CHALMERS

An Analysis of Strategic Possibilities for LNG within the Swedish Industrial Market

Master of Science Thesis
in the Management and Economics of Innovation Programme

IGOR DJOKOVIC
JOSEPH NASSIF

Department of Technology Management and Economics
Division of Innovation Engineering and Management
CHALMERS UNIVERSITY OF TECHNOLOGY
Gothenburg, Sweden 2014

Report no. E 2014:009

MASTER'S THESIS E 2014:009

An Analysis of Strategic Possibilities for LNG within the Swedish Industrial Market

IGOR DJOKOVIC
JOSEPH NASSIF

Tutor, Chalmers: Jonas Hjerpe
Tutor, ÅF: Mattias Wesslau

Department of Technology Management and Economics
Division of Innovation Engineering and Management
CHALMERS UNIVERSITY OF TECHNOLOGY

Göteborg, Sweden 2014

An Analysis of Strategic Possibilities for LNG within the Swedish Industrial Market

IGOR DJOKOVIC
JOSEPH NASSIF

Master's Thesis 2014:009

Department of Technology Management and Economics
Division of Innovation Engineering and Management
Chalmers University of Technology
SE-412 96 Göteborg, Sweden
Telephone: + 46 (0)31-772 1000

Chalmers Reproservice
Göteborg, Sweden 2014

Abstract

Liquefied natural gas (LNG) is natural gas frozen down to -163°C to be able to transport it easier. LNG is new on the Swedish market and it is an option that makes it possible for businesses that are not connected to the gas pipeline, in west Sweden, to use natural gas. LNG is expanding in Sweden and today there are two import terminals that deliver LNG to the Swedish market, one in Nynäshamn and the other one in Fredriksstad, and there are more terminals that are planned to be built. Today the knowledge about LNG is limited in the Swedish industries, as well as the knowledge where the fuel can be best utilized, and in which industries it can be used. Therefore the purpose of this thesis has been to investigate growth factors and potential new industries to target.

This thesis is carried out in two studies since the knowledge is limited among all the actors in the field, a pre-study is first conducted to give a broader understanding of the LNG market and to identify potential new markets. The second study that is the main study will explore the identified application areas from the pre-study at targeted industries to be able to identify the industry's capabilities and it willingness to convert to LNG. In both studies semi-structured interviews was used to interview businesses that have converted to LNG and businesses that are potential future customers. Databases and literature was also reviewed to analyses with the empirical findings.

The outcome from the pre-study revealed that industries that can use LNG in a wide range of applications are potential future customers, since LNG can be utilized in different parts of their operation e.g. in the production, for cooling of facilities and transport. With this conclusion, the food and brewery industry was chosen to do the main study on, because there is a need of an energy source in the production, it has a big cooling need and it has allot of goods to transport.

The conclusion from the main study was that LNG isn't a very good match to the food and brewery industry due to tax changes for fossil fuel, and because the industry has only a need of producing steam in the production. This makes fossil fuel free alternatives viable for the industry. Another conclusion is that most of the food and brewery facilities have, or have plans to outsource the transportation of their goods to carrier companies. The proposal of using LNG in the production and as a transportation fuel become harder since it demands collaborations between two different parts or that the factories ordering the transportation start to demand that the transportation companies driving their goods should use LNG-trucks. Since LNG is still quite new on the market this kind of collaboration or demands are still too early.

Keywords: LNG, Liquefied natural gas, Swedish LNG market, LNG within food and brewery industry.

Acknowledgments

This thesis was carried out at ÅF's industry division in Gothenburg during the fall of 2013. This thesis was preformed within the master's program Management and Economics of Innovation at Chalmers University of Technology. We are grateful for the opportunity to do this thesis in cooperation with ÅF and there are many people that have helped us with our work.

We would like to thank and express our gratitude to everyone who has given valuable input to the result of this thesis. First of all we would like to thank our supervisors at ÅF, Sten-Åke Barr and Mattias Wesslau, Sten-Åke Barr for initiating the project and giving us the opportunity to write this thesis, and Mattias Wesslau for his valuable inputs, support and encouragement throughout the thesis. Secondly, we would like to thank all the interviewed companies that has been very helpful and given valuable input to this thesis.

From the academic side we would like to thank our supervisor Jonas Hjerpe form the department of Technology Management and Economics at Chalmers University of Technology. He has been very supportive throughout the thesis, with challenging questions and constructive input to help us achieve the best possible result.

Last but not least we would like to thank family, friends, and Igor would also like to thank his girlfriend, for believing in us and giving us the support we needed.

Gothenburg, January 2014

Igor Djokovic *Joseph Nassif*

Table of Contents

List of Figures

List of Tables

Glossary list

LNG – Liquefied natural gas. It is natural gas that is cooled down to -163°C.

LNG cold – The energy that can be extracted from the cold from the gasification process of LNG.

LNG import terminal – A terminal where LNG is imported and stored before distribution to local markets.

LNG trucks – Trucks that run on LNG.

Natural gas hub – A local market where natural gas can be bought and traded.

Oil linked pricing – The price of natural gas is linked to the price of oil.

Pipeline – Transportation of natural gas through pipes.

Spot prices – The current market price that a commodity can be bought or sold and immediately delivered.

1. Introduction

This chapter aims to introduce the subject and why it is important. It starts with a brief background followed by the purpose. The chapter also introduces the research questions and the scope and limitation of the study.

1.1 Background

Natural gas in Swedish industries is still very rare, since the country doesn't have a good gas pipeline network developed (Stenkvist et al. 2011). The existing pipeline goes along the Swedish west cost up to Stenungsund. In order to deliver natural gas to the rest of the country it has to be transported in another way. Liquefied natural gas (LNG), which is natural gas converted to liquid form by freezing it down to -163˚C, which makes the gas take up to 600 times less space then it does in gas form (AGA AB, 2013). This makes the gas possible to transport with boat, train and truck, which makes the gas much more available in a country as Sweden. LNG is the second most common way of transporting natural gas in the world after pipelines and it is growing fast.

Natural gas is a possible replacement to oil as a fuel and a more environmentally friendly alternative. The carbon dioxide emissions form the combustion of natural gas is about 30-40% lower compared to the combustion of crude oil (Stenkvist et al. 2011).

The infrastructure for distributing LNG to the Swedish industry today is limited. Today there is two import terminals in Scandinavia that distribute LNG to the Swedish market and they are located in Fredrikstad in Norway, and Nynäshamn in Sweden. But the infrastructure for LNG in Sweden is expanding with new terminals in progress in different parts of the country. Soon LNG can be distributed to most parts of the country to competitive prices, mainly compared to oil but also to some extents to LPG.

Today the knowledge about LNG is limited in the Swedish industry, as well as the knowledge where the fuel can be best utilized and in which industries it can be used. ÅF, which is one of the largest energy and environmental technology-consulting firms, has an interest in exploring the possibilities for LNG and its market potential within the Swedish industries. To get an understanding of LNG's potential in Sweden a market investigation has to be made. Since the knowledge is limited among all the actors in the field a more explorative investigation about LNG has to be done, before investigating targeted industries.

1.2 Purpose master thesis

The overall purpose of this thesis is to investigate new potential industries and application areas for the usage of LNG. The thesis is divided into two studies, where the purpose of the pre-study is to give a broader understanding of the LNG market, its barriers and incentives, and to identify additional application areas for LNG. This will be based on databases, literature and expert interviews with companies that have already converted. The purpose of the main study is to explore the identified application areas from the pre-study at targeted industries. This will be done through a case study that will map the industry's capabilities and willingness to convert to LNG.

Purpose pre-study

The purpose of pre-study is to get a broader understanding why companies have converted to LNG, discover barriers and investigate additional application areas for LNG. This will be achieved through databases, literature and expert interviews with companies that have already converted to LNG.

Purpose main study

The purpose of the main study is to further explore the findings in the pre-study, namely to investigate the potential value of LNG in plants that can use it in a wide range of applications in its operations. This will be done through a case study at targeted industry that are believed to fit the framework from the previous study. The case studies will identify the targeted industry's capabilities and willingness to convert to LNG.

1.3 Research Question

To fulfill the purpose of the thesis, the following research questions will be addressed:

Pre-study:

- Why do companies choose to convert to LNG?
- Which are the incentives and barriers for converting to LNG?

Main Study

- What are the targeted industries attitudes towards LNG?
- Does LNG usage in other applications, beside in the production, create a higher value proposition?
- What are the competitive choices of energy within the targeted industry?

1.4 Scope and Limitations

Only the possibilities for usage of LNG within industries and heavy transport are looked upon. LNG is being used as fuel for boats in some parts of the world right now. But that isn't of interest for this thesis, and no research is going to be done in that area.

The focus of the thesis is going to be on the possibilities for LNG in the Swedish market and no other markets are going to be considered.

The main focus is on LNG, but research of combination of LNG with other gases is not excluded e.g. biogas. Sometimes a mix of gases is used as fuel for different purposes, and that may be relevant to look upon.

2. Methodology

This chapter entails an elaborate description of how this thesis was conducted, what methods for collecting data were used, how the data was analyzed, and finally a discussion of the quality of the study. Since this thesis is divided into two parts, so will each segment of the methodology chapter be as well.

2.1 Research Process

This thesis is divided into two parts, namely a pre-study and a main study. The pre-study was conducted to explain the Swedish energy market and the companies that have converted to LNG, while the main study was done to explore a new market and find new potential adopters of LNG.

