Abstract

The waste incineration business is facing a rapid development in forms of expansion of new and existing plants. To fully understand the issues facing such a growth the historical development until today has been accounted for. This historical review is followed by a description of the current situation.

The future development of the availability of waste incineration plants is analysed and strategic issues for this expansion are outlined.

Distance to other waste incineration plants is the most important factor to take into account when planning new ones. Lack of such distance might result in a price-cutting competition and thereby cause severe financial problems.

This report concludes that the threat of political change in governmental environment policies might prove devastating for the expansion and is a clear threat. The extent of the planned expansion is due to this and to other reasons considered dangerous, from a financial perspective. There are other factors speaking for a more moderate expansion.

Key words: waste incineration plants, waste incineration industry, strategic analysis, power plants, power industry

Sammanfattning

Sopförbränningsbranschen står idag inför en kraftig expansion av nya förbränningsverk. För att till fullo förstå de problem och frågor som en sådan expansion står inför måste först den historiska utvecklingen utforskas. Denna historiska tillbakablick följs av en beskrivning av dagens situation.

Den framtida utvecklingen av tillgängligheten av sopförbränningsverk analyseras och strategiska frågor som denna expansion ställs inför analyseras.

Avlägsenhet till andra sopförbränningsverk är den enskilt viktigaste faktorn att ta med i beräkningarna när nya sopförbränningsverk planeras. Brist på sådan avlägsenhet kan resultera i priskrig mellan verk och således också kraftiga finansiella problem

Denna rapport kommer fram till att politiska förändringar är ett tydligt hot mot expansionen av sopförbränningsverk. Graden av den planerade expansionen kan på grund av detta och andra skäl ses som farlig ur ett finansiellt perspektiv. Det finns vidare andra faktorer som också talar för att en mer moderat expansion skulle vara lämpligare.

Preface

This thesis has certainly been a learning experience, not only about the waste incineration business as such, but also in general strategic issues that any business could face.

The thesis was written in collaboration with Nordea Bank in Stockholm who has provided me with a great deal of support, not only when participating for interviews, but also when providing me with valuable feedback. Especially my tutor at Nordea Bank, Niclas Lemne has been very supportive in this position. Also Daniel Källenfors at Nordea Bank has been of great assistance. For this I am very grateful.

At Lund Institute of Technology I have been in frequent contact with Pernilla Olausson at the Department of Heat and Power Engineering. Her expertise in the area and valuable feedback has been very helpful.

Lastly I would like to thank my tutor at Lund University, Ingela Elofsson at the Department of Industrial Management and Logistics, Lund Institute of Technology. Her dedicated commitment and support for this thesis has been very valuable not only to the project as such, but also to me in my work.

Stockholm, May 2004

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Table of Contents

1 Introduction

This introductory chapter deals with several fundamental parts of an academic report. The chapter begins with a short background and continues with a problem discussion. Thereafter follows the purpose of the report, a discussion of the scope and an identification of the target group. The chapter ends with a brief explanation how the report is structured.

1.1 Background

The waste incineration business is today at perhaps its most interesting point in history. New laws have come into force, and more will follow within the next year. This has created an increase in market demand by about 100% - a demand that has to be met over the next very few years. This thesis will explain what key factors are to be considered, how the market looks today and how the market will develop within the next few years.

1.1.1 What is a Waste Incineration Plant?

The major difference between waste incineration with energy recovery and other power plants is its fuel. Instead of very expensive fuel such as nuclear rods, oil or coal, these plants use waste as fuel. The waste can be household waste or industrial waste.

1.1.2 Why are Waste Incineration Plants Interesting?

There are a few key aspects to why waste incineration plants are interesting. The first one is the pricing of waste. The second question is the legal and political aspect of how waste must be handled.

The pricing of waste is very different from all other fuels to power plants. The reason being that the price of waste is actually negative – the plant receives money for taking care of the waste, which of course is a very attractive feature.

Although the Swedish government is, like in many other countries, aiming towards more recycling, it is definitely working against further deposit of waste. Instead, what is not recyclable is better to incinerate in order to gain energy from the waste and to minimize the physical space the waste that needs to be deposited will occupy (Nilsson, A., 2003). With the steadily increasing amount of household waste deposited by the population, we would be facing very high costs in the future if this is not taken care of in a proper manner (Söderberg, 2004-02-12).

1.2 Problem Discussion

While the thesis was initiated by the author, the problem was formulated in collaboration with the tutor of the thesis and other interested parties at Nordea. Nordea began by describing the problem they faced. Nordea believes the market of waste incineration plants will boom within the next few years and they want to become an actor in financing this development. To succeed in that ambition they need to thoroughly understand the market. What will happen? Who will the actors be? What are the driving forces behind this development?

Nordea first became interested in the waste incineration business only a few years ago. They noticed that more and more companies started to ask them questions in areas of co-financing and to borrow money with waste incineration plants as securities. This resulted in an internal PM that was written last year about the subject, where it was realized that the issue is of great influence to many of the bank's customers.
Nordea concluded that waste incineration is a rapidly expanding market, much because of the more and more restrictive legislation in waste depositing. Today, the necessary incineration capacity to meet the new legislation simply does not exist. Nordea has estimated a possible short-term market expansion of about 20 new plants, each averaging about 200 MSEK in costs. While far from all of these will be available for co-investments by the private business-life, probably enough of them will be, to make the market highly interesting for the bank.

To fully understand their incentive to this thesis several interviews with employees of the company were held. The questions have been attached in Appendix A: Interview Form.

To be able to achieve a comprehensive outcome, the author has divided the questions to be answered by this thesis into several sub-problems.

1.3 Purpose

First, to appreciate why the extension of waste incineration plants looks like it does today understanding of the historical development is vital. This historical review also accounts for very recent change in laws that have become the major driving forces for the development of the waste incineration market.

Secondly, the current situation of waste incineration plants in Sweden is discussed. This discussion is carried out as a present time analysis along two dimensions, being the geographical dimension and identification of owners.

The third and final part covers the future development of waste incineration plants. This expansion is being understood using PESTEL (see chapter 2.3.3) and later strategic issues from this study are extracted using a SWOT analysis (see chapters 2.3.4 and 6).

1.4 Scope

This thesis primarily covers the Swedish market. The thesis covers most of the waste being incinerated, with the exclusion of industries incinerating their own industrial waste. This waste is excluded due to lack of statistics and data in the area. This part of the industrial waste being incinerated should however be a very small portion of the total amount of waste generated each year (Profu, 2003).

The thesis is furthermore limited to Swedish waste and trading of waste across the national and county borders has to a large extent not been taken into account.

Some of the waste produced in Sweden goes to recycling rather than incineration. This waste is also excluded from the study as the focus of the study is on waste incineration.

1.4.1 Historical Review

For the historical review of the environmental policy this thesis is limited to the progress in Sweden and is primarily looking at the period from 1980 until today. The reason for this limitation in time is the lack of political awareness in this area before 1980. To completely understand the course of events in the Swedish environmental policy, global events and events in the European Union also must be taken into consideration and have therefore been reviewed.

This historical review covers not only waste incineration specific issues, but also some general ones. One should however be aware of that this review was written with focus on waste incineration and might therefore tend to be incomplete when applying it to other areas.

1.4.2 Current Situation of Waste Incineration Plants in Sweden

The mapping of waste incineration plants has been made with the data available when the thesis was written. This mapping is limited to present time and along two dimensions: geographical and owner-structure. In the geographical dimension plants already decided or planned to be constructed are included, for completeness.

The owners mentioned are based on historical data and could therefore be different in the future.

1.4.3 Analysis of the Waste Incineration Expansion

The expansion of the waste incineration industry was primarily analysed with the waste policies in mind. This report is furthermore limited to waste incineration rather than competing ways of treating waste. The reason for this is that waste incineration is the most economically beneficial technique in the short run.

The only environmental effect considered in the report is the greenhouse-effect, as it is the politically highest prioritized environmental issue and that is also where the most money is to save or gain.

1.4.4 Identification of Strategic Issues in the Waste Incineration Expansion

The choice of PESTEL (see chapter 2.3.3) as a model might limit which strategic issues are identified and prioritized in the outlook on the future.

1.5 Target Group

This thesis has two target groups. The first group is employees at Nordea who wants to expand their knowledge in the area. The new knowledge will be used in numerous departments of the organization, ranging from the Energy Group, a group formed to understand energy related issues, to customer understanding both in project financing and in the retail division of the bank, at offices with customers in the waste incineration business. Furthermore, this understanding Nordea hopes to use to expand the project financing in the area.

The second target group is students who are interested in either the policies or the strategic aspects surrounding waste incineration plants. Hopefully this thesis will serve as a source of inspiration for further research in the area.

