problem and that the process of collecting food waste to produce biogas is a great waste management system. The positive view of process is mainly based upon the requirement of an upgrade and a reduction in fossil fuel and diminishing the greenhouse gases in the atmosphere. The procedure is a better alternative for the environment, rather than throwing away the food waste for incineration. There are a few shortcomings with the process, such as the choice of collection methods, pollution of methane gas and the requirement of simplicity. The positive view towards the procedure might also be problematic, since it may lead to an optimistic view among individuals. Due to the knowledge of the process recycling benefits, the procedure might encourage people to throw away the food rather than focus on reducing the food waste.

The relation is quite obvious between the issue of food waste and the process of producing biogas out of food waste. Although the connection is quite clear, the impression from the respondents is that these two subjects should be handled separately, since they lie collaterally to one another. The problem of several definitions within the concept of sustainable consumption might be linked to the difficulty of apprehending the connection. The variety of definitions between consuming less, consuming differently and consuming responsibly, may consequently result in not knowing which procedure is the right one to follow. There is a conflict between the requirement of reducing the food waste (consuming less) and the process of producing biogas out of food waste (consuming differently). However, the respondents claim that it is most important to reduce the food waste firsthand, since it is a better alternative for the environment. Even though the reduction is greater, there is still a requirement of having a functional waste management system as well. Especially while reconsidering the assumption that there always will be unavoidable food waste. To create prevention, there is a prerequisite of reducing the food waste and to have a functional waste management system.

The question whether the process of collecting food waste to produce biogas could be seen as a possible benefit towards a reduction in food waste is rejected. It is unknown whether the process would lead to a potential decrease of food waste in societies. In an environmental perspective, the procedure is a better choice for the environment in comparison to the process of incineration. The process manages the problem of food waste better, since the food waste is reused within the procedure. However, the process is not a management to rely on regarding
the issue of food waste in the future. The human population will presumably continue to escalate in numbers in the future, and it may lead to increased requirements of food production. In other words, a circumstance of the tragedy of the commons will be a fact.

The process of collecting food waste to produce biogas in the municipality of Stockholm has great goals. However, it might be difficult to achieve the main goal of collecting at least 50 per cent of the food waste by the year of 2018. The difficulty of achieving the goal has partly to do with the large number of inhabitants living in the municipality. Nevertheless, the municipality of Stockholm is convinced of achieving the goal, especially since the collection method of an optic separation is confirmed in the area. A management control measure, called subsidized rate, is established in the municipality today. It is not mandatory to separate the food waste in the municipality of Stockholm, however, the subsidized rate makes it cheaper to separate the food waste rather than throw it away for incineration. There are several collection methods in the municipality, such as the common method of having separated containers for the organic waste and the incendiary waste, waste grinders and containers. It is essential to have a diverse set of collection methods, since different techniques increase the collection. Due to the large number of people living in the municipality of Stockholm, it is especially important to have a variety of collection methods.

If the process of collecting food waste to produce biogas in the municipality of Stockholm are functioning depends on the observed consumer category. The collection of food waste is functional in the section of restaurants, however, not that fortune within households. In order for the municipality to accomplish their goals of collection, there is a requirement of increasing the collection of food waste within households. However, the municipality and the government must also influence the households to separate their food waste. In other words, the process of producing biogas out of food waste in the municipality of Stockholm could have been more successful. Especially while reconsidering the areas resource potential. Nevertheless, there seems to be three main factors causing complexity of the successfulness with the procedure in the municipality. These are the factor of simplicity, profitability and trust. The factor of simplicity mostly refers to that the process should be simple to conduct. For example, in order for the households to start separating their food waste, there is a need of having uncomplicated collection methods. The factor of profitability has mainly to do with the desire of knowing beforehand that the process is beneficial for the municipality. The factor of profitability was also the reason why the procedure was challenged in Stockholm in at first. The challenge was based upon the contradictions whether the procedure was effective
enough in comparison to the process of incineration. Controversially, the process of collecting food waste to produce biogas contributes to an upgrade in automotive fuel, which may be seen as a better investment for the environment in the future. Finally, the factor of trust might have complicated the functionality of the procedure, since there are many people involved in the process and it may cause clashes of interests. However, the factor of trust might also be linked to the certain rush of introducing new waste management systems, such as the construction of treatment plants. A potential rush might in the end result in a threat towards the acceptance of the process.

Due to ethical reasons the respondents were kept anonymous in this master thesis. There is a possibility of clash of interests, since the connection between the issue of food waste and the process of producing biogas out of food waste is a relatively contradicted theme. To avoid social harm for the respondents, the interviewees were kept anonymous. The respondents were also able to read their parts of the result chapters afterwards. Since the interviews were translated from Swedish to English, there is a possibility that the answers might turn out a bit skewed. It is possible that the answers from the respondents did not turn out as precise in the thesis. Out of ethical reasons the respondents were able to read their parts of my thesis before the submission, in order to avoid any confusion or difficulties for the interviewees at their workplace.

To finalize, it is most important to reduce the food waste in the societies, and later on focus upon a functional waste management system. To be able to reduce the food waste in societies, further improvements are required. Even though there are goals towards a reduction of food waste, the goals seems to be shifting. There seems to be a shift from consuming less to consuming differently, hence, the process of producing biogas out of food waste is central. In other words, there are requirements of further improvements in the work of reducing the food waste and the situation within the waste management. The connection between the subjects of food waste and the process of collecting food waste to produce biogas might be seen as a dysfunctional connection. However, the dysfunctional connection is probably a result of not apprehending their relation. Due to the difficulties of apprehending the connection between the two subjects, further research is obligated to comprehend their relation. Although there is a knowledge gap about their interaction today, this master thesis reveals the significance of studying the subject’s correlation to each other. This master thesis may be seen as an original study, since there are scarce researches about the connection. For those reasons, further research is essential in the future. To be able to reduce the food waste and to establish a
functional waste management system, there is a requirement of connecting the topics into one complex matter, to understand and improve future sustainable developments in societies.
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