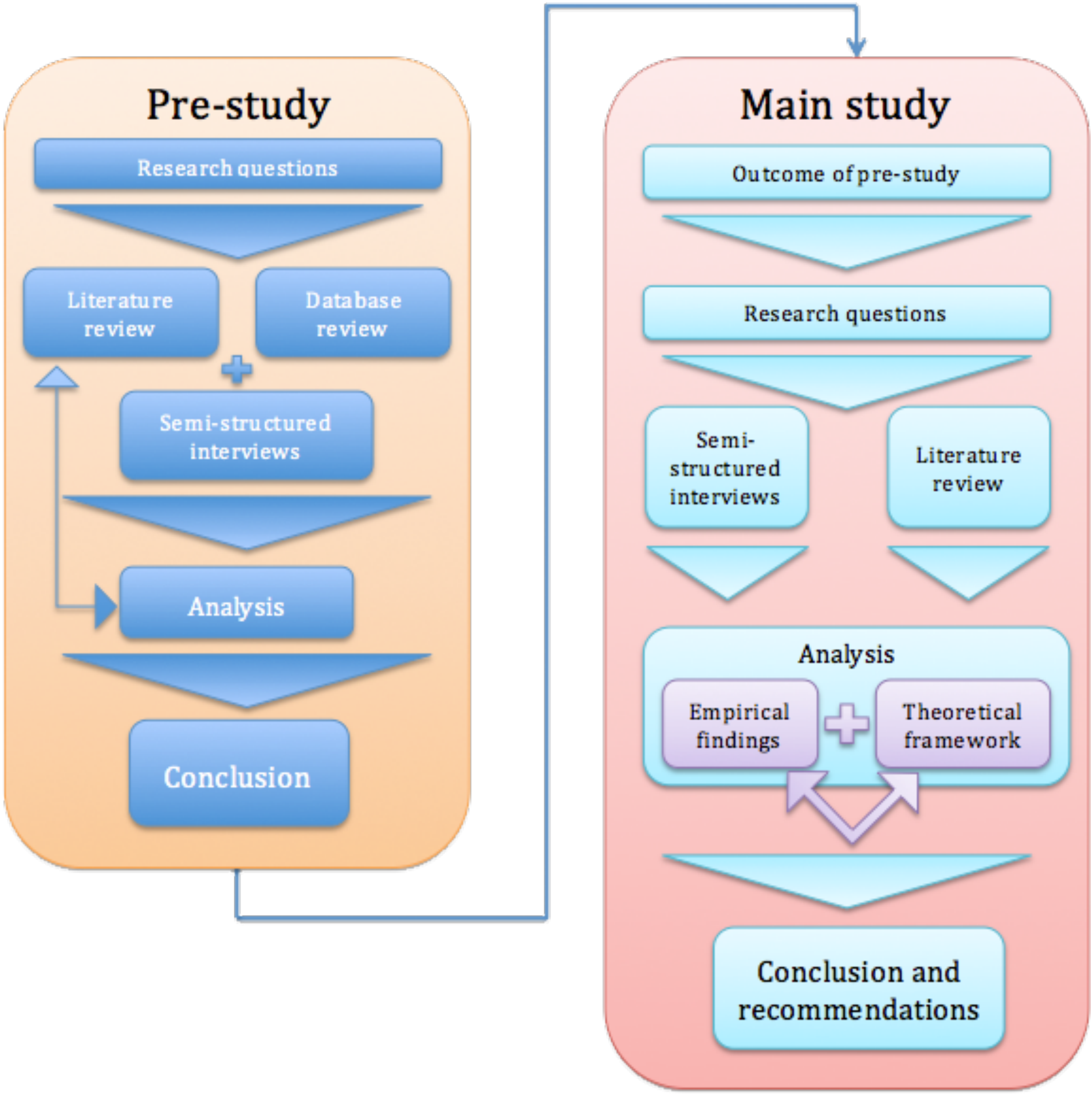

Figure 1 Shows the research process throughout the thesis

2.2 Research Design

This thesis consists of two case studies, namely the pre-study and the main study. Eisenhardt (1989) defines a case study as a research strategy to get an in-depth understanding of a single setting. Case study is used to examine a phenomenon in its real life context, according to Yin (1984) and Eisenhardt (1989) a case study can have multiple levels of analysis e.g. analysis of industry and firm. There are three ways to conduct a research design, namely exploratory, explanatory, or descriptive. Since the phenomenon's wasn't clearly defined and it is unexplored, the research design was of an exploratory nature.

Pre-study

The phenomenon that needed to be explored was why companies chose to convert to LNG and to get an overall understanding of the Swedish energy market. With help from this study it was possible to identify key factors that are affecting companies' choice of energy, and also what type of companies that are potential LNG adopters. The data that was collected was of the qualitative nature, since little was known about the subject, a better understanding was needed and to find some points of interest to explore further.

Main study

The main study investigated both a specific industry, by examining firms within that industry, and the product LNG. This was a qualitative single study with two levels of analysis. With an in-depth knowledge on industry requirements and the product, conclusions could be made to determine how well the product met these requirements.

2.3 Data collection methods

Both the pre-study and the main study contained qualitative data. According to Bryman & Bell (2011) data that is provided in words are considered as qualitative data, while data that is generated numerically is quantitative.

2.3.1 Literature and database review

Knowledge that is gathered from literature and databases are often used as a complementary data, which was also the case for major parts of this thesis.

Pre-study

A literature study was carried out to get a comprehensive picture of the industry and also to identify tools for the analysis. The literature review to find analytical tools was done throughout the whole pre-study, it was conducted this way since there was new findings emerging continuously and the literature needed to be complemented for the analysis.

Reports from consultancy agencies, governments and other organizations were reviewed to learn about what is known today. Some reports where recommended by tutors at ÅF, and others where found through Internet search engines. Main keywords that where used was: LNG, Liquefied natural gas, Swedish energy demand, LNG in Sweden, Pricing of LNG.

In addition to the reports, scientific articles from previous courses and articles found through the search engine of Chalmers e-library was used, these articles served as analytical tools. Key words that were used for this search was: Customer analysis, Market size, and Market growth.

Databases at Statistiska centralbyrån (SCB) were used to obtain the data of the energy consumption in Sweden per region. This part was executed in order to find high consuming regions that would be interesting to investigate further.

Main study

In this part literature was studied both to get additional information about the global market and development in the trade of natural gas, and to build a theoretical framework that would be used to analyze the findings. The literature was constantly updated and adjusted so it would fit the findings. Typical keywords for this chapter were: Adoption curve, Market profitability, Lock-in effects, Dominant design, PEST, Rate of adoption, World energy demand, Pricing of LNG, and Trade of LNG.

2.3.2 Interviews

According to Bryman & Bell (2011) the intention with interviews is to gather information that you cannot find in another matter, or to find problems that you didn't know existed or were of interest. Semi-structured interviews were used in both the pre-study and the main study, since qualitative data was desired in both cases. Since little was known about the subject of study, it was good to keep the questions open so the respondents could answer in their own terms and to have the flexibility to probe deeper when encountering an interesting topic. Besides the flexibility it was important to have some comparability among the different interviews, this is another reason why the semi-structured approach was chosen.

Pre-study

An interview guide was constructed where the same questions were used in each interview, which facilitated the comparability of the findings. Although the same questions were used, the order and phrasing of the questions had a tendency to shift, because the formulation of the questions had to be adapted to each individual interviewee. The interview guide was built with consideration to the research questions that was posed for the pre-study. The interview guide was adjusted after each interview because some questions was unclear or repetitive and already answered by previous questions. The final version of the interview guide can be found in Appendix 2.

The interviews started of with a short description of the master thesis' background and its' purpose, and after that the interviewee presented themselves and its' background. This part was done to give the interviewee a better understanding why the interview was performed, and also for the interviewers to understand the interviewees role in the company. The next part of the interviews focused on obtaining information that could answer the intended research questions. At the end of the interview, the interviewee was asked to recommend other people to talk to that could be relevant for the study. This was asked since it is important to talk to the "right" people in order to get accurate information (Bryman & Bell, 2011).

In total four interviews were held, three over phone and one face to face. All the interviews was both recorded and documented. The downside of recording is that the mood of the interview can become stiff and the interviewee might feel limited to what they can say. On the other hand it facilitates the process of after-documentation and ensures that everything was understood correctly. At the interviews there was always one interviewer and one person that documented the conversation, this was done to make sure the rhythm of the interview wasn't disturbed. All though there was only one interviewer that asked the questions from the interview guide, the other had the possibility to pose follow up questions when an interesting topic arose.

Main study

After the pre-study was done, an interview was performed with an industry expert in order to control that the conclusions from the pre-study was accurate and that the study was heading in the right direction. For this interview a specific semi-structured interview guide was designed, which was just used for this interview. During this interview, the interviewee was asked to recommend potential industries that would be interesting to interview.

After this interview was held, a new interview guide was constructed that was intended for the main study. This interview guide was used through out the whole main study, with relatively open questions that was revised after each interview if something was unclear. The interview guide was built from the outcome of the pre-study and with consideration to the research questions for the main study.

In the main study there were nine companies that was interviewed. But since the interview guide was quite comprehensive and covered a lot of areas, it was hard for just one interviewee to answer all the questions. So at some companies several people were interviewed to get more accurate answers. One of the interviews was done face to face at the company, while the rest was done over phone. Just as in the pre-study, the interviews started of with a brief explanation of the master thesis and it's purpose. After this the interviewees introduced themselves and what their role is in the company. The rest of the questions aimed to answer the three research questions intended for the main study.

2.3.3 Sampling

Snowball sampling was used in both studies, since it is the best way to find the right people to talk to according to Bryman & Bell (2011). Since snowball sampling isn't a probability sampling it is not likely to be representative, but is better suited for qualitative research (Bryman & Bell, 2011), which was desired for this thesis.

Pre-study

Initially industry experts and experts from ÅF was consulted, to get recommendation on what companies to contact and to be able to address the right people. For this part of the project, companies that already had converted to LNG or were in the process of converting were contacted. The targeted sample were employees that were involved in the decision making to convert or in the process of realizing the transition. These employees where experts in that field and was selected since a deeper understanding of the process of converting to LNG was desired, and reasons why they chose to convert to LNG.

Main study

For the main study the targeted population revealed itself after the pre-study and with consideration to the outcome of the pre-study. To get in touch with the right people, a brief explanation of the thesis was written in an e-mail and it was sent to employees that worked with human relations so they could recommend a relevant interview candidate. The candidate was contacted with e-mail at first to book a meeting, and if they didn't answer after a week they were contacted over phone. Some interviewees could answer all of the questions themselves, while some could only answer some segments of the interview guide. These interviewees were asked to recommend other candidates in their company that could help to answer the rest of the interview guide. This was done to get more accurate results that reflected the companies' views correctly.

2.4 Data analysis

Pre-study

The data that was gathered from consultancy and government reports, articles, databases, and interviews was analyzed with reference to scientific articles, which were used as analytical tools. The literature that served as analytical tools had to be updated continuously in order to be in line with the constantly emerging findings, which occurred during the data collection period.

Main study

The main study was analyzed with reference to a theoretical framework that was constructed with help from scientific articles, which was relevant for the findings and this type of case study. The theoretical framework was constantly updated, through an iterative literature study, in order to fit new empirical findings. The framework was divided into two segments, product and customer, and the findings was analyzed accordingly. After analyzing the customer side and product side areas of improvement revealed themselves, and market possibilities could be identified.

2.5 Thesis quality

The concepts reliability and validity are the two most common criteria to evaluate the research quality. According to Yin (2003) and Cepeda & Martin (2005) to determine the quality of a case study, considerations have to be taken to the following criteria: Construct-, Internal-, External validity and Reliability.

Bryman & Bell (2011) claims that the reliability of a study depends on weather the research process are repeatable with the same results. According to Forza (2002) the researcher is concerned weather the measures are stable and consistent. Validity controls weather the right concept is being measured. If you measure what you intend to measure then you have high construct validity. The construct validity is often increased by triangulation and chain of evidence. According to Bryman & Bell (2011) internal validity demonstrates weather a casual relationship between two variables is solid. Ghauri & Grønhaug (2005) claims that in qualitative research this relationship is measured in the consistency between the researchers' observation and their theory. The external validity is used to evaluate how well the findings can be generalized outside of the research context.

Pre-study

The reliability and validity for the pre-study is quite high since the research questions are clear and have been properly answered in the conclusion. All the data that was collected was from trustworthy sources from e.g. government, university, or consultancy agency databases. All the interviews were done with two interviewers present, where the interview was both documented and recorded. This was a way to make sure that the findings was correctly understood and that all that was said during the interviews was captured. Interviews were also made with industry experts that could validate the findings. The measurements are relatively stable and consistent, but they can be affected by major factors as politics and technology. Since triangulation was made, with multiple sources of evidence, the construct validity was quite high. But since this was a case study the external validity was low, because case studies are often hard to generalize.

Main study

Overall in the study the reliability is high. The research process is done with reasonable care and the process is well documented, which facilitates replicability of the study to other authors. Just as in the pre-study the findings are stable, but can change due to macro factors that can affect perceptions and opinions of interviewees.

The construct validity is high, since several interviews are made with companies in the same industry, which showed a chain of evidence. Industry experts and tutors at ÅF were consulted before the interviews were made, to make sure that right concepts was measured. At some companies there was interviews made with more then one person, in order to get specific information for some segments of the interview guide. Because of this, thick descriptions could be made and casual relations between some variables could be stated during the analysis and conclusion. This increased the internal validity of the study. Like in the pre-study this was a case study, which in general has a low external validity. The same applies for this study, because the findings represent a specific industry and are hard to transfer and generalize to other industries.