1.6 Structure of the Report

Chapter 1 covers the background leading to the writing of the thesis as well as problem discussions. The purpose of the report as well as the scope is also included in the mentioned chapter.

Chapter 2 is used to outline the data collection process and the criticism concerned.

Chapter 3 covers the historical development of governmental energy policy related to the waste incineration industry. This is being done by first covering the historical development of waste incineration in Sweden followed by the historical development of the power supply in Sweden. Hereafter follows a description on electrical certificates used in Sweden. After these parts have been covered, the general global development is analysed and applied to Swedish circumstances. Lastly, a more focused perspective is taken on waste incineration and its development. Here the very important development of the Swedish legislation is discussed.

Chapter 4 includes a description of the current and planned waste incineration plants in Sweden today. Owners of the plants are also accounted for.

Chapter 5 provides an understanding of the expansion of the waste incineration plants. This is being done using the PESTEL framework.

Chapter 6 takes a strategic stance to analyse the waste incineration expansion in the form of a SWOT analysis.

Chapter 7 includes the author's conclusions and suggests areas for future research.

Chapter 8 includes references, both to primary and secondary sources.

Appendices consist of the tables used in the thesis as well as an interview form used in the writing of the thesis.

2 Methodology

2.1 Introduction

This chapter presents the methodology used in order to create an understanding of the nature of the thesis. The chapter covers areas such as methodological approach, theoretical frame of reference, the methodology used in practice, a collection of primary and secondary data and finally criticism of the covered sources.

2.2 Methodological Approach

One of the most important choices to make when writing a research report is to decide whether a qualitative or quantitative approach should be taken. It should furthermore be decided whether the research should be based on a few cases of deeper studies or if a wider range or more general case studies should be used. These choices are discussed in this chapter.

2.2.1 Quantitative or Qualitative Approach

Quantitative research is often based on numbers rather than words. The results are often analyzed using statistical methods. Results are presented as quantifiable units. Quantitative research has a tendency to be described with analysis and is often used in large-scale studies (Denscombe, M., 2000).

Qualitative research is often based on words rather than numbers. The research is thus associated with descriptions rather than analyses. While the data will most likely not be useful for statistical models it is rather used to describe something. One of the major advantages with qualitative research is that it can often be done with much fewer simplifications than quantitative research. This is especially important when doing research which future investments should be based upon. Qualitative research has furthermore a tendency to be associated with small-scale studies. Quantitative research can be pure information gathering and by that have a value in itself (Denscombe, M., 2000).

From the descriptions above and considering the very purpose of the thesis, a qualitative approach was considered more suitable. The main reason for this choice was the very investigative nature of the purpose, considering both the mapping of the waste incineration plants and the identification of actors.

2.2.2 Objectivity

Objectivity can be seen as relative neutrality to the question. If prejudices exist, openness about those is necessary to sustain objectivity (Denscombe, M., 2000).

The author did not have a previous experience with waste incineration plants or other forms of power plants or any other related subjects before the writing of the thesis. The author has also tried to give a fair picture of the waste incineration market, rather than a subjective one.

While subjectivity would exist if the author would try to wrongly please Nordea with interesting findings, the author does not consider that to be the case, but rather that he has given an objective view of the findings.

With these remarks, objectivity of the author and in the thesis should be established, and the thesis can therefore be considered written from an inductive point of view.

2.2.3 Reliability

The criterion of reliability in the context of qualitative research is whether the same results would be concluded if the research was to be conducted by someone else. If that is the case, reliability is said to be established (Denscombe, M., 2000).

As this thesis is based on qualitative research and thus partly relies on priorities set by the author, absolute reliability should not be expected. However, this thesis is still much based on information gathering – information that is consistent no matter who gathers it. Therefore the thesis should be considered fairly reliable.

2.2.4 Validity

Validity means that the analysis actually measures what is relevant for the study (Internet: Flensburg, Per).

This thesis is much based on information gathering and as such, large amounts of different data from different sources have been studied. The different data sets studied has been highly supportive of each other. This is natural as much of the data comes from official sources and should therefore not be biased. While some of the data has been up to the author's interpretation, much has been possible to verify from other sources, either via publications or through interviews.

The validity is furthermore increased by several interviews with employees at Nordea to fully understand the purpose of the thesis.

The author thus claims the validity of the thesis to be established.

2.3 Theoretical Frame of Reference

This chapter describes the methodologies or tools used to clarify the often complex relationships and problems each of the part of the thesis is facing.

2.3.1 Historical Review

For the historical review, two approaches for a structure have been taken. The first approach is to see how waste incineration plants and the general power supply have developed in Sweden.

The second approach is to study the environmental issues on a global level, represented by the United Nations, and from there, via the European Union, continue the studies at a domestic level. Both the United Nations and The European Union are highly influential on Swedish policies and laws, why they have been chosen.

2.3.2 Current Situation of Waste Incineration Plants in Sweden

The situation of the waste incineration industry at present time was conducted along two dimensions; geographical and owners of the plants. This study results in a table listing all current and planned plants and their respective owners, which were possible to identify.

2.3.3 Analysis of the Waste Incineration Expansion

For the study of the waste incineration industry's expansion, the structure has been based on the PESTEL-framework. The framework helps in understanding macro-environmental drivers for an organization. This is being done by thoroughly analyzing aspects according for the following criteria (Johnson, G., Scholes, K., 2002):

- Political criteria
- Economical criteria
- Socio-cultural criteria
- Technological criteria
- Environmental criteria
- Legal criteria

2.3.4 Identification of Strategic Issues in the Waste Incineration Expansion

The outcome of the PESTEL framework was scrutinized using a SWOT analysis. This analysis was conducted to understand the strategic issues of the expected expansion of the waste incineration plants. A SWOT analysis is a tool to assess the strengths, weaknesses, opportunities and threats facing a business. The strengths and weaknesses focus on micro-environmental aspects, while the opportunities and threats focus on macro-environmental aspects. The tool aims to focus the strategic audit on the most critical issues (Kotler, P., et al, 1996). A SWOT analysis was accordingly applied on the expansion of waste incineration to thoroughly understand the most critical issues facing the expansion.

2.4 Methodology in Practice

Once the scope and purpose of the thesis were complete and approved, the search for literature began. The study started off very well thanks to Pernilla Olausson at the Department of Heat and Power Engineering with Lund Institute of Technology who provided the author with many good suggestions for literature to study.

After a thorough study of this material, extensive searches on the internet on specific topics were conducted. Some websites representing significant Swedish organizations in the area were also visited. After completing the studies of written material, interviews with experts were held, both to gather information and to secure the validity in the already gathered and distilled information.

2.5 Data Collection

For the author to gather as much knowledge in the area of the thesis as possible, both primary and secondary data has been used as sources of information. Primary sources of information can be defined as collection of new data. In this thesis this was done by conducting interviews. Secondary sources are sources of information already collected for other purposes. This can typically include technical literature and documents.

2.5.1 Primary Sources

Primary data for the thesis was primarily collected from interviews. Interviews were held in two different contexts.

First, several interviews with employees at Nordea were held to verify and to fully understand what they were interested to know. These interviews were held on-site, using face-to-face interviews. The interviewees had received the questions (see Appendix A: Interview Form) well in advance to be able to prepare. The advantage with holding several interviews was that the very core of the purpose could be identified. When conducting several interviews as was done here, diversified views were expressed and personal wishes could be identified to find the purpose that would benefit Nordea as a company the most. The result of these interviews later formed the purpose of the thesis.

Secondly, interviews were held with industry experts to both gather data and to verify findings. This also included one visit to SYSAV in Malmö as well as participation at a seminar held by representatives from Baker & McKenzie in Stockholm. The interviewees were chosen based on their exclusive expertise in their respective area. The author's tutor Ingela Elofsson also provided valuable input on whom to contact.

A full list of primary data sources can be found in chapter 8.1.

2.5.2 Secondary Sources

Most of the data for the thesis were collected from secondary sources of information. The use of secondary sources provides several benefits. Secondary data often provides a wider perspective to the issue at hand, something that can be helpful to gain new perspectives on the topic studied. Moreover, secondary data such as literature or documentation does not change with time and is therefore possible to re-examine at a later point in time.

The choice of which secondary sources to study was partly based on information from industry experts, such as Pernilla Olausson and other interviewed experts (see chapter 2.5.1 for information about the interviews).

To complete this base of information, certain vital references in the books already studied were used. This enabled the author to get a wider perspective on which issues were relevant for further studies.

The collection of information was completed by extensive search for information on the internet, much from official governmental sources.

A full list of secondary sources can be found in chapters 8.2 and 8.3.