3. Pre-study

The purpose of pre-study is to get a broader understanding why companies have converted to LNG, discover barriers and investigate additional application areas for LNG. This will be achieved through databases, literature and expert interviews with companies that have already converted to LNG.

3.1 Research question

Why do companies choose to convert to LNG?
Which are the incentives and barriers for converting to LNG?

3.2 Literature study

The purpose of the literature study is to go through relevant literature to present a framework for analysis of data. It will present a framework for new and existing market needs.

3.2.2 Market Size

It is important from a market analysis perspective to be able to estimate the size of the market as well as submarkets. Estimations can be based on governments - or trade organizations but also sale from public financial sources (Aaker and David A, 2001). It is also important to consider the potential market, since a new user group or a more frequent usage could dramatically change the size and the expectations for the market (Aaker & David A, 2001).

A mistake many businesses do is that they have policies to not invest in small markets, but in an era of micromarketing much of the action is in small-niched segments. Avoiding them may mean that a firm will miss out on much of the vitality and profitable of a business area. Another aspect is, that avoiding the small market can mean that a firm might lose the advantage to be the first-mover at the market. (Aaker & David A, 2001)

3.2.3 Market Growth

It is important to understand the growth of the market to be able to understand how large the market will be in the future. Growing markets is often attractive since it often results in more sales and profit, and it can also mean less price pressure when demand increases faster then supply. It is important to understand the driving force behind the market to be able to understand if the market will grow or decline. The driving force will help to describe how the market will behave. In some cases indicators can be helpful in forecasting the growth or decline of the market, typical indicators can be demographic data or sales of related equipment. (Aaker & David A, 2001)

3.2.5 Customer Analysis

To analyze the customers is often the first logical step in most strategic market planning. One way to analyze customers can be to divide the customers into understandings of, how the market segments, analysis of customer motivations and exploration of unmet needs. (Aaker & David A, 2001)

Segmentation

By segmenting the market it will be easier to target and reach out to the customers. In a strategic context, segmentation means the identification of customer groups that respond differently than other customer groups to competitive strategies (Aaker & David A, 2001). To identify segments is hard, since there is many different ways to divide up the market. It is important to consider a wide range of variables to avoid missing a useful way of defending segments. A segment needs to be large enough to support a unique business strategy, but you can still target multiple segments (Aaker & David A, 2001). In general, it is costly to develop a strategy for one segment, if not the effectiveness of the strategy will compensate for this added cost.

Customer motivation

To know what motivate customers and what lies behind their purchasing decision is very important. When knowing the problem the product solve for the customers the selling point becomes much easier. Aaker & David A (2001) suggest, customer motivation analysis should start off with identifying motivations for a given segment, this is many times obtained from getting customers to discuss the question why e.g. why is the product or service being used? After that it is important to group, assess and assign strategic roles to the motivation as seen in the figure 2.

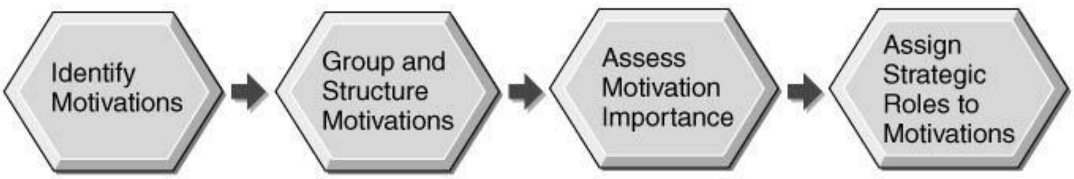

Figure 2 Customer Motivation stages (Aaker & David A, 2001)

Bendapudi & Berry (1997) states that customer is motivated to maintain the relationships, either because of constraints (they "have to" stay in the relationship), or because of dedication (they "want to" stay in the relationship). Here it is important, if possible, to try to build up dedicated relationships, since it provide opportunities for expansion and enhancement of the relations. On the other hand constraint based relationship leads at best to you get to keep the relationship.

Unmet needs

Unmet needs can represent good business opportunities, but are sometimes difficult to identify. An unmet need is a customer need that is not being met by the existing product or service offerings. A way of exploring new unmet needs can be by stretching or applying new features to the product or service.

Unmet needs are strategically important because they represent opportunities for firms to increase their market share, break into a market, or create and own new markets (Aaker & David A, 2001). Customers are sometimes not aware of their unmet needs because they are so accustomed with how the existing equipment is solving their problem. As an example Aaker & David (2001) use, a farmer from the 1890s that had wished for a stronger and a more endured horse, not for a tractor. “How does somebody know what they want if they haven’t even seen it?” quote, Steve Jobs[1].

3.3 Empirical findings and previous reports

The purpose of this chapter is to present the findings from the expert interviews and previous report independent from the literature study. This chapter goes first through natural gas and LNG’s role in Sweden and after that present the findings from the expert interviewed.

3.3.2 Energy needs for natural gas in Sweden

Natural gas is a fuel that is used relatively little in Sweden compared to most parts of Europe. This is mainly because central Europe has a developed pipeline distribution network for gas. Sweden has only a pipeline network in the southwest part of the country, to get gas delivered to other parts of the country the gas has to be transported by trucks or railway. This has made natural gas a rare fuel in many parts of Sweden. (Stenkvist et al. 2011)

Figure 3 Pipeline system in Sweden (www.nyteknik.se)

[1] Steve Jobs was the co-founder and CEO of Apple Inc.

During 2011 two LNG import terminals one Nynäshamn in Sweden and the other one in Fredriksstad in Norway has been put into operation, additional three import terminals is under consideration in Gothenburg, Lysekil and Tornio (Stenkvist et al. 2011).

The emerging infrastructure for LNG in Sweden gives many industries the opportunity to use natural gas as a fuel instead of oil. According to Stenkvist et al. (2011) many industries within the iron- and steel industry as well as in the chemistry industry in Sweden are interested to convert to LNG. The import terminals can distribute LNG to industries that are at a distance of approximately 30 - 35 mil from the facility, after that it becomes too expensive (Stenkvist et al. 2011). According to Stenkvist et al. (2011) a minimal critical volume of 15 GWh has to be delivered to the factories that want to use LNG, with lower volumes then that LNG becomes to expensive compare to oil, then the transportation and the facility cost becomes to large for every delivered kwh LNG.

To look closer where exactly the converting potential is, statistics about the Swedish industries' oil consumption can be extracted from the Swedish Central Bureau of Statistics[2]. The map (figure 4) is a compilation of every municipality's industrial consumption of heavy oil in Sweden.

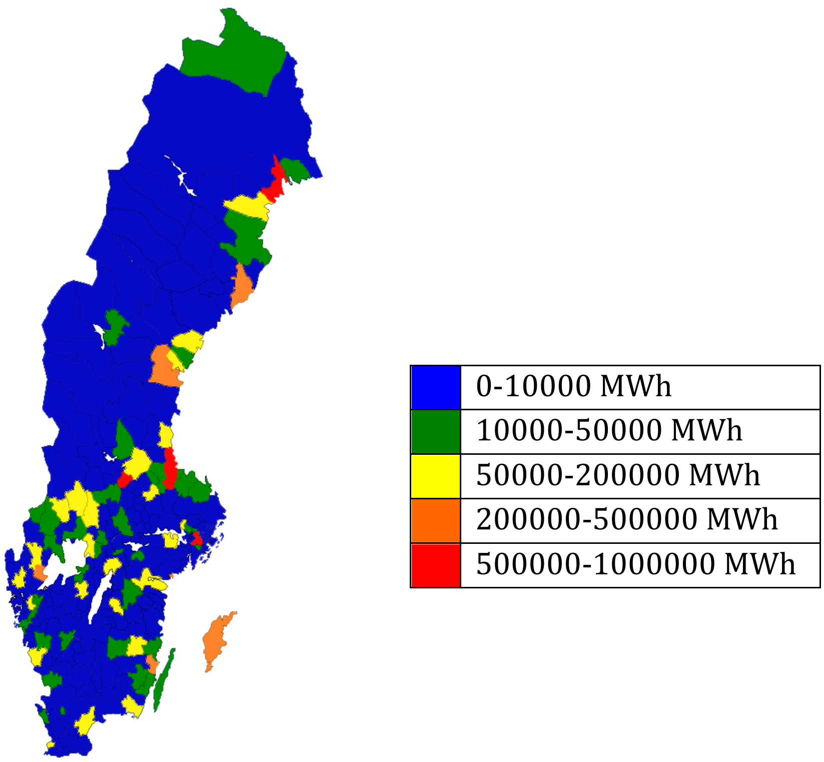

Figure 4 The oil consumption of every municipality in Sweden

As seen in the figure 4 the biggest oil consumption is in the central part and at

2 www.scb.se

the northeast coast of Sweden. The terminals that are operational and under construction as mention above will be able to cover central Sweden's demand, but those terminals are on a too far distance to cover the north coast. According to Gävle hamn (2013) there are discussions to build an import terminal in Gävle, which will be able to deliver LNG as far as to Sundsvall. Despite the terminal in Gävle a large part of northern Sweden still don't have the opportunity to get LNG delivered to a competitive price. According to Stenkvist et al. (2011) except a terminal in Gävle there is as well in need of a terminal in Sundsvall and Luleå, to cover most of the industry areas in northern Sweden that are interested of LNG as a fuel in their productions.

Skangass is a dominating player in Sweden when it comes to delivering LNG to the Swedish industry. Skangass owns the terminal in Fredriksstad, the terminal under construction in Lysekil, and Skangass will also own the terminal in Gävle that is under discussion. The terminal in Nynäshamn is owned by AGA, but they get their gas delivered from Skangass in Norway. The most common direction is that the terminals is both owned and operated by the same owner.

However according to Göteborgs hamn (2013) the terminal that is planned in Gothenburg port will be based on the principle "open access", which means that everyone who is interested in supplying LNG to the Swedish market can buy capacity in the terminal. This provides consumers with the opportunity to purchase LNG at the best global price (Göteborgs hamn, 2013). An open LNG terminal means that the ownership and the operation of the infrastructure are kept separate from the production and the energy trading. These will lover the investment cost for other players to enter the market since you don't have to invest in your own import terminal. This makes the terminal in Gothenburg unique to the other terminals in the country, and will hopefully in the long run open up the LNG market to more players.

The Swedish market for natural gas is still in a very early stage at the moment there is only one import terminal operational in Sweden and one close to the Swedish border in Fredriksstad. But as mentions there are a lot of discussions and plans for more import terminals in the country. So far the business model for the distribution companies have been to both own, and operate the import terminals. But as mentions above Gothenburg port's terminal is going to be operated with a different business model, where you have one owner of the terminal and other players that handle the operation and distribution, which makes it easier for other players to enter the market.

3.3.3 Expert interviews

Interviews were held with four different companies that have or will convert to LNG shortly. The interviews gave us understanding in how and why the companies decided to convert to LNG. The four different companies Artic Paper, Uddeholm, SCA and Gyproc are different type of manufacturing companies. Artic Paper and SCA operates within the paper industry, Uddeholm are in the iron and steel industry, and Gyproc produce plasterboards. At Artic Paper and Gyproc the interview was held with the operating CEO, at Uddeholm the interview was held with the project leader for converting to LNG and at SCA the interview was held with the safety manager for SCA at Lilla Edet. These four companies are among the first to convert to natural gas delivered as LNG.

Why convert to LNG

In all four cases LNG replaces oil or LPG (liquefied petroleum gas) or as in one case both. Common reason for all the companies and one of the main reasons for all is that they are converting to LNG for economical benefits, as the CEO for Artic Paper said, “Price is driving the cost”.

Artic Paper has passed between oil and electricity before, but the oil has become more expensive lately and the electricity is unpredictable. LNG is still a more expensive version of natural gas but cheaper than oil, and as a plus they get better environmental values. At Artic Paper the electricity most likely are going to dominate in the near future, since LNG is still too expensive. Another reason for converting is the short payback time, Artic Paper believe that they will have the money back on the investment within a year. An alternative to LNG according to Artic Paper was bio oils, but it was too hard to secure a regular supply. LNG has stronger players on the market and is safer when it comes to delivery reliability.

Uddeholm was running their factory on both oil and LPG; the switch to LNG is hopefully going to give them cheaper fuel in the long run. It will also give lower nitrogen dioxide values, which will improve the working environment. A disadvantage that Uddeholm see with LNG is that now they only stand on “one leg” since LNG replaces both oil and LPG, so it is really important that there is strong and reliable players on the market that can deliver LNG to a competitive price. Before they had the opportunity to choose between oil and LPG, depending on which was cheapest. Uddeholm is expecting a payback period of three to four years.

SCA was running their factory on LPG but LNG is a cheaper fuel for them, there of the exchange. LNG is also a better product for the environment, which makes it more reliable.

Gyproc thinks it is important from an environmental aspect based on financial reasons. To build green houses is very important today, so the greener their plasterboards are the more they can charge. Gyproc used oil in their processes before, and LNG is 20-25% more environmentally friendly. It is also a process advantage, because it is easier to make changes compared with oil. The investment costs was approximately 10 millions SEK, and the payback is of course depending on the price on LNG contra oil. But when the decision to switch to LNG was made the payback time was not more then 5 years.

The process of converting

All four companies mentioned the authorities as a problem, since LNG is new in Sweden the authorities don't know what the rules is and how the safety regulation should be designed. So the permissions from the authorities took very long time to get, in all the cases.

The converting time differs slightly; mainly depending on how much struggle you had with the authorities. It approximately takes 2-3 years to switch to LNG, but when the reconstruction starts it goes quite fast and will take approximately 6 months.

Suppliers' role

The choice of supplier was selected in all the cases by the geographic position of the factory. Since there is very few import terminals in Sweden today and transportation cost is a quite large cost, when it comes to LNG. This has resulted in low market competition, since if the factory is located at the west coast within a 30-35mil distance from Fredrikstad, Skangass will be your supplier and that was the case for Artic Paper, Uddeholm and SCA. Gyproc that is located on the east coast has AGA as supplier and they deliver LNG from Nynäshamn.

In all four cases the supplier, both Skangass and AGA, built the LNG terminal at the factory, and is accounted for almost everything such as the tank, carburetors, valve clearance and control equipment. The companies are accounted for the daily maintenance and the groundwork if that was needed. Skangass and AGA is renting out the terminals to the companies, which is bounded to a contract that extends between five to ten years. Gyproc have the option to purchase their terminal after the contract has expired. SCA mentions something similar, but of course all four companies hope for long-term and good cooperation between the two parties.

Believed improvement potential for the future

The potential to use LNG for cooling e.g. in the air conditioning, is something both Artic Paper and Gyproc has discussed but not acted on. Both saw it as a positive bonus feature if it would be economically viable, but none of them have acted on it yet. Artic Paper hesitated regarding the concept, to pull the cold that you get from LNG to their air conditioning in their office buildings. This was mainly because they are very doubtful whether it can recover the investment on the technical lifetime.

Artic Paper sees potential for LNG in the future. They think mainly that LNG has a struggle against biofuels in the future, where the variable costs of LNG is higher, but the investment cost is much lower then for biofuels. Here it is very important to expand LNG's distribution network and exploit it to the fullest, so you get the variable costs for LNG down.

The possibility to convert to biogas from LNG isn't anything that the companies had in mind or anything that had an affect on the decision to convert to LNG. Since they don't think there is any possibility in the near future to convert to biogas.

Something that all the companies expressed, which can be made better in the future is the process with the authorities, since it often was slow and unclear. The recommendation is that when the decision to convert to LNG is taken, the work with the authorities should start as soon as possible, to not get delays. A summary of the pros and cons from the expert interviews is shown below in the table 1.

Pros	Cons
+ **Price** + **Lower greenhouse gas-emission compared to oil** + **Process advantages (Easier to handle)** + **Short payback time** + **Nicer working environment**	– **Government permissions** – **High competition from other alternatives** – **Needs strong and reliable actors on the market to deliver LNG at a competitive price**

Table 1 Identified pros and cons for LNG among already converted companies

3.4 Analysis

In this chapter new and existing needs are identified from the empirical findings and analyzed according to the literature study presented in an earlier chapter.

3.4.2 Potential Customers

When analyzing the Swedish market there are three main customer segments that can be identified to fulfill the purpose of this study and be interested to use LNG:

- Industries that use heavy oil or other fossil fuel in their production
- Land transportation

- Industries that can utilize the cold from LNG in combination with one of the other two segments.

The industries that use heavy oil in their production are the main potential customer group, and also probably the first group to convert to LNG. For that reason there are also in this group the exploratory expert interviews was held. This group use often oil in their manufacturing processes, and here is LNG a good substitute. When it comes to land transport it is mostly heavy transport that is used at the moment. Here LNG can be used as a fuel mainly instead of diesel. The last segment is not so explored yet and here there might be some potential for LNG. A opportunity that other fuels don't have, when heating up LNG to gas form there is a lot of cool that get lost that can be procured.

The customer motivation for LNG is mainly price, environmental reasons, low investment cost, an easier fuel to handle than oil, and a trust in LNG as a fuel for the future.

The biggest and most significant motivation is price, the belief that converting/using LNG will give an economical advantage. Another economical reason is the low investment cost, which gives a good payback time. The environmental reasons is often communicated to the public since it gives goodwill, which makes it easier to motivate a conversion to LNG. If LNG had been a cheaper fuel than oil but less environmental sustainable it had been much harder to motivate a conversion. The trust in LNG as a future fuel comes from the large investments that is made globally right now within the area, many believe that the fuel will be used a while after 2050.

One unmet need that has been identified and will be more explored in the next study is the possibilities with the cold of the LNG. Here there are opportunities to use the cold for applications that is in need of much cooling. The discussion to utilize the cold has been up among the companies that has been interviewed, but still not been utilized. In those cases the need for cooling wasn't so big, which make the utilization of the LNG-cold not so prioritized. But there are industries in much more use of the cold such as the food industry, and this will be further explored.

When looking at potential customers in Sweden there is mainly the production industry that is of interest. But as seen above industries that can use LNG in a wide range of applications are potential future customers, because by combining different energy needs, they would get a higher energy demand on one specific fuel. In these industries, LNG can be used in everything from production, facility to transportation.

3.4.3 Market size and growth

The market size for LNG in Sweden is at the moment small, there aren't many companies that have converted to LNG yet, and of those that have, the majority is still in the converting process. But the market is growing; one indicator is the large investments are being made in the market. We can also see from the empirical findings that Sweden has allot of industries that is using oil in their productions today, and as seen from figure 4 the biggest converting potential is in the central part and northeast coast of Sweden. This shows that the market can grow fast when the infrastructure for supplying the industries is in place. The driving force right now is that companies wants cheaper fuel, and as long as the price on LNG can be kept lower than oil the market is going to grow.

The demand for cheaper fuel and the belief that natural gas prices will go down are making governments and companies invest in infrastructure for natural gas. And the transportation of LNG is connecting the natural gas market.

3.5 Conclusion

These studies identify four incentives for converting to LNG; cost savings, low investment cost, the belief for natural gas as a future fuel and the environmental aspect. Despite LNG's new arrival in Sweden as a fuel, it is already competitive to oil in many sectors. The belief that LNG is a cheaper fuel than oil and the low investment cost, which will give a good payback time, is the main driving forces. There is as well a belief that the price will go down further in the future, which might even give a better price than electricity and other energy sources. Although natural gas is a fossil fuel there is a belief that it still will be used in the decades to come and replace the oil in the increasing extent, which builds confidence for investment. The environmental aspect is always important nowadays, and LNG is a more environmentally friendly fuel then the competing alternative oil.

There are mainly three barriers for LNG in Sweden according to the pre-study: infrastructure, price and that it is a fossil fuel. The two first ones depend on each other to get the prices down there is an issue of economics of scale and with an infrastructure still under development it is hard get economics of scale. That natural gas is a fossil fuel and an issue for many businesses because they aim to be fossil free in the future and don't think it is a good idea to switch to another fossil fuel despite that it is more environmentally friendly.

Incentives for converting	Barriers to converting
Cost savings	Infrastructure
Low investment cost	Price
Future fuel	Fossil fuel
Environmental aspect	

Table 2 Incentives and barriers for converting

There is a growing LNG market in Sweden and infrastructure investments are being made. But the LNG market is still quite small in Sweden and there are only two major players that supply the gas. This leads to a high supplier power, since they control the whole market and companies that use LNG don't have a good bargaining position. The potential customers for LNG are mainly the high oil consumers e.g. the iron- and steel industry and the chemistry industry. But as this study points out, industries that can use LNG in a wide range of applications are potential future customers, since LNG can be utilized in different parts of their operation e.g. in the production, facilities and transport. One of the potential areas is the cold that is stored in LNG, where the cold can be utilized for various cooling processes in connection with the combustion of LNG. By using LNG in a wide range of applications, it can become profitable even for production plants with lower energy needs than in e.g. the iron- and steel and the chemistry industries. Thereby it will be possible for smaller plants to reach the critical volume that is needed too be consumed to make LNG competitive against oil. The possibility to utilize LNG in plants that can use it in wider range of applications is something that will be further investigated in the following study.

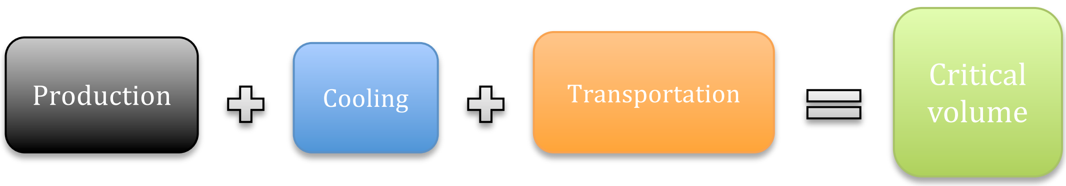

Figure 5 Usage of LNG in a wide range of applications

4. Theoretical framework

This chapter will go trough relevant literature and present framework for analysis that later will be used to analyze the empirical findings. It will present a framework for assessing customers' need on the market and different strategies for product success. The presented theories will be divided into two sub-frameworks, which combined will be used to identify market possibilities.

4.1 General Framework

The views of what should be taken into account when trying to expand a product's market share is that the products features has to match the needs of the mainstream costumers otherwise the market share of the product will be very limited. Without market insight, an invention is just a novel technology, product, or service (Furr & Ahlstrom, 2011). It is important to combine an invention with a market need.

Therefore this framework will be divided into two different fields. The fist one will address how an invention/new product should target the market and the second one will address the costumers, who are they and what are their needs. By combining these two fields a main framework can be constructed to match the product with the market. A basic structure of the main framework is presented in the figure 6.