2.6 Sources Criticism

When using sources, primary or secondary, the information might be biased or even wrong at times. It is therefore important to keep a critical attitude to the information at hand.

This thesis was written by a single author who both conducted the data gathering, the analyzing of the data as well as drew the conclusions. The result might therefore be coloured by personal interpretations from the author. The author has tried to minimize this effect by being aware of the issue from the very beginning of the thesis and has thereby tried to keep an open mind during the entire thesis project.

2.6.1 Primary Sources

Primary data collection in general and interviews in particular might be subject to data-quality issues. There are two main issues at hand, first is the risk of bias and secondly is the risk concerning data reliability.

Bias might be present both from the interviewer, who would like to see information supporting his or her theories, and from the interviewee, wanting to wrongly please the author by giving him or her information supporting his or her hypothesis.

Reliability occurs in the form that data gathered from different interviews might result in different answers and data.

In this thesis the author has actively worked deliberately to minimize both the mentioned issues above. This has been done by conducting several interviews regarding the same issue and in those searching for the smallest common denominator. Where only one interviewee has been available the author has tried to verify the information gathered from another primary or secondary source.

The interviews have furthermore been held in a neutral and open manner, in order not to steer the interviewees into specific tracks.

The impression of the author is that the interviewees have given reliable, credible and comprehensible data and answers.

2.6.2 Secondary Sources

Secondary data has, by definition, been put together for a specific purpose that does not match the purpose of this thesis. As such, it might be biased toward a purpose other than the one of this thesis. It might therefore be harder for the author of this thesis to identify the bias.

The secondary data often contains conclusions hard to verify due to the summarized form of the underlying data. The material has furthermore been interpreted by the author of this thesis, often due to that the underlying data is presented in a summarized form. This implies that the data might have been subject to bias by the author.

The author has been aware of the problems described during the entire thesis project and has therefore minimized the effect of the issues by taking a distant approach to the literature. Information gathered has often been verified by several authors to establish its authenticity.

Much of the information used in the thesis is moreover gathered from official governmental organs and should therefore not be subject to bias or to reliability issues. The data in the material should therefore be considered more reliable than it otherwise might be.

3 Historical Development of the Energy Policy in Sweden

3.1 Introduction

The main driving force of the rather sudden interest in waste incineration in Sweden is the recent prohibit against landfill waste. Electrical certificates (comparable to Green Certificates, more commonly used internationally) will also play a certain role in the future development of waste incineration. Emission trading will not play a direct role in waste incineration but is one of the major steps of the international and national energy policy as of lately. Both these areas will consequently be discussed in this chapter.

To understand not only the current energy policies in Sweden, but also to predict the future development of the policies, understanding the historical development in the area is important. The development of the Swedish energy policy is clarified, also with respect to the development on a global base and on what the effect is from the European Union.

First, focused historical review of the waste incineration in Sweden is discussed. This is followed by the historical development of the power supply in Sweden. Hereafter a discussion on the global development, the development in the European Union and in Sweden follows. While much of these later chapters do not have a direct impact on waste incineration, they are still important to understand the historical development as of today, and what might be expected in the future.

3.2 Historical Development of Waste Incineration in Sweden

3.2.1 Introduction

Waste incineration has seen a rapid increase since 1994, with a total expansion of 47% until 2001. This development is now expected to increase even further thanks to new laws. This development is illustrated in Figure 1.

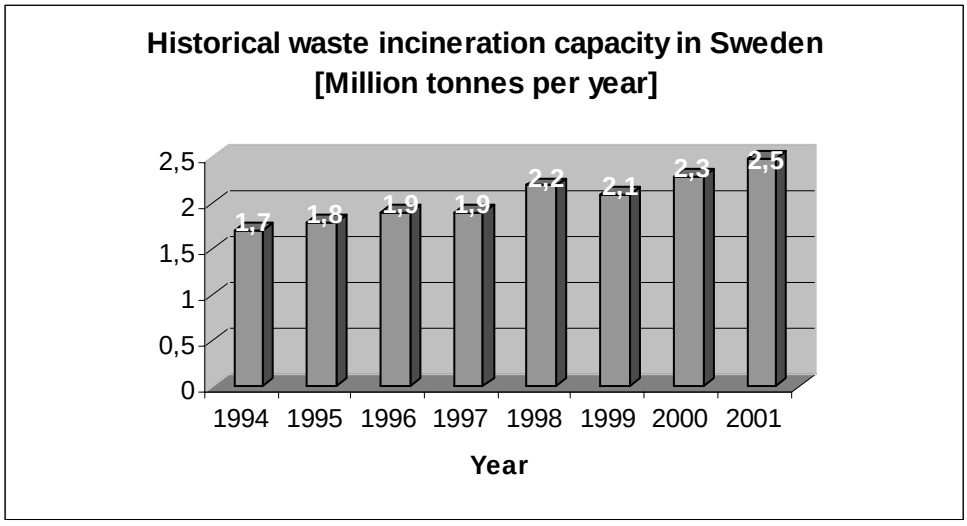

Figure 1: Historical waste incineration capacity in Sweden (Profu, 2003)

3.2.2 Political Policies

During the 1990s the environmental responsibility for produced articles has been shifted over to the producers themselves. This led to heavily increased recycling. During the same period the earlier monopoly-based municipal waste handling has been opened for competition. This has happened in parallel with increased technological demands on the entire chain of waste treatment.

3.2.3 Technological Progress

The technological progress of waste incineration has been constant and the technology is very well tested. The discharge of hazardous material has been steadily decreasing since the introduction of waste incineration plants.

3.2.4 Landfill Waste Policies

Due to environmental reasons the Swedish government is now actively trying to reduce the amount of waste generated. This is being done both by pushing the producers to produce articles generating less waste and by expanding the scope of recyclable articles.

The government looks upon waste as a hierarchy where it is preferred that it is not produced in the first time. If it is produced however, there is an uncertainty whether it is best to incinerate it (and thereby gain energy) or to recycle it. What is agreed upon is nevertheless that deposition of waste being the worst possible choice. Due to this fact the government tries to limit this landfill waste by introducing taxes, as penalties. This hierarchy has its heritage in the European Union (Nilsson, A., 2003).

To prevent waste production in the first place, and landfill waste in the second, the government has over the years introduced several penalties. A few of these are worth mentioning here. In 2000 a waste tax was introduced. This was followed by a producer responsibility of electrical products from July 1, 2001. The most important step for waste incineration was however taken by the prohibition of depositing sorted waste that instead can be incinerated, in 2002. This will be followed by possibly an even more important step with the prohibition of organic waste deposition from January 1, 2005. This law has already been decided on and it would therefore take an active step not to let the law become active (Nilsson, A., 2003). The work on landfill waste taxes was initiated in the European Union (Naturvårdsverket II, 2003).

Historically the amount of waste going to landfills has decreased by 33% from 1994 to 2001. This number is expected to decrease further with the new laws being implemented.

The historical development is illustrated in Figure 2.

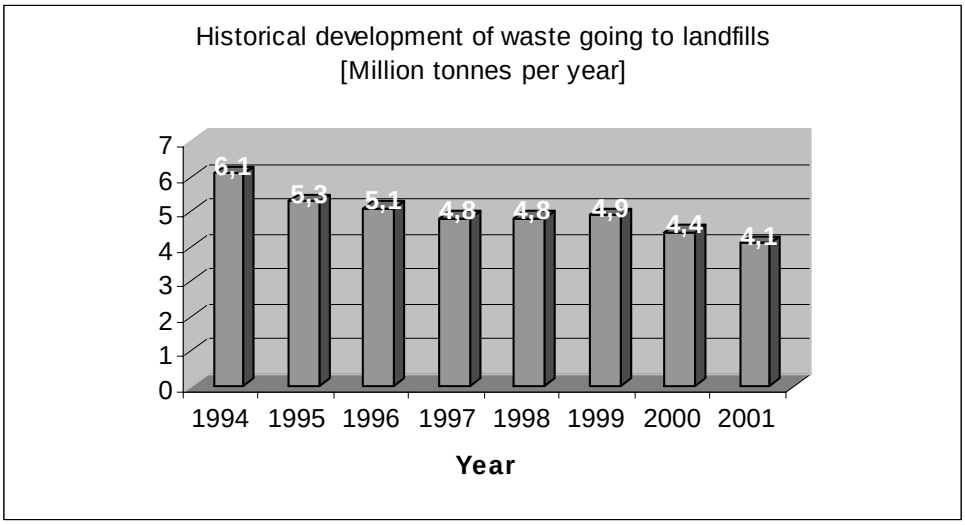

Figure 2: Historical development of waste going to landfills (Profu, 2003)

The mentioned taxes are all executing as means of control in the same direction, to reduce waste and to give an incentive to manufacture articles in a more environmentally friendly manner (Resare, R., Ingelson, M., 2002). The quantitative goal with the taxes, together with other incentives, is to cut the amount of deposited waste by another almost 50% in around 2010 (Naturvårdsverket, 2001).