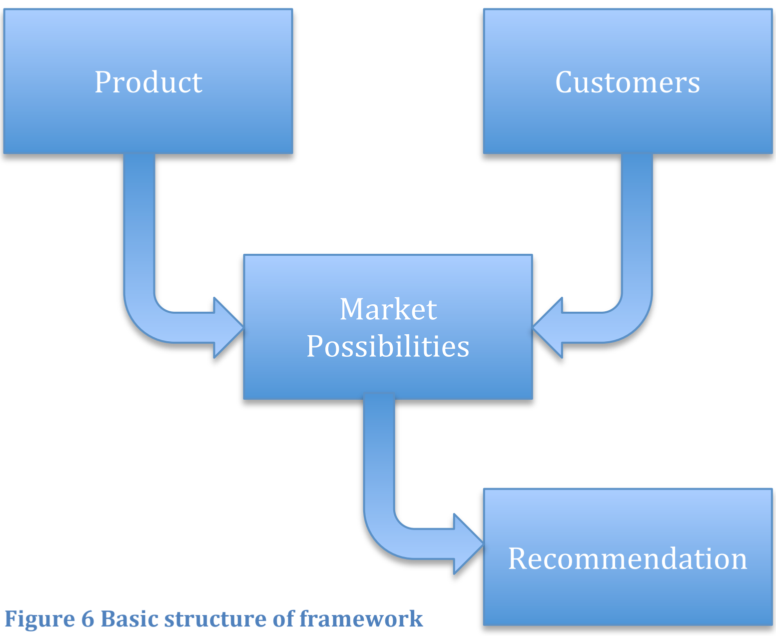

Figure 6 Basic structure of framework

4.2 Framework for analysis of customers

The trend is that customers are more demanding and knowledgeable and therefore it is important to understand the customers to be successful in the market. Woodruff (1997) claims that to understand the costumers and create a superior customer value is a major source for getting competitive advantage. This statement is something that is supported by Slater & Narver (1994), they also claim that in order to preform above industry average it is important to have a competitive advantage by mainly delivering and creating sustainable value to the customers. To be able to stay competitive in a niched market and gain a leadership position in that market, a precondition is to understand how to create superior customer value (Day, 1990).

To understand how to create customer value and how to find the customers this framework will explain the adoption curve and how lock-in effect can influence the customers.

4.2.1 Adoption Curve

Different customers choose to adopt an innovation at different stages of its development process. Some customers are bolder and willing to adopt a new product, even though it isn't fully developed, while others need a guarantee that it works properly before adopting it. Rogers (2003) divides them up into five segments: Innovators, early adopters, early majority, late majority, and laggards.

Innovators and early adopters are risk-takers that take a chance on a new product even though the value of the product isn't obvious yet, while the early majority and late majority are more careful and wait until they have proof of its value (Furr & Ahlstrom p. 32, 2011). This framework, similar to the work of Anderson, Varnhagen, & Campbell (1998) and Zayim, Yildirim & Saka (2006), will be divided into two major segments, which in this thesis will be called initiating adopters and mainstream adopters.

Initiating adopters

Innovators: This segment consists of pioneers that adopt a new idea in its early stage. They are few, tolerant of shortcomings, accepting of uncertainty, and willing to invest a lot of time and effort in the idea in order to improve it (Rogers, 2003; Sahin, 2006). Rogers (2006) called them the gatekeepers that bring in the innovation to the system.

Early adopters: The early adopters are a bit more careful then the innovators, but as soon as they see some benefits from the innovation they become interested and jump in. Early adopters are seen as visionaries that see the potential of the innovation early, and are looking to get an advantage by being first (Moore, 1999; Rogers, 2003). The members of this segment tends to hold leadership roles and are typical opinion leaders (Rogers, 2003) that is why their role is important, because they validate and make the innovation visible to the mainstream, which decreases the uncertainty of it (Ram & Jung, 1994; Jacobsen, 1998)

Mainstream adopters

Early majority: This category of adopters are the first segment of the mainstream adopters, and they usually take a bit more time then the previous two to decide whether or not to adopt an innovation (Sahin, 2006). The early majority needs solid proof of benefits before they choose to adopt, which makes them more risk averse and more cost sensitive. They do not tolerate shortcomings of the product as the innovators or the early adopters, instead they want a product that is fully developed, simple, and that will provide a value instantly (Rogers, 2003).

Late majority: This segment is not much different then the early adopters, the difference is that they are even more careful and less willing to take risks (Rogers, 2003). Before they can adopt an innovation, there has to be some mainstream users.

Laggards: They are the last segment to adopt the innovation, and are typically skeptical to it. According to Rogers (2003), the laggards hold out to the end before they adopt, mainly because they have to, and because they want to take as little risk as possible.

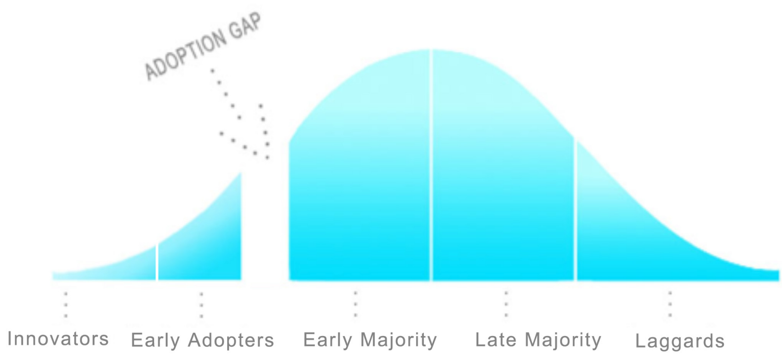

Figure 7 The adoption curve and its segments with the adoption gap

Rogers (2003) highlighted that only innovations that are successful form a curve like the one in figure 7 during their life cycle. In most adoption processes there is a leap from a small-scale usage to getting a majority to adopt an innovation, Moore (1999) calls it the chasm. According to Furr & Ahlstrom p. 33 (2011), there are a lot of innovations that don't get to the mainstream users and fail to cross the chasm, mainly because the early adopters and mainstream adopters have different needs and purchasing requirements. To cross the chasm and go from the early adopters to the mainstream market, the product needs to have a proven value and low uncertainty, in order to convince the mainstream adopters to take the risk and adopt the innovation. This requires that the product is simple to use, easily accessible and provides a higher value for the customer, and then it has a chance to cross the chasm.

4.3.2 Lock- in effect

Customer lock-in is a critical factor when evaluating different firms' market power. If the customers are limited in their flexibility to switch to another service provider or product, due to switching cost, then for example it will decrease the elasticity of demand, which may lead to price increase (Teece et al. 1997). It may also raise the barriers for competitors to enter the market, or existing competitors to be able to expand, giving the incumbent firm to get a very strong market position.

According to Arthur (1989) there isn't necessarily the superior technological variant that becomes the dominant design and thereby locks the other technologies out. Instead Arthur (1989), says that inferior designs can become locked-in on the market through a path-dependent process in which timing, strategy and historical circumstances, as much as optimality, determine the winner. This is something that Unruh (2000) claim has happened in the energy sector. Unruh (2000) claims that industrial economies have become locked into fossil fuel-based technological systems through a path-dependent process, driven by technological and institutional increasing returns to scale. This is established through a co-evolutionary process among technological infrastructures, organizations, society and governing institutions, which Unruh (2000) select to call techno-institutional complex (TIC). Below a table 1 shows some examples.

Unruh (2000) further say that TIC might create barriers and delay new green technology but it can't prevent it.

Lock-in source	Examples
Technological	Dominant design, standards technological architectures and components, compatibility
Organizational	Routines, training, departmentalization, customer-supplier relations
Industrial	Industry standards, technological inter-relatedness, co-specialized assets
Societal	System socialization, adaption of preferences and expectations
Institutional	Government policy intervention, legal framework, departments/ministries

Table 3 Sources of lock-in

4.3 Framework for analysis of product

When a new product enters a market there are allot of different factors that can determine weather the product will be successful or not, regardless of the product itself. Factors as adoption rate, network effect, complimentary products, and dominant design can all affect the product in different ways depending of the strategy.

Therefore this framework will go through attributes for successful products, market probability, and how collaborations and dominant design can affect the product's success.

4.3.1 Attributes of Successful Innovations

According to Sahin (2006), an innovation can be an idea, behavior, or object that was invented a long time ago, but it is unknown and perceived as new to an individual. A major obstacle that stands in the way for an innovation to be adopted is uncertainty (Rogers, 2003). It is important for a company to be informed about the innovation's advantages and disadvantages in order to reduce the uncertainty.

Rogers (2003) brings up five characteristics of an innovation that can reduce the uncertainty of an innovation, namely; Relative advantage, compatibility, complexity, trialability and observability. By having good knowledge about an innovation it is easier to appreciate it's value, which can speed up the rate of adoption. It's believed that if an innovation possesses these five characteristics the adoption process will be faster.

Since this thesis is conducted to investigate the potential to convert and adopt a new energy source, the trialability will be a trivial feature because it is hard to test a new energy source without completely converting to it. The rest of the characteristics will be further described:

Relative advantage: Rogers (2003) defines it as "the degree to which an innovation is perceived as being better than the idea it supersedes" (p.229). A company will only adopt a new type of energy source only if it provides a higher value then the one they use today. Economic profitability, reduced cost, or multiple application area usages are typical attributes that decide the level of advantage (Rogers, 2003). Relative advantage has proven to be one of the best indicators of an innovation's rate of adoption, the greater the relative advantage is perceived, the faster it will get adopted.

Compatibility: According to Rogers (2003) "the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters" (p.15). Customers have certain needs that are met by their existing product, in order to get them to adopt a new product it has to fulfill at least the same needs and values. Sometimes customers don't know they have a certain need, until they are aware of the innovations results. As Henry Ford[3] said, "If I had asked people what they wanted, they would have said faster horses". A product that is at least compatible with customers existing needs and if this is clearly noticeable, then the uncertainty of the product is reduced (Sahin, 2006). The more the product fits into customer's current requirements the smoother the transfer will be.

Complexity: Rogers (2003) explains complexity as "the degree to which an innovation is perceived as relatively difficult to understand and use" (p. 15). Innovations that require the user to learn new skills often get adopted much slower then those that are easy to use. People in general have a hard time adjusting to change; therefore a high degree of simplicity in a new product usually facilitates the transition and speeds up the adoption.

Observability: "The degree to which the results of an innovation are visible to others" (Rogers p. 16, 2003). It is important for a new product to have clear and visible results in order for customers to appreciate the value of it. The more the results are visible the lower the uncertainty will be towards the product, and the easier it will be to communicate to others the value of it.

Why some products get adopted and other doesn't, or not to the same extent, can't be explained to 100%, but according to (Rogers, 2003; Sahin, 2006) a product that possesses the above-mentioned characteristics are more likely to get adopted.

4.3.2 Market competition and profitability

For this thesis Porter's five forces will be used to determine the competitive environment for LNG, and to discover potential growth and profitability for it in the Swedish food and brewery industry. Since the analysis will be made on a fossil fuel, which is highly influenced by macro factors, it will not be enough to just consider Porter's five forces. Therefore a PEST-analysis will be made as an additional "sixth force".

PEST-analysis

To determine if a product will be prosperous it is hard to do for sure, since there are several factors, both macro and micro, that affects the profitability. It is important to be mindful of major external factors. The following factors are explained according to the article A Level of Achievement PEST-Analysis (2004):

3 Henry Ford was an American industrialist that founded Ford Motor Company and contributed to the development of the assembly line technique of mass production

- Political factors - Environmental regulations and taxation policies
- Economical factors - Economic growth, taxation, and inflation rates
- Social factors - Attitudes and perceptions
- Technological factors - New inventions and developments, and rate of technology transfer

These factors are forever changing and can't be controlled, but preparation can be made to determine a strategy to cope with major events that might occur.