The 2000 tax on waste was initially set to 250 SEK per tonne waste that was deposited or stored for a period of more than three years. The idea with the tax was to increase the incentive to treat waste in an environmentally better way. This tax has since its start been raised twice and is currently at 370 SEK per tonne. There are currently no plans to raise it further.

In the 2002 law regarding waste deposit probation an exception was introduced for areas lacking enough incineration capabilities. These exceptions are approved for one year at a time (Nilsson, A., 2003). They are however already diminishing with the expansions of new waste incineration plants. Naturvårdsverket estimates that these exceptions will no longer, or scarcely, be necessary from 2005-2006. It is moreover considered to remove this option of exceptions entirely in a few years time (Naturvårdsverket II, 2003).

These discussed taxes are the main reasons behind the recent development in waste incineration. One might however argue that this prohibit is an outcome of the global awareness of the waste problem.

3.3 Historical Development of the Power Supply in Sweden

Historically there have been a few very big producers of energy in Sweden. While the produced electricity has been easy to sell, selling the district heating has been harder. This is much due to the lack of necessary physical networks in many areas of the country. Instead of focusing on supplying the households, the producers of district heating often sell to major industries with very long-term contract due to the costly initial investments. That said, the district heating networks in Sweden are considerable, especially compared on an international level (Olausson, P., 2003).

The electricity production in Sweden is today dominated by hydro power and nuclear power. Due to geographical constraints, the hydro power governs the northern part of the country. There has however been a high demand for power in the more densely populated southern part of the country, which in the 1970s led to the introduction and expansion of nuclear power (Olausson, P., 2003).

In 2001 the first step towards a nuclear phase-out was taken with the decommissioning of one of the two reactors at the Barsebäck power plants, in the very southern part of the country, and the second reactor is projected to shut down earliest by 2004. There is still a surplus of electricity produced in Sweden, but only in the northern part, and there is no transmission capacity to distribute this equally across the country. Due to this reason, the southern part of the country might be in the situation of lacking capacity of self produced power in the next few years and would then have to import foreign produced power instead (Olausson, P. et al., 2003).

3.4 Electrical Certificates in Sweden

Electrical certificates were introduced in Sweden in May 2003 (Olausson, 2003). They consist of a market based system to promote renewable energy sources for electricity production. It gives producers of such electricity an opportunity to receive money by generating so called Electrical certificates (comparable to international green certificates). The producers thereby gain an extra income on top of the electricity they can sell (Näringsdepartementet, 2003). An electrical certificate is created upon production of 1MW electricity.

To create a demand for electrical certificates, it will become obligatory for end-customers to buy a certain amount of certificates in relation to the total electricity consumption. This level is, in Sweden, set by the parliament. The market is thus upheld by governmental regulations (Näringsdepartementet, 2003). During the first year of these certificates (2003) 7.4% of the total production had to be covered with such certificates, to increase to 16.9% in 2010 (Internet: Svensk Energi). The renewable energy sources entitled to generation of green certificates are wind power, solar power, geothermic power, small scale hydro power, wave energy and bio-fuelled power. Existing large-scale hydro plants are on the other hand not included (Olausson et al., 2003).

The electrical certificates are, from an economical point of view highly effective, if the administration costs can be kept low (Nicholson, W., 2002).

In Sweden the administration surrounding the electrical certificates is handled by Svenska kraftnät and by STEM[1]. Svenska kraftnät is also responsible for continuous publication of the current prices. The administrative costs will probably be high in the beginning but eventually fall (Näringsdepartementet, 2003).

The long term target for the Swedish environmental politics is to remove as many of the related taxes and deductions as possible and to rather extend the implementation of electrical certificates (Andersson, N. et al., 2001).

[1] Staten Energimyndighet, the Swedish governmental energy organ.

3.5 Environmental Policy Development on a Global Level

The first global climate conference was held in 1979, where researchers discussed how climate changes will affect humanity. Here a first declaration was signed to encourage confidence in climate changes possibly affecting humanity in a harming way. Researchers became more and more aware of the problem during the 1980s and the 1990s, and several more conferences were held (FlexMex2-utredningen, 2003).

In 1988 the Intergovernmental Panel on Climate Change, IPCC, was founded, and they issued their first climate evaluation report in 1990. This report discussed both the problems and possible solutions and was given great significance, both for the development of the global policy on environmental problems and for the awareness of the general public. Furthermore, IPCC convinced the United Nations' general council that a global agreement was necessary. The first step towards such an agreement was taken at the world top meeting in Rio de Janeiro, Brazil in 1992. In this agreement all industrial countries agreed to take measures to limit pollutions of greenhouse gases. The countries also agreed to report on the development and the progress of pollution limitations to the United Nations (Statens energimyndighet, 2002).

In Berlin, Germany, 1995 it was concluded that the steps taken in Rio de Janeiro were not enough and that a legally binding treaty was needed (Statens energimyndighet, 2002). The first legally binding treaty[2], the Kyoto Protocol, was signed in 1997 in Kyoto, Japan (FlexMex2-utredningen, 2003). The Kyoto Protocol was signed by 84 states, of which Sweden was one. The reason for a global treaty is the fact that emissions distributes globally[3], so abatement in one country will benefit all other countries, and vice versa. The goal of the Kyoto Protocol is that it aims to limit the amount of discharge, especially focusing on carbon dioxide but also including five other greenhouse gases (Statens energimyndighet, 2002). This leaves room for alternate, environmentally friendly, power plants to grow, while the environmentally non-friendly supply is capped (Intergovernmental Panel on Climate Change, 2000).

According to the Protocol the states are committed to decrease the amount of emissions with 5% as an average of between the years 2008 – 2012, compared to the level of 1990. The European Union has furthermore the intention to decrease the emissions with 8%. In practice, this will require an estimated reduction of 14% compared to business-as-usual forecasts (IEA Coal Research, 2001). The Protocol has only been agreed upon until 2012, where after the future remains uncertain, but will most likely follow in the same track as the current protocol (Intergovernmental Panel on Climate Change, 1999).

After the agreement in Kyoto further developments have been made, both in Haag, Bonn and Marrakech. These are however minor refinements of the Kyoto Protocol and the initial aims of the Kyoto Protocol still hold (FlexMex2-utredningen, 2003). The negotiations in Haag, Bonn and Marrakech have mostly centred on the flexible mechanisms of the Kyoto Protocol (Statens energimyndighet, 2002).

[2] It became legally binding after the Marrakesh Accords in 2001. (Statens energimyndighet, 2002)

[3] In 1980 17% of the fall-out of SO_2 in Sweden was domestic. In 1988 that number was down to 7% (Statens energimyndiget, 2002)

3.5.1 Flexible Mechanisms of the Kyoto Protocol

To render more cost-effective solutions possible three so called flexible mechanisms are included in the Kyoto Protocol. The first mechanism is the trading of emission rights (each such right is called an "Assigned Amount Unit", but often called allowance).

Since the nuclear power in Sweden is being phased out, it is most probable that Sweden has to import allowances from other countries to meet the domestically set limit of a 4% decrease of pollution compared to the domestic pollution level of 1990 (Olausson et al., 2003).

The two other flexible mechanisms are project based and called Joint Implementation (JI) and Clean Development Mechanism (CDM).

The trading with allowances is in the Protocol only mentioned as trading between countries, but each and every country will be given the opportunity to delegate this trading to juridical persons, for instance corporations. Without this trading development of new power infrastructure would per definition be impossible (Jansson, K. et al., 2003). This trading will however create the necessary flexibility and freedom to find cost-efficient solutions. It can be proven that these certificates, rather than a tax, will create a cost-minimizing distribution of the emissions, at least if the overhead cost for handling the trading is low (Nicholson, W., 2002). Very small actors will probably be exempt from the system as the management costs for them otherwise would be out of proportion (Näringsdepartementet, 2001).

This trading is much more regulated in the Protocol than what is discussed here, but that is out of the scope of this report.

The idea with Joint Implementation is that a country should be able to invest in a project for emission cut-down in another country (which also signed the Kyoto Protocol) and get that abatement accredited for in their home country. This should be possible both for nations and corporations to do. The other system, CDM, is very similar but with the difference that the countries where the investments take place have not signed the Kyoto Protocol. This mechanism is therefore primarily aimed towards developing countries. The World Bank is leading a project for trading of these emissions (IEA Coal Research, 2001).

3.6 Environmental Policy Development in the European Union

In the year 2000 the European Climate Change Programme, ECCP, was founded. The program aims to identify the most efficient and cost-effective solutions that can be taken within the European Union, to undertake the commitment from the Kyoto Protocol, possibly by implementation of the flexible mechanisms (FlexMex2-utredningen, 2003). In June 2001 the ECCP published a report where the opportunity for a joint system for trading with allowances within the union was discussed (Jansson, K. et al., 2003). The environmental policy of the European Union is clearly influenced and guided by the global protocols, such as the Kyoto Protocol and its successors.

One step taken lately by the union is the prohibition of waste deposition. The importance of this is comprehensively discussed in chapter 3.2.4.

3.7 Environmental Policy Development in Sweden

Sweden has actively limited its pollution of greenhouse gases since late 1980s. In 1987 a resolution over the environmental policy for the 1990s was taken. This ruling especially focused on the pollution of carbon dioxide and it was decided that the carbon dioxide pollution was not to increase over the level of the year 1988. Further resolutions were accepted in 1991 and in 1993 to limit the pollution of carbon dioxide. It was decided that the pollution level in 2000 was not to exceed the level in 1990, and would after the year 2000 be decreased further. These decisions were taken in alignment with the United Nations' climate convention. In the 1993 resolution it was stressed that the climate policy should be shaped with an international perspective in mind. One of the key aspects of this was to make sure that Sweden's costs for its environmental efforts was not much higher than other countries for its industries to stay competitive. Tradable pollution rights were mentioned as one way to generate cost effective solutions, but it was also concluded that such a solution would be far ahead (FlexMex2-utredningen, 2003).

In 1997 a new resolution was ratified. This mentioned that the Swedish pollution of carbon dioxide should be limited as far as possible with respect to competitive power, employment and welfare. The resolution also mentioned that the Swedish pollution strategy should be shaped in the light of measures taken by other countries, to again help the Swedish industry to stay competitive (FlexMex2-utredningen, 2003).

The next major resolution was ratified in 2002. This resolution concluded a very ambitious goal, in which the Swedish pollution of greenhouse gases is to decrease by 4% over the period 2008 to 2012, compared to the pollution level in 1990 (FlexMex2-utredningen, 2003). This can be considered especially ambitious as the agreement in the European Union allows Sweden to actually raise its emissions by 4% over the period 2008 – 2012 (Jansson, K. et al., 2003). This might however be a very hard goal to meet, considering the planned decommissions of nuclear reactors in Sweden (Olausson, 2003).

3.8 Conclusion

From this historical review it can be seen that the United Nation and the European Union have played significant roles in the development of local policies in Sweden. One of the main reasons for this is that greenhouse pollution affects the world on a global scale – pollution in Europe also affects Asia and vice versa. This is why it is important to collaborate globally on the matter of pollution control.

Sweden has always been on the front edge of pollution control and with the current political climate in the country that seems unlikely to change. However, the combination of pollution decrease together with nuclear plant shutdowns seems like a very hard task to fulfil if Swedish industries are to stay competitive on an international level.

It should again be stressed that the major reason behind the recent interest in waste incineration is not thanks to any of the many treaties signed, but rather due to the recent landfill waste taxes. Electrical certificates will help to add to the attraction of waste incineration plants, but will play a minor role compared to the landfill prohibit. The level of contribution from electrical certificates remains unclear as it is still unknown to which level waste incineration plants will be able to receive such certificates.

4 Current Situation of Waste Incineration Plants in Sweden

4.1 Introduction

In this chapter the current situation of waste incineration plants is covered, with special emphasis on the geographical locations of the plants as well as identification of the owners of the plants. An identification of new plants already planned to be constructed is also conducted. The chapter starts with an overview, continues with a mapping of the locations of the waste incineration plants in Sweden, goes on with identification of the actors and ends with a conclusion.

4.2 Overview of current situation

In 2002 there were 24 plants incinerating a total of 2.7 million tonnes of waste per year. This capacity is however far from enough with lots of waste still going to the landfills. The demand for further capacity will increase even more with the 2005 law regarding prohibition of depositing organic waste. There are however plans to construct another 24 plants within the next few years[4] to double the total capacity. This is a project that will result in 5.4 million tonnes of waste being incinerated each year. 1.6 million of the above mentioned expansion have been decided, while the other 1.1 million tonnes are still in the planning stage[5] (Naturvårdsverket II, 2003). This development is furthermore illustrated in Figure 3.

[4] Estimated completions of the plants are in 2006-2010, while most of the plants will be completed already in 2004-2006. (Profu, 2003)

[5] The first 1.6 million tonnes worth of plants are estimated to be completed in 2005-2006. (Naturvårdsverket II, 2003)

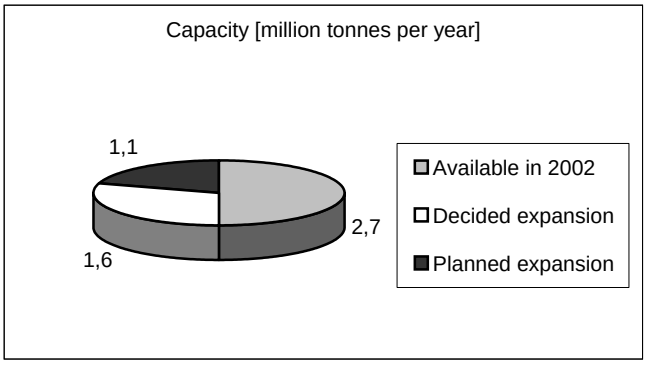

Figure 3: Waste incineration capacity development

4.3 Mapping of Waste Incineration Plants Locations

Mapping of waste incineration plants in Sweden has many interests. The reason it is done here is to find out where there are enough plants and where more might be needed. Therefore it is not enough to map the actual plants, but also the demand for further waste incineration plants must be mapped.

Profu[6] (Profu, 2003) has made a detailed mapping of the incineration plants in Sweden today and how the expansion plans look for the next few years. A copy of this mapping is provided in Table 2 and in Table 4, both available in the appendix**.**

It should be further noted that anyone of these plants might be close to the border of another county and therefore importing waste from neighbouring counties.

4.4 Owner Structures of Waste Incineration Plants

The prime owners and administrators of waste incineration plants incinerating household waste in Sweden are the municipalities themselves (although the plants are often owned through fully owned companies).

[6] Profu is a Swedish consultant agency frequently hired by the Swedish government and international organs for environmental investigations.

In Table 1 in the appendix, a list, which should be fairly comprehensive, of waste incineration plants for household waste in Sweden is given. From this table it is possible to conclude that out of the 26 plants identified, 20.5 (79%) are directly or indirectly owned by one or more municipalities, while only 5.5 (21%) are owned by other companies. These other companies are Fortum, Sydkraft EcoPlus AB and Vattenfall Värme AB. The ownership structures of the plants are furthermore illustrated in Figure 4.

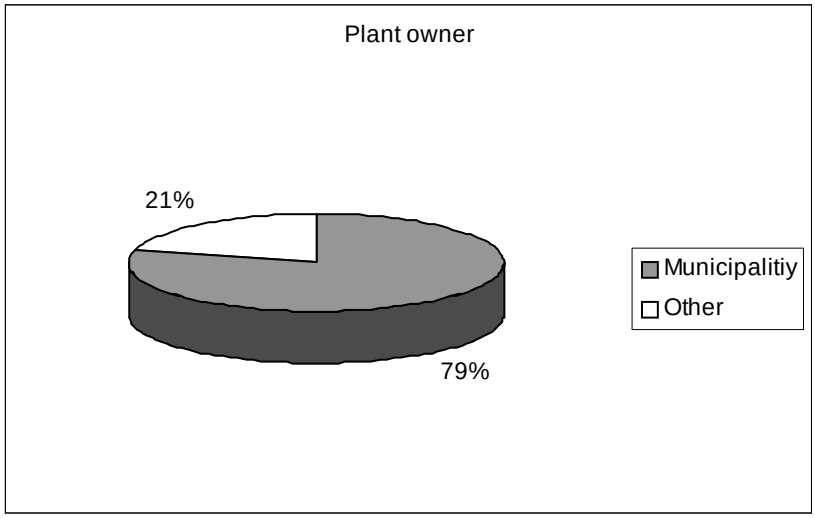

Figure 4: Waste incineration plant ownership

4.5 Conclusion

This chapter identifies current waste incineration plants as well as those planned to be built. The chapter also identifies the owners of the plants. This information is digested in the appendix.

5 Analysis of the Waste Incineration Expansion

5.1 Introduction

To understand the driving forces behind the probable and planned expansion of the waste incineration industry the PESTEL framework (see chapter 2.3.3) was applied. This framework goes through the political, economical, socio-cultural, technological, environmental and legal aspects and identifies the driving forces of each and every one of these. The chapter ends with a conclusion.