Porter's Five Forces

A common tool that is used to determine the competitive environment and profitability in a market or an industry is Porter's five forces. The five forces consist of competition from substitutes, threat of entry, jockeying for position, and supplier and buyer bargaining power (Porter, 1979; Grant, 2010).

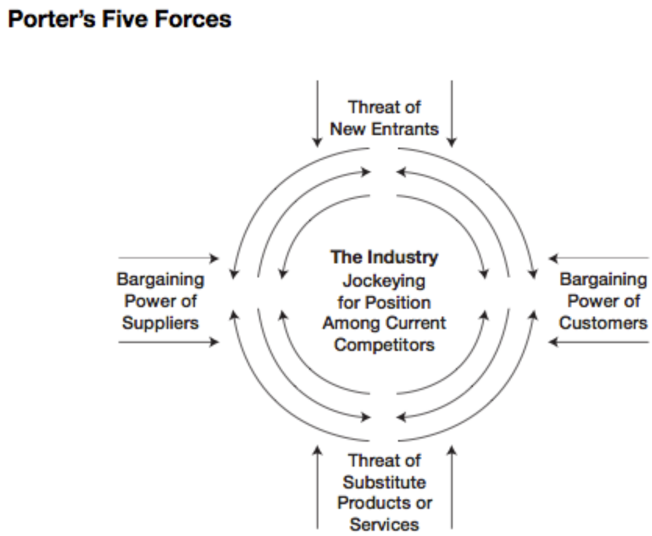

Figure 8 Porter's five forces (Porter, 1979)

Competition from substitutes: The more choices a customer has, the easier it is for them to choose one that fits their needs the best. Grant (2010) claims that the number of substitute products determines customers' price elasticity. A high level of close substitutes, increases the probably that customers will shift to the one with the best offer. To decide weather to switch or not, customers consider the trade off between the substitute product's value and performance, and the difficulty of switching and using it (Porter, 1979; Grant, 2010).

Threat of Entry: New entrants to a market are aiming to grab market shares and adding a new option to the market, which often leads to higher competition and lower prices or drives up the costs. Most industries make it difficult for new companies to enter, according to Porter (1979) the seriousness of the threat of a new entrant depend on, how high the barriers to entry are. Relevant barriers for this thesis are: Economics of scale, capital requirements, cost advantages and governmental or legal barriers.

Jockeying for position: A rivalry between established competing forces are in most cases the main determinant of the level of competition. This depends on the concentration of competitors, diversity of competitors, and product differentiation (Grant, 2010).

Bargaining Power of Buyers and Suppliers: The barging power of buyers depends on two factors, their price sensitivity and relative bargaining power. Buyers' price sensitivity will be affected by a trade off between the importance of the product and the cost of it, transaction cost to switch to other suppliers, intensity of competition among buyers, and how important the supplier's product is to the buyer's final product (Grant, 2010).

A buyer's relative bargaining power depends on several factors:

- How large volume of the product they purchase
- The concentration buyers compared to suppliers
- To what extent buyers are informed about the product and industry
- Whether the buyers have the ability to supply the goods themselves

(Grant, 2010) & (Porter, 1979).

For this thesis the suppliers are commodity suppliers. According to Grant (2010), commodity suppliers are small companies that supply large manufacturing companies and have a low bargaining power, to increase their bargaining power they form cartels e.g. OPEC.

The factors that affect a supplier's bargaining power are similar to the ones of the buyer, just that in this case the firms in the industry are the buyers (Grant, 2010).

4.3.3 Collaboration

Often firms don't have the right competence or the capabilities to develop a new product or don't have the right infrastructure to reach the right consumers for their product. Because collaborations with other firms or organizations can often enable the firm to achieve more then they can achieve alone, at a faster rate, and with less cost or risk.

The advantages with collaborations are many but the most common one is that it can enable a firm to obtain necessary skills or resources more quickly than developing them in-house (Schilling, 2010). By collaborating with another firm it is possible to get rapid access to important complementary assets as a ready infrastructure for your product. Other benefits with collaborations are the possibility to obtain necessary capabilities or recourses for reduce its asset commitment and enhance its flexibility, it can be an important source of learning, and the firms share the costs and risks (Schilling, 2010).

In isn't always an advantage to collaborate, some reasons for going solo are because needed capabilities are available, if the firm want to protect proprietary technologies, and if the firm want to control the technology development and use (Schilling, 2010). Another reason for going solo can be that there may not be any available partners that are appropriate or willing to collaborate.

4.3.4 Dominant design to get an increased return

A reason for markets to merge around a single dominant design rather then support a variety of technological options is that many industries experience increasing return to adoption. This means that the more the technology is adopted, the more valuable it becomes. The value of a new product offers a customer, consists of different things. The combination of the products technical value combined with the installed base, and the complementary goods availability makes up the costumer's total value. The value of the technology that does not change when the installed base changes is called the technology's stand-alone value, the model is seen in figure 9 (Schilling, 2010). (Duan & Chen, 2007) have a similar approach saying that installed base and quality are two key factors to achieve success with a new product, which factor being the most important depends on the strategy for the product.

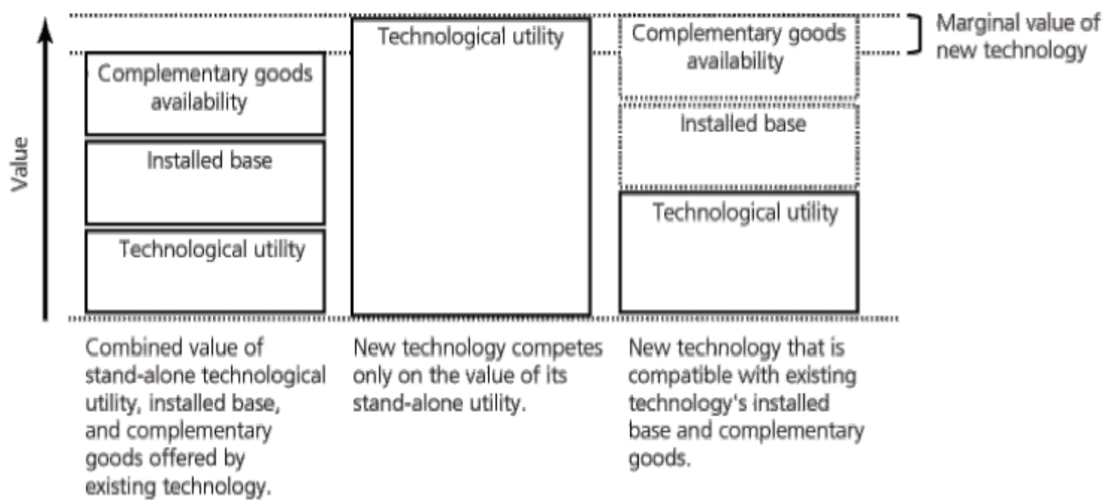

Figure 9 Product Value (Schilling, 2010)

There are manly three different sources for increasing returns and thereby also to become a dominant design and those are scale effects, learning effects, and network effects, but also in some industries government regulations can have a big effect (Schilling 1999). Scale effects or economies of scale, meaning that as productivity increases the cost for each produced unit will decrease, as the fixed cost will be divided into more units.

Learning effects describe how the organization accumulates experience to become more efficient. It is more common for companies to build on their own knowledge base instead of approaching unfamiliar areas. Firms may refine the technology to develop complementary assets, which in turn enhances the value and attractiveness for other firms to adopt the original technology. (Schilling 1999)

Network effects can be defined as, when the economic utility of using a product gets larger as the number of suppliers or users increases. In some industries or markets where different technologies are battling for a dominant design the government can go in and regulate by enact laws or by put in a large order, if the government think that one technology will benefit the majority of the population more then another.

It is important to understand the sources for increasing return and their consequences to be able to deal with the challenges with competing on the market with a product. The challenges are manly (1) fighting the battle for technological standard, (2) influencing customers' expectations, (3) avoiding lockout situations, (4) shaping network competition and (5) exploiting the installed base (Hartigh & Langerak 2001).

4.4 Summary and Main-Framework

The theoretical framework presents relevant concepts from the literature that will be used later in the analysis to answer the research questions. As explained earlier this chapter is divided into two sub-frameworks that combined will create a main-framework. The sections below provide a brief summary of the most important findings in the theory chapter.

4.4.1 Customers

These sections explain how the costumers affect the product. The main takings are.

- Customers are different when it comes to willingness to adopt new technologies.
- Innovators and early adopters is the two customers segment that should be approached first when presenting a new product on the market.
- The innovators and the early adopters are the customer segments that help the product's development and its infrastructure.
- To reach the majority of the customers the chasm has to be crossed.

- Costumers' lock-in is important to limit the costumers to switch to another provider and decrease the elasticity of demand, which may lead to price increase.
- Lock-in is often determined from a path-dependent process, in which timing, strategy, and historical circumstances, as much as optimality, determine the winner.
- There are tendencies of a lock-in effect on fossil fuels.

4.4.2 Product

These sections explain how the product can be affected of different structures on the market. The main things are.

- Five characteristics of an innovation that can reduce the uncertainty and speed up the adoption of an innovation, namely; Relative advantage, compatibility, complexity, trialability and observability.
- To get the right capabilities or infrastructure for a product it can be important to collaborate with firms that have the complementary needs.
- Since the fossil fuel market is highly affected of macro factors in the world, a PEST-analysis will be used as a "sixth force" to Porter's five forces to determine the competitive environment for LNG.
- The combination of the products technical value combined with the installed base and complementary goods available makes up for the costumer's total value.
- Dominant design will give an increased return.
- There are manly three sources for increasing returns scale effects, learning effects, and network effects.

5. Empirical Findings

This chapter presents the empirical findings of the main study. The chapter is independent form the theoretical framework and the findings will be used later in the analysis to answer the research question. The findings consist of data from interviews, energy- and governmental reports, and previous energy studies. It starts with a motivation of chosen industry and its needs and capabilities followed by key factors effecting choice of energy source within the chosen industry. The chapter goes on with pricing, a generic case, the choice of fuel and willingness to convert.

5.1 Choice of industry

The food and brewery industry is the chosen industry to do this study on since it is believed to fit the framework from the pre-study. The hypothesis investigated for this study is, "Is the food and brewery industry a good fit for LNG, since it has a need for producing steam, a cooling need, and they often manage their own transport of their goods", these are three areas where LNG can be utilized in.

5.2 The food and brewery industry needs and capabilities

The food and brewery industry have primarily a need of producing steam to their production both for cooking food and brewing beverages. The steam can be produced in many different ways, but the most common way today is by oil or LPG since it seems to be the best price alternative. This industry has also a large cooling need since their goods often needs to be refrigerated. The refrigeration plants are mainly operated by electricity. The companies that have their own truck fleet often have between 10-15 trucks driving to different collection destinations in Sweden.

5.3 Key factors affecting choice of energy source

When taking a new investment decisions in food and brewery industry there are numerous external- and internal factors that affect the decision. Following are the relevant factors presented.

5.3.1 Price

The price for the different fuel alternatives may vary considerably during a normal year. Allot of different factors can affect the price, some energy sources varies during the year depending on the season e.g. electricity other energy sources varies allot depending on availability and world politics, especially oil but also natural gas and LPG. Therefore it is important to have the possibility to secure a good price over time, since small changes in policies can make the investment unprofitable. But for some energy sources it can be very hard to secure good prices over time. This has forced some industries to run their production on two or more different energy sources to spread the risk and optimize the price.