5.2 Political Aspects

The main drivers behind the current expansion of waste incineration plants are the new prohibitions regarding landfill waste. These are discussed in detail in chapter 3.2.4.

The political aspects are however not only positive for the waste incineration industry. Politicians might also, on a more local level, become obstacles in the expansion of waste incineration plants due to reasons mentioned in chapter 5.4. This is by Naturvårdsverket considered to be one of the potential threats to the planned speed of expansion (Naturvårdsverket II, 2003).

While much of the current energy in the waste business is focused on expansion, the government's long term plans are more focused on recycling rather than waste incineration (Nilsson, A., 2003). This could lead to a scenario where there is a heavy expansion of waste incineration plants in the short term, but where they become redundant in the longer term. If the speed of recycling development is higher than the waste generation increment rate, this policy may possibly constitute a serious threat to the many waste incineration plants that are planned to be built. This is an especially important issue, considering the long pay-back time profitability plans of power plants often are based upon.

To steer the focus toward recycling rather than incineration, taxes on incinerated waste are being discussed. An investigation has already discussed the pros and cons with such a tax at different levels. The investigation concluded that such a tax would not be suitable right now due to a lack of foundation for the tax. Instead the investigation suggested further analysis to be done before such a tax would be put into place. They did however not exclude the possibility of a tax on waste incineration, which could be a potential threat to the waste incineration business (Nilsson, A., 2003).

5.3 Economical Aspects

As for the income of waste incineration plants, about 2/3 of their income comes from the waste they incinerate. The remaining 1/3 is from the electricity or heat sold by the plants (Johansson, 2004-03-12).

The future for waste incineration plant financiers and manufacturers is indeed prosperous. Calculating with an average investment cost of 200 MSEK for a plant, the 24 planned plants will add up to a total cost of 4.8 billion SEK.

Most of the plants to be built will be significantly smaller than the existing ones, which might affect their profitability. See Table 4, in the appendix for exact sizes of the planned plants.

5.4 Socio-cultural Aspects

While waste incineration plants seem to be a necessity, many municipalities oppose them. The main reason for this is that the plants should be closely located to landfills, and landfills are often both big and smell badly. The reason the plants should be closely located to the landfills is that they cannot incinerate everything and the remains have to be deposited on the landfills, which should then be conveniently located for economical reasons.

Moving these incineration plants away from the urban areas might sound attractive, but that involves other problems. To be economically efficient, the plants need to be connected to a district heating network, which often is exclusively located in the cities. See chapter 5.5 for further discussion. The district heating networks are however under expansion (Profu, 2003). The landfills are moreover often located near the cities for reasons of convenience.

The balance of these factors needs to be taken into account when deciding locations for future plants.

Threats to the speed of expansion of waste incineration plants are besides the political aspects mentioned in chapter 5.2, also a potential lack of suppliers of furnaces as well as a lack of qualified personnel (Naturvårdsverket II, 2003).

5.5 Technological Aspects

The effectiveness of waste incineration plants have increased rapidly in the past. Today they are considered fairly efficient and can be made environmentally safe, causing very small amounts of pollution. Another advantage with the waste incineration technique is that it has been extensively tested over the years and therefore is highly reliable.

What also distinguishes the waste incineration facilities in Sweden is that they mostly produce Heat rather than Electricity[7], due to the fairly extensive network for district heating quite uniquely available in Sweden, and also due to the higher efficiency in the mentioned process (Hagelin, 2004-03-08). Therefore the waste incineration plants should be located conveniently to be connected to district heating networks (Johansson, 2004-03-12).

[7] In 2002 the total Heat production from Waste incineration was around 8 TWh and the electricity production was 0.6 TWh.

5.6 Environmental Aspects

Profu has conducted a detailed research regarding the future need of incineration capacity (Profu, 2003). They concluded that, with an increase of waste generation of 2% per year[8], this planned expansion will result in a slight overcapacity of about 0.3 million tonnes. This number has been calculated using the exemptions approved for landfill waste. There is however a major risk of uncertainty with this calculation, that the tax for land filling of waste will increase the amount of recycled waste. This would instead decrease the amount of waste to be incinerated and an even higher overcapacity of waste incineration plants would be a fact. A major recycling capacity is however unlikely to develop within the foreseeable future. The development of the population also needs to be taken into account.

Another factor to take into account in the development of new plants is whether the district heating networks are dimensioned for the expansion. If this is not the case, a suboptimal incineration process will take place, and financial losses will occur. This might not only happen due to competing waste incineration plants, but also because those other forms of heat production that also might assist in producing this overcapacity (Naturvårdsverket II, 2003).

The amount of energy produced in these waste plants are rather insignificant from a national point of view – in late 2002, waste incineration plants represented only 1.4% (8.6TWh) of the total energy production (around 600TWh) in Sweden (Internet: Svenska Renhållningsverks-föreningen).

Furthermore, the waste in Sweden is located at numerous smaller landfills[9], which might, due to transportation costs of waste, make it more probable that the development of new plants will be focused on several smaller power plants, rather than fewer bigger ones, even though the fixed initiation costs would be higher in the first case.

[8] This number is in line with the increased consumption in society. The number is based on historical development only and is therefore uncertain. The historical data is however accurate in both a near-term and in a long-term perspective. Profu estimates this number to be in the lower range, and an increase of 3% per year would not be surprising.

[9] In 2002, the 20 biggest received over half the waste, while the 75 smallest sites received no more than 2 percent of the waste. (Internet: Svenska Renhållningsverksföreningen)

With the planned expansion Profu expects an overcapacity to occur in Östergötland and in Mälardalen, while there might be a lack of capacity in Skåne and in Västra Götalands län. This calculation assumes however that no waste is being transported across the county borders (Naturvårdsverket II, 2003). While this assumption seems natural to make, it might result in devastating consequences as transportation of waste across county borders is very common due to the high initial cost of building a plant. The transportation sector is likely to be included in the Kyoto Protocol in the period following 2012 (Olausson, Pernilla). If that is the case, transports will become more expensive. The reception area of the plants might thereafter become smaller due to the above mentioned reason.

5.7 Legal Aspects

The legal aspects are very important for the future development of waste incineration plants. The plans for the future are fairly certain until 2005, but more uncertain after that. It is however likely that the future legal aspects will continue on the same track as it has been on in the past. The legal aspects of waste incineration are comprehensively mapped in chapter 3.2.4.

5.8 Conclusion

While there are several driving forces contributing to the expansion of the waste incineration industry, the legal forces are by far the strongest. The laws already decided contribute greatly to the income of new plants. This occurs by forcing the creation of a trading market for waste to be incinerated.

The development of the market is based on political decisions and might therefore change. The analysis should thus be considered an estimation rather than a fact. As political decisions are the main drivers behind the rapid expansions, the expansion would definitely suffer a major setback if the planned laws are changed before they become active.

The strategic values of these driving forces are analyzed in chapter 6, using a SWOT analysis.

6 Identification of Strategic Issues in the Waste Incineration Expansion

6.1 Introduction

The expansion of waste incineration plants appears to be a fact. During the thesis the author has found several advantages with such an expansion, but also some disadvantages. These will be exposed in this chapter using a SWOT-Analysis (see chapter 2.3.4). This analysis is divided into four parts. The first two consist of micro-environmental issues and the later two consist of macro-environmental issues:

- Strengths
- Weaknesses
- Opportunities
- Threats

6.2 SWOT Analysis

6.2.1 Strengths

There are a few major strengths to the waste incineration business, and surely the motive behind the rapid expansion is based on these.

The major driving force behind the expansion are the rather recent laws prohibiting landfill waste. These laws are further supported by the European Union which even more verifies their strength and stability.

Another important issue why waste incineration plants have gained such popularity is their negative pricing of waste – that the plants actually receive money for accepting the waste, compared to other power plants which have important costs for their fuel.

The waste incineration technique is furthermore extensively tested over a long period of time and is therefore very reliable.

6.2.2 Weaknesses

While the strengths of waste incineration plants sound impressive, they also have some major drawbacks. These will be discussed in this chapter.

Waste incineration plants are extremely expensive, with costs being calculated in 100s of millions SEK. These costs might not seem very high compared to other power plants, but waste incineration plants produce much less energy than most other plants. They are therefore highly dependant on the income from the waste they incinerate.

These plants are often physically very big and demand nearness to landfills as much of the waste they receive is not possible to incinerate and must therefore be landfilled. If the distance between the plant and the landfill is significant, the plant will suffer high transportation costs. While it in many cases would be suitable to place the incineration plants close to already existing landfills, this might not be feasible due to many other reasons.

Waste is being incinerated at surprisingly low temperatures. At such temperatures it is much more efficient to produce heat rather than electricity. To sell this heat the plants need to be connected to a district heating network. Sweden has a major advantage over many other countries with many distributed networks of district heating. These are however often located in cities and therefore the plants must also be located close to the cities. This is a drawback considering their need of nearness to landfills, which are big and might smell badly.

Regarding the income profile of waste incineration plants, a vast majority comes from the waste they are supplied (at a negative price). This means that if the price of waste falls, this will rapidly affect the income of the plants as well.

Profu (2003) mentions three other weaknesses to the speed of expansion, rather than to the business as such. These weaknesses are:

- Lack of skilled personnel
- Lack of capacity of suppliers to the incineration plants
- Underestimation of planning time for constructing the plants

6.2.3 Opportunities

The main opportunity for waste incineration plants is if they can expand their scope of waste being incinerated. The reason this is their only opportunity is that their price of heat or electricity is to a large extent set by the market. This mentioned expansion can either be domestic or international. For it to work domestically the prices have to be low enough for long transportation to be beneficial. For this expansion to work internationally, the laws and tax regulations of the receiving country has to be adapted to such a situation.

There is still much uncertainty how electrical certificates will affect waste incineration plants. The effect will most likely be positive, but it remains unclear to which degree. Current waste incineration plants will state their return of income for the Swedish tax authorities. From that point a discussion and a negotiation with the tax authorities will follow on how much benefit they will earn in forms of electrical certificates.

Another opportunity is if the scope can be expanded of waste that must be incinerated. One possibility is if sludge would be included in the landfill prohibits, which already is the case in Denmark. This could increase the size of the market by another 1.3 million tonnes per year. Another option for an expanded scope would be if more industrial waste was to be incinerated (Profu, 2003).

6.2.4 Threats

On the macro level, there are several potential threats to the waste incineration business. These will be analyzed herein.

The waste incineration plants often produce heat rather than electricity. To sell this heat they need to be connected to a district heating network or an industry. These district heating networks are far from global, but are often rather restricted to a limited area, such as to a city. Waste incineration plants are far from the only heat producing plants benefiting from selling heat. The outage from these networks are however limited. If there are too many producers of heat competing over this limited outage prices will drop and the plants might eventually have to get rid of the excess heat and thereby loose money, rather than to sell it via the district heating network. This is a clear threat to waste incineration plants, but is even more serious to other plants, which often gain a larger portion of their income from the heat, where waste incineration plants make most of their money from receiving waste. Instead of being connected to a district heating network there is the possibility of producing heat for a specific industry, which might be especially attractive if the industry and the waste incineration plant share the same owner. The demand for nearness to waste still holds, however.

Investors should also take into account the ownership of the district heating and how these owners might use their power. It has already occurred in Sweden that one owner of a district heating network refused another plant to enter the network as the owner prefers its own plant produce the heat to be sold.

Another potential threat is that the political policies when it comes to waste seem to shift over towards recycling rather than incineration. This might make waste incineration less profitable, perhaps due to new taxes that already are being discussed, while making recycling more profitable. In the long run, this might also decrease the amount of waste available for incineration and thereby severely cap the potential income of the plants. The current expansions of plants have been based on a calculation with increased recycling of 2% per year. A slight increase of this recycling would not affect waste incineration plants in a significant manner (Profu, 2003).

The current expansion of plants is based on a calculation where the amount of waste generated is to increase by 2% per year. While this number has been historically true, there is no guarantee that this number will continue to be valid. This number might be an especially dangerous estimation if the political plans start shifting towards recycling.

While an increased international trading of waste might be an opportunity if the Swedish politicians make the necessary changes of the laws it might also be a threat if they choose not to. Then it might become more profitable to export the waste produced in Sweden to other countries, which again would cap the potential income for the plants.

While one can expect two competing waste incineration plants not to be placed right next to each other, as the municipalities often are the main drivers behind the plants, this threat from competing plants still exists. If another plant accepts waste cheaply enough to transport the waste there, and still suffer lower costs, this will most likely be the choice for many actors on the market. If a plant cannot incinerate waste at a high enough speed sub optimality in the incineration will occur, and the plant will encounter higher costs for the produced energy (Söderberg, 2004-02-12).

Biological treatment of waste is another method to take care of waste. This method is gaining popularity and is rapidly expanding. The business of biological treatment is however fairly small, and even though it might double within the next few years it is still not expected to take a very large piece of the market share, but rather remain at a smaller one (Profu, 2003).

7 Concluding Remarks

This chapter concludes the report with some final remarks and the author's own conclusions. The contribution from this report and final reflections are also outlined. The chapter ends with suggestions of areas for future research.

7.1 Conclusion

A rapid expansion in Sweden of waste incineration plants is a fact. New laws are forcing an immediate expansion, where the existing capacity cannot answer to the demands of the law of 2002, and very much less to the law coming into force in 2005. The capacity in 2002 of 2.7 million tonnes being incinerated each year is expected to rise to about 5.4 million tonnes over the next few years.

This planned expansion will with existing calculation result in investments of about 4.8 billion SEK over only a few years of time, and thus make a very interesting market for many actors.

The historical review shows that the new laws concerning landfill of waste coming from the European Union is a natural step, as the Swedish legislation and policies many times before have been based on laws from the European Union.

Today, the major players in the waste incineration market are the municipalities. They are however accompanied to a smaller degree by a few private or state-owned actors, such as Fortum, Sydkraft EcoPlus AB and Vattenfall Värme AB. According to the author, one of the major reasons for this owner-structure might be the strong connection between waste collection and waste incineration.

The feasible areas in which new plants might be built are rather limited, as several factors should be taking into account when making such planning. These factors include nearness to landfills and district heating networks or industries as well as distance to cities. Capacities of the district heating networks, or the industry if connected to such, are also of major importance. Moreover, many cities oppose these plants as they are big and their nearness to landfills might make them smelly and ugly and thus a less attractive element of the scenery.

A vast majority of the income for the waste incineration plants comes from the waste they incinerate. This means that an overcapacity in an area might be devastating for a plant if the overcapacity results in a price-cutting competition between the plants.

The major threat to the current expansion of waste incineration plants is if the political focus towards more incineration only is a short-term focus, and the long term focus is on more recycling as the primary measure and incineration only as secondary. Today, even taxes on incineration are being discussed. This might severely cap the profitability of waste incineration plants and might therefore halt the expansion, and cause financial problems for the already built plants.

To end this conclusion, the author is concerned primarily with the combination of political threats of changing focus toward recycling and the planned overcapacity. This might result in a scenario with a heavy competition among the plants for the waste, coming down to price-cuts together with less waste being available for incineration due to recycling. As the plants are highly dependant upon the income they receive from the waste combined with very long pay-back times these factors make investments in waste incineration plants risky. A lack of waste for the plants to incinerate will also end up causing other financial issues with lower efficiency in the incineration, generating less electricity or heat than would otherwise be the case. If financiers are properly compensated for these risks, waste incineration plants as investments might still be attractive. This will however only work if the risk is low enough to be considered investment risk. If the risk is higher and becomes classified as a mezzanine risk, many banks will be excluded and financing for the plants will be much harder to achieve due to the small market for such financing.

The new laws coming into force do make the market of waste incineration more attractive as they create a forced market for waste. It is also highly unlikely that enough recycling capacity could be built in the foreseeable future, making this threat only practical in a more distant future[10]. The fuel for these plants, the waste, having a negative price is of course also a highly attractive feature. Considering the above mentioned facts, the author suggests for future investments to consider the lack of nearness to other plants (current or planned) a key issue, at which higher profitability should be expected. This will at least avoid price-cuts due to competition, while the recycling policy of course remains uncertain.

7.2 Contribution

This chapter describes the contribution from the author to the topic of waste incineration as such. The contribution is divided into a theoretical part and a practical part.

7.2.1 Theoretical Contribution

The theoretical contribution can be derived from the applications of PESTEL and from the SWOT frameworks.

The most important theoretical contribution from the eyes of the author is that general strategic frameworks, such as the PESTEL and the SWOT models, have been applied to the waste incineration industry. These frameworks are old and well tested in many other applications. The authenticity of their findings should therefore be considered stronger than if newer, less thoroughly tested, frameworks had been used.

7.2.2 Practical Contribution

The practical contributions that the author hopes Nordea to benefit from are the PESTEL and SWOT frameworks and their findings on which areas to concentrate on. Hopefully these findings will serve as strategic guidelines for future investments in the waste incineration industry.