5.3.2 Reliability

Producing steam, which is what is needed in the food and brewery industry, there is allot of different alternatives. But some is less reliable then other e.g. something that is very popular right now is to try to use different types of biofuels. But that often is produced locally, which means that you become very dependent of that supplier and if that supplier goes bankrupt there is very hard to find another one. Therefore it is very impotent to have reliable energy source that can be bought in a functional market place with several players. These lower the dependents on one single player and increase the flexible.

5.3.3 Collaborations

Since many of the plants within the food and brewery industry are located in the countryside and thereby in smaller municipalities, collaborations with the municipalities are often common. An example is that the food and brewery industry has own waste that can produce biogas; therefore there is an interest in using biogas in their production or selling it to a biogas facility. Since a biogas facility is very expensive there is a need of partners to make it happen and municipalities are often a good partner, since a biogas facility is good for industry establishments and PR. But this is a long and complicated process and has in many cases not progressed beyond the planning phase because it has become too expensive.

Another common way of collaboration is by getting the steam directly from a district heating plant. This however requires that the district heating plant is located close to the food or brewery industry since the energy is transported directly from the plant. This is in many ways a very good solution due to it is possible to get direct steam and thereby can avoid producing it; the disadvantage is that one becomes very depended on the district heating plant.

5.3.4 Taxes and Environmental Impact

The Swedish government has a vision that Sweden shouldn't have any net CO_2-emissions by 2050 (Svensk Energi, 2012). One step in that direction is the Swedish government taking now. Today industries get a large subsidy on carbon dioxide and energy tax when using of fossil fuels, up to 70%. But the 1 January 2015 this tax subsidy will be reduced to 40%. This has lead to that those industries that have the ability to switch from fossil fuels to renewables such as bio-oil, biogas or pellets considering it. The goal with this tax is to reduce greenhouse gas emissions by two millions tons by 2020. Figure 10 below show the change in how much of the fossil fuel taxes that have to be paid by the industries. This makes the environmental impact very important since the taxation rules from the government are regulated after how much environmental damages the different energy source does.

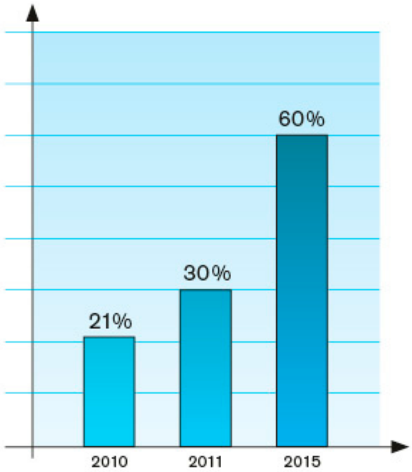

Figure 10 Tax changes for fossil fuel

5.4 Industry knowledge of LNG

The food and brewery industry knowledge of LNG is mixed. Some companies have looked at LNG and considered it and others have not even discussed it. Those companies that hasn't looked into LNG, is mainly because natural gas is a fossil fuel and some companies has as goal to be fossil free in the future.

In those situations where LNG has been looked at as a main fuel it has been excluded because of better alternative such as pellets or getting direct steam from district heating plants. A big reason for that is the tax relief on fossil fuel for industries that changes on the 1st of January 2015, from 70% to 40%. This means that after the 1st of January, industries have to pay 60% of the fossil tax. This makes fossil fuel free alternatives as pellets more profitable compared to the fossil fuels alternatives. But in some cases when biogas has been of interest for the company, LNG has been considered as a complementary fuel. Since it is very hard often to secure the right quantities of biogas. One example of that is one brewery that had a plan of running their production on biogas with a EU-contribution and use LNG as a complementary fuel. This plan was shut down because the brewery decided instead to enter into an agreement with a nearby district heating plant to get direct steam from them.

In the case of using LNG in different applications of the operation e.g. for transport and cooling there is a lack of knowledge. Only in one case, where LNG had been looked at, did the company consider using LNG in other applications then in the production. In that case the amount of LNG needed in the production would become too small, so they considered building a tank station for LNG where they can tank their trucks, in order to get the consumption of LNG up. The most common reason for the rest of the companies to not consider LNG for transportation is that they don't own their transportation, instead they hire other transportation firms to deliverer their goods. When it comes to the cooling there is a general knowledge that it is possible to use it but the knowledge how and to what extent it can be used is very limited.

The knowledge about LNG within the food and brewery industry is limited, since it in many cases has not even been considered as a fuel. Mainly because of taxes changes for fossil fuels, not competitive prices, and that there are fossil fuel free alternatives out there that are competitive in this industry. But the attitude in the industry can change if biogas becomes more relevant, since LNG is very homogenate with biogas and can there by be a good complement.

5.5 Pricing

This chapter will explain how the natural gas and LNG trade looks today globally and in the Swedish market, different methods for pricing of natural gas, in what part of the world each pricing mechanism is used and predictions for the future price will be addressed.

5.5.1 Pricing in the world

All though renewables have a steeper growth rate than fossil fuels, it is not completely viable yet and the fossil fuels will still dominate the coming decades with natural gas as the fastest growing energy source (U.S. Energy Information Administration, 2013). Today there is no pricing mechanism that is used globally for natural gas; instead it differs depending on what part of the world you are in, how the contract structure is set up and the timing. The pricing of gas can mainly be organized into four categories; namely Hub-based, Oil-linked, regulated and subsidized (World LNG report IGU, 2011).

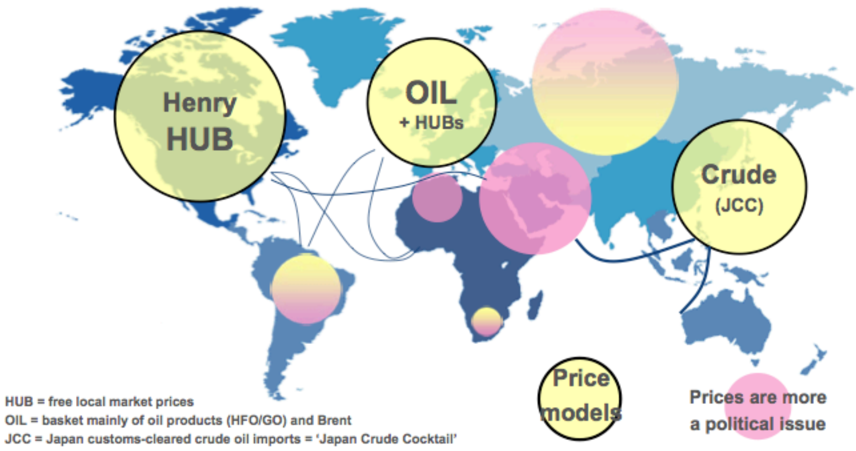

Figure 11 Different pricing mechanisms around the world (Bergen Energy, 2011)

The most common mechanism that is used is oil-indexation; due to historical reasons, where the production and trade was done locally (Melling, 2010). This is mainly done in Europe and Asia while in the US trading is done through hubs. For the last two decades Europe has also began to use hubs for pricing of natural gas, which has divided the continent into having two ways of setting the price of natural gas. At the moment there is a battle going on to decide what way will become the standardized way to set the price of natural gas. According to Skangass, the trade of LNG is moving towards hub pricing, mainly because it has been cheaper the last couple of years, which can be seen in figure 12 below. Although hub based pricing are the cheaper alternative today it doesn't mean that it will stay like that forever, even so Stern & Rogers (2011) believes that hub pricing will become the dominant way of pricing in Europe.

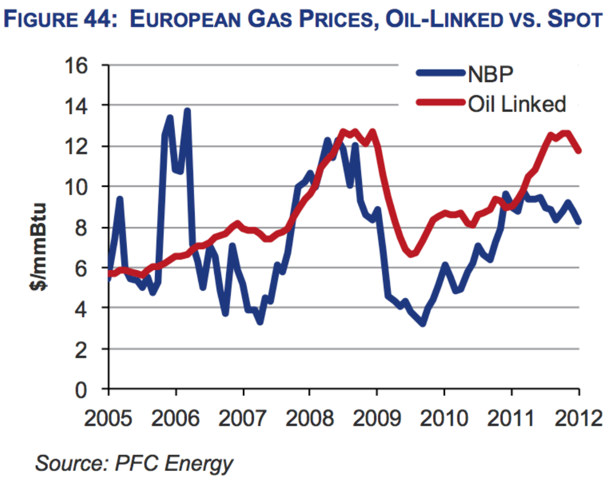

Figure 12 Shows how the pricing trend has changed for oil-linked pricing and for hub pricing (World LNG report IGU, 2011)

Traditionally LNG is long term contracted and linked to oil prices, but the last couple of years spot pricing[4] has become more popular. Although the trading of LNG has decreased in 2012 for the first time (BP Statistical Review of World Energy, 2013), it is expected to double from 2010 through 2040 and represent the fastest growing share of the international trade in natural gas (U.S. Energy Information Administration, 2013). Figure 13 below show the natural gas trade movements in 2012.

[4] Spot price is the current market price that a commodity can be bought or sold and immediately delivered.

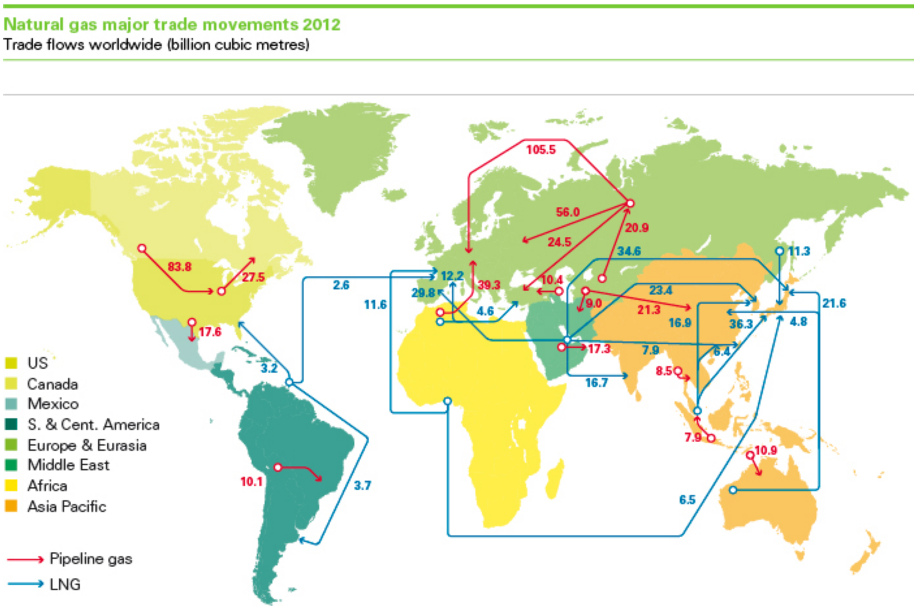

Figure 13 Natural gas trade movements in 2012 (BP Statistical Review of World Energy, 2013)

Since the Fukushima nuclear power plant accident in Japan in 2011 the LNG market has shifted from not having a big enough demand to having a shortage of supply (World LNG report IGU, 2013). Together with raised oil prices and the increased LNG demand, after the Fukushima disaster, the spot prices for LNG has risen significantly around the world with the prices in Asia being in the top. Gas prices are displayed in figure 14 bellow. According to Skangass, the high prices in Asia makes it much more attractive for major actors to put their operations in Asia instead of other continents e.g. Europe. This leads to a shortage in the supply in Europe, which will increase the price to similar levels as in Asia.