This thesis contributes with an understanding of the waste incineration business as an entity. The thesis has outlined how the market looks today, why it looks like it does and how it is expected to develop.

[10] Considering that pay-back times of waste incineration plants often are 15-20 years, recycling capacity might still become a credible threat within that period of time.

The major strategic challenges and prospects for the planned expansion of the industry are also discussed. From these facts some conclusions have been drawn of key areas to focus on for new plants in general and for financial investors of such in particular.

7.3 Reflections

The author has found the area of waste incineration as a research area highly interesting. The business is indeed accurate and will in a very short period of time face a rapid expansion of 100%, or more impressive of an estimated 4.8 billion SEK. This sets high demands for accurate strategic and financial estimations.

The waste incineration industry will over the next few years face several strategic challenges, with changing laws and a likely political change of focus toward recycling rather than incineration.

Certainly, this thesis has been a learning experience. This learning experience can be divided into two fields. The first part is the specific field of waste incineration and the challenges facing that industry, both today and tomorrow. The second part accounts for the more general strategic issues any industry might face. Many of the strategic issues learnt from this thesis can certainly be extrapolated into other areas as well.

Introductory in the report the purpose was established, this was to understand the historical development of the industry, to identify the major actors of the industry and to understand the future development of the industry. These areas have all been thoroughly covered in the thesis and the purpose has thus been fulfilled from the standpoint of the author.

7.4 Future Research

The author's research has raised a number of interesting questions, but as they do not directly correspond to the problem description of this thesis they are instead suggested as areas for further research.

Nordea would surely benefit from further research in these areas as that should allow the bank to make even more qualified investments in the waste incineration industry, and allow the bank for an even better understanding of the industry.

7.4.1 Optimal Location of Plants

There are several issues that need to be addressed in the decision of exact location of waste incineration plants, such as nearness to cities, landfills and district heating networks. Another issue is the distance from where the waste is collected – often in the cities. Economy of scale is another issue that has to be taken into account.

To thoroughly address this topic the researcher would have to both be concerned with socio-cultural issues and optimization issues, to find optimal placement given the questions above.

7.4.2 International Trading of Waste

To fully understand how the future of international waste trading will look, one would have to thoroughly address the laws of each respective country in question. Historically waste has been imported to Sweden all the way from Canada (Söderberg, 2004-02-12). A thorough mapping of two issues would be necessary to understand the future of international trading of waste. Firstly, to identify which countries obey to laws which force waste incineration to take place. Secondly and which laws, taxes and fines each of these countries follows. It would also be interesting to see if there are countries to which Sweden could export its waste. That would make a serious threat to the current expansion of waste incineration plants.

7.4.3 Maximization of Prices

Today there are great differences in price between the waste incineration plants for accepting waste. If a pricing model for waste could be derived, one could calculate how big these differences can be before the customer chooses another plant for its waste. This would be a valuable addition to further optimize the location of new plants (see also chapter 7.4.1).

7.4.4 Securitization of Waste

While there are transparent markets for oil and for energy, no such market is available for waste. There are however some hard issues to be solved before a securitization of waste can be realized. The most complex issue would probably be to generalize waste in a proper manner. This could for example be done by energy content in the waste, and there give an acceptable, wide range.

If a market for waste could be implemented it would create major advantages to the entire business. Long-term contracts could be signed with a much smaller marginal than is used today. In the long run such a market might even make it directly profitable for households to sort their waste, as sorted waste most likely would be cheaper to sell to the incineration plants.

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Appendices

Appendix A: Interview Form

The following questions were asked to several employees at Nordea. The aim of the questions was to clarify the purpose of the thesis and why the topic was initiated by Nordea. As the interviews were held in Swedish, the questions are also quoted in Swedish.

- Varför har Nordea initierat detta examensarbete?
- Vad är Nordeas bakomliggande syfte?
- Hur är denna information tänkt att användas?
- Vilka kommersiella möjligheter finns, och varför uppkommer dessa just nu?

Appendix B: Tables

Owner	Plant
Fortum	Källhagsverket i Avesta
Bodens Energi AB*	Värmeverket i Boden
Bollnäs Kommun*	Säverstaverket i Bollnäs
Borlänge Energi AB*	Backelundsverket i Borlänge
Eksjö Energiverk AB*	Eksjö Energiverk
Renova*	Sävenäsverket i Göteborg
Halmstad Renhållnings AB*	Kristinehedsverket i Halmstad
Karlskoga Kraftvärmeverk AB*	Karlskoga Kraftvärmeverk
Karlstads Energi AB*	Hedenverket i Karlstad
Kiruna Värmeverk AB*	Kiruna Värmeverk
VMR AB	Norsaverket i Köping
Landskrona Kommun*	Hetvattencentralen i Landskrona
Lidköpings Värmeverk AB*	Lidköpings Värmeverk
Tekniska Verken i Linköping AB*	Gärstadverket i Linköping
Ljungby Energi AB*	Ljungsjöverket i Ljungby
Sysav AB*	Malmö Avfallsvärmeverk
Sydkraft EcoPlus AB	Värmeverket i Mora
Norrköpings Kommun/Sydkraft EcoPlus AB**	Häradsudden
Fortum	Högdalenverket i Stockholm
Sundsvall Energi AB*	Korstaverket - Sundsvall
Söderenergi AB*	Igelstaverket i Södertelje
Umeå Energi AB*	Ålidhemsanläggningen i Umeå
Umeå Energi AB*	Dåvamyran i Umeå
Vattenfall Värme AB	Avfallsförbränningen Uppsala
Vattenfall Värme AB	Bollmora Värmeverk
Västerviks Värmeverk AB*	Stegeholmsverket i Västervik

Table 1: Waste incineration plants in Sweden incinerating household waste

In Table 1 a list of the majority of waste incineration plants incinerating household waste in Sweden is given. The owners marked by a star (*) indicate ownership directly or indirectly by one or more municipalities. (Internet: Svenska Renhållningsverksföreningen)

** This plant is jointly owned by the municipality and by Sydkraft EcoPlus AB

Municipality	Capacity in 2002	Capacity in 2008	Date*	Decision**
Avesta	40 000	50 000	2003	Yes
Boden	26 400	48 000	2003	Yes
Bollnäs	40 000	40 000		
Borlänge	40 000	40 000		
Eksjö	25 000	40 000	2007	
Göteborg	430 000	550 000	2007	
Halmstad	72 160	170 000	2003, 2004	Yes
Haninge	10 600	0	2006	
Karlskoga	45 000	100 000	2003, 2007	Yes
Karlstad	50 000	50 000		

Table 2 (continuing on next page): Existing plants and their planned expansion (Naturvårdsverket II, 2003)

* Date for capacity increase

** Decision for capacity increase taken

Municipality	Capacity in 2002	Capacity in 2008	Date*	Decision**
Landskrona	22 400	25 000	2007	Yes
Lidköping	100 000	100 000		
Linköping	250 000	350 000	2004	Yes
Ljungby	40 000	30 000		
Malmö	207 100	350 000	2003	Yes
Mora	20 000	25 000	2007	Yes
Stockholm	450 000	700 000	2007	Yes
Sundsvall	40 000	200 000	2007	Yes
Södertälje	260 000	260 000		
Umeå Dåva	150 000	240 000	2007	
Umeå Åliden	35 000	35 000		
Uppsala	226 100	350 000	2005	Yes
Västervik	40 000	50 000	2003	
Sum:	**1 840 600**	**2 715 000**		

Table 3 (continued from last page): Existing plants and their planned expansion (Naturvårdsverket II, 2003)

* Date for capacity increase

** Decision for capacity increase taken

Municipality	Capacity in 2008	Date*	Decision**
Borås	80 000	2004	Yes
Brista	100 000	2005	
Eslöv	10 000	2005	
Falun kommun	10 000	2008	
Finspång	23 000	2004	Yes
Fiskeby Board	45 000	2004	
Gävle	115 000		Under discussion
Hässleholm	45 000	2004	Yes
Jönköping	150 000	2005	Yes
Kalmar	80 000	2008	
Karlskrona	50 000	2008	
Katrineholm	50 000	2005	
Kil	12 000	2003	
Kumla, SAKAB	75 000	2003	Yes
Markaryd	45 000	2005	Yes
Motala	40 000	2008	
Norrköping	175 000	2003	Yes
Ronneby/Kallinge	30 000	2005	
Simrishamn	15 000	2005	
Skövde	50 000	2005	
Uddevalla	40 000	2008	
Västerås	200 000	2008	
Ystad	15 000	2005	
Örnsköldsvik	40 000	2008	
Sum:	1 495 000		

Table 4: Planned new waste incineration plants (Naturvårdsverket II, 2003)

* Date for capacity increase

** Decision for capacity increase taken