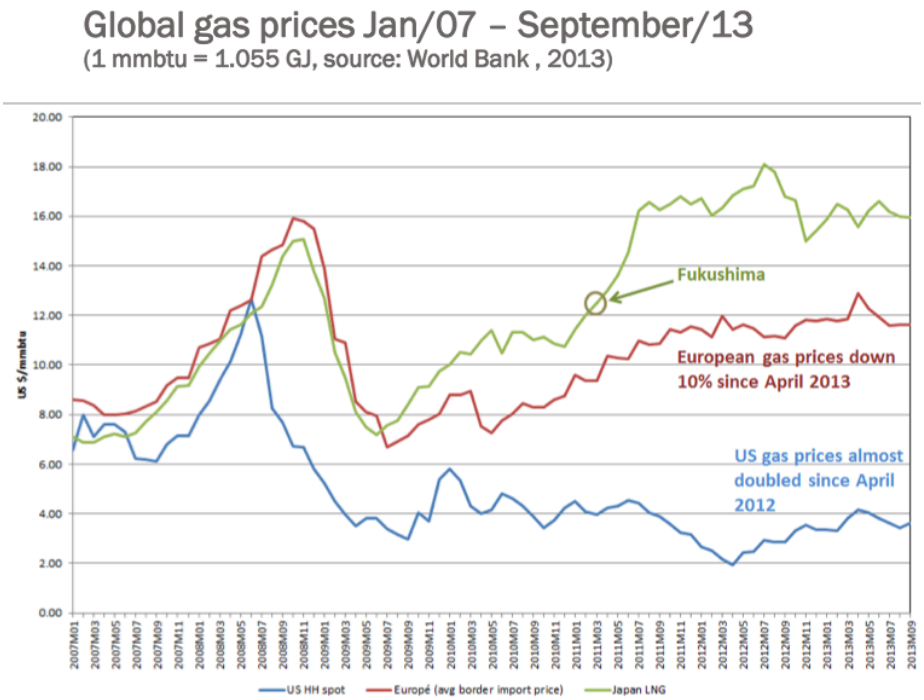

Figure 14 Gas price in Japan, Europe, and the US (The Role of Unconventional Gas in Global Gas Supply, 2013)

In the US the prices on natural gas have gone down instead of up, unlike other parts of the world. This is because of the increased extraction of shale gas in the last couple of years, with gas prices in US being 68% lower then in Japan during 2011 (World LNG report IGU, 2011). The shale gas is projected to correspond for half of the natural gas production in the country by 2040 (U.S. Energy Information Administration, 2013). With the US gas production increasing, thanks to the shale gas, the US don't have the same need to import LNG, instead the US has the potential to become a massive LNG exporter.

Skangass believes that it will take some time before the US becomes a major LNG exporter; they need to build the infrastructure first in order to make an impact on the global LNG trade. The biggest obstacle for the LNG export in North America is to get governmental approval to export and build liquefaction facilities. In 2013 there have been 26 new liquefaction projects proposed, showed in figure 15, with 20 being in the US and six in Canada.

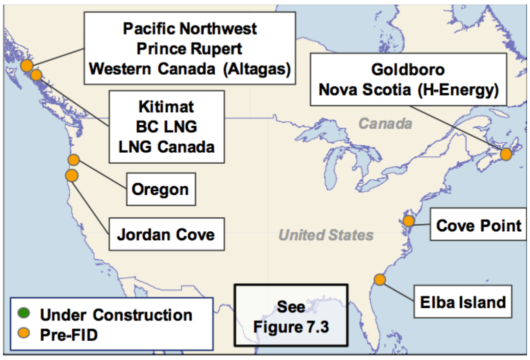

Figure 7.2: Location of Proposed North American Liquefaction Projects, excluding Gulf of Mexico

Sources: PFC Energy Global LNG Service

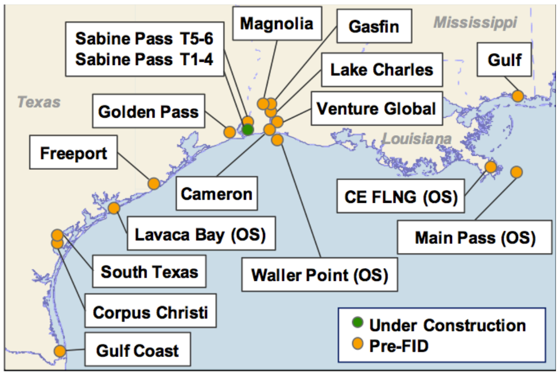

Figure 7.3: Location of Proposed North American Liquefaction Projects, Gulf of Mexico

Sources: PFC Energy Global LNG Service

Figure 15 Displays the proposed liquefaction projects in North America (World LNG report IGU, 2013)

Depending on the outcome of the political decisions in North America the LNG market might go through a major change in the next coming years, since the US will be able to offer its' low prices to the rest of the world. But it is not only the US that has shale gas reserves; there are a lot of other countries that could follow. If other countries would follow, then the same trend can occur in other parts of the world as in the US.

5.5.2 Pricing Sweden

The Swedish and the Scandinavian market is still a small market with a low level LNG trade without an own hub for competitive pricing. Like in the major part of Europe the dominant pricing mechanism of natural gas in Sweden is through oil-index. According to Skangass, who are the major suppliers of LNG in Sweden, it is important to acquire a portfolio with both oil linked natural gas and natural gas bought at hubs, to make sure that you can offer the customer both alternatives.

Sweden is an expensive country and has a remote location from the European continent, which doesn't make it a top priority for companies to invest in. Two companies, Skangass and AGA, dominate the Swedish LNG market. This doesn't give the users much bargaining power since there isn't a lot of competition among the suppliers, which is a contributing factor to the high prices in Sweden. Another reason for the high prices is an insufficient infrastructure that needs to be developed before LNG can become completely competitive.

The value chain below shows the price for the different activates for buying LNG on the Swedish market. The three first steps in the value chain are designed by Bergen Energi (2001) and the last step was calculated with the help of the model given in Liljemark (2006). The figure 14 shows the spot price for three different hubs in Europe over time. When Swedish actors buy LNG from hubs with spot price it is most common to buy from GTF (Gas Transfer Facility) now days, it is a new hub located in Denmark. The hub has both competitive prices and is nearest the Swedish market.

Value chain for Swedish market

100 to 500 SEK/MWh	50 to 100 SEK/MWh	50 to 100 SEK/MWh	20 to 50 SEK/MWh

Which source?

1. Import from small scale LNG as Norway
2. Other European regas terminals?

Which route?
LNG cost of transmission depends on:

- Maritime distances
- LNG carriers size
- Number of off-takes by carrier

Storage capacities?
How to follow the demand pattern on short term?

- Physical storages
- Flexible supply

Transport from nearest storage facility to end-user a distance of 100-350 km by truck

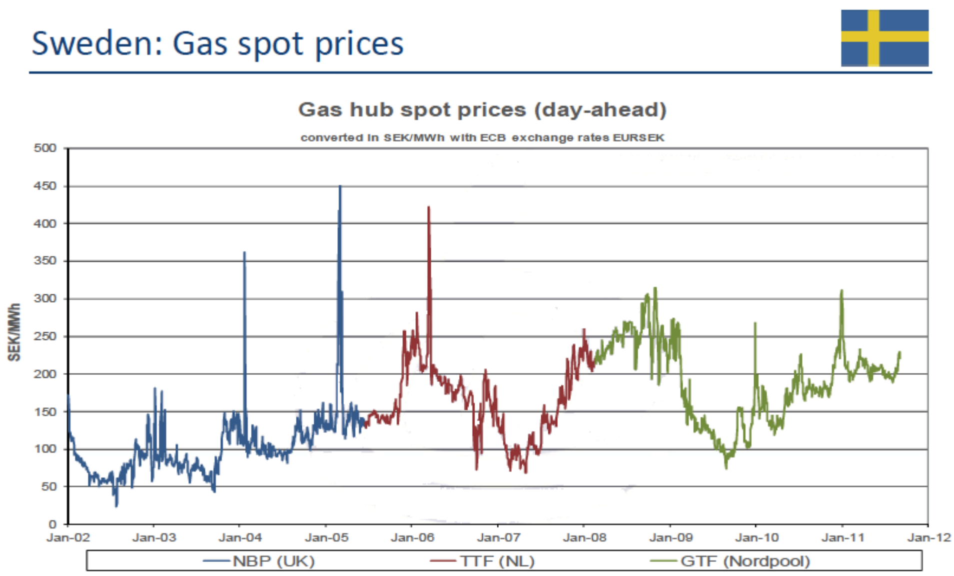

Figure 16 Spot prices for natural gas (Bergen Energy, 2011)

From the value chain it possible to see that the first step is the step that affect the price, by far, the most. But it isn't a step that is possible to affect so much, from a Swedish perspective. The rest of the three steps is supply chain and here prices goes down with size, and also here it is possibilities to reduce those costs. With bigger carriers, more takeoffs from carriers, and more import terminals; the prices all over the supply chain will go down.

5.6 LNG utilization in different areas

In this chapter a case will be presented for LNG usage in different areas.

5.6.1 LNG for transportation

Gas has long been used as a fuel within transportation but it has been difficult to use gas for longer transports, since gas takes allot of space, which makes it hard to fuel large quantities. Volvo trucks have now developed a new solution in which they run methane gas in liquid form (LNG) with a small amount of diesel in a diesel engine. This new technique will double the mileage between the fuel stops which will give a driving distance up to 800km on LNG (www.volvotrucks.com). By using gas in liquid form that has a higher energy density then pressurized gas (CNG) which often been used before, makes it possible to store more fuel in the tank. The Volvo tuck has also the flexibility to run on only diesel.

5.6.2 LNG for cooling

LNG as mentioned before is liquefied natural gas frozen to -163°C but the gas evaporates when it will be used. This will make it possible to use the cold for ventilation or for process cooling, as for refrigeration.

5.6.3 Case-study on a food manufacturer in Sweden

A case on an average food manufacturer in Sweden is done below to estimate how much difference it makes to utilize LNG in different applications in its operation. A typical food manufacture is in need of an energy source for steam production, has a cooling need, and often has an own truck fleet. In this case it is assumed that the company has 12 trucks. The annual consumption in the production is assumed to be 15GWh LPG. The case will look on using LNG in mainly three areas, production, cooling, and transport, in the operations to calculate its profitability. The calculation is an approximation to get an overview, so precise numbers hasn't been used.

Fuel used in the factory

As mentioned above the consumption assumes to be 15GWh gas every year, which recalculated in liters, is:

Data:
Natural gas: 5,8kWh/liter[5]

15 000 000/5,8 = 2 586 207 liter/year

Transportation
Assumptions:
- 12 Volvo FM/FMX trucks
- Large tank that holds 540 liter LNG
- The trucks works 300 days/year and refuels every workday

That will give a consumption of:

$12 * 540 = 6\ 480\ liter$ LNG/day
$6\ 489 * 300 = 1\ 944\ 000\ liter$ LNG/year
$1\ 944\ 000 * 5{,}8 \approx 11$ GWh/year

Cooling
Here below is an overall estimation provided of how much energy might get out from combustion of 15GWh LNG.

Formulas:
$Q_v = m * c_p * dT$
$Q_k = l * m$

Q_v – Energy extraction at temperature change Q_k – Energy extraction at phase change m – Mass c_p – Specific heat capacity dT – Temperature difference l = Enthalpy

Data:[6]
1 kg LNG = 15 kWh
c_p = 1,7 kJ/kg * C
l = 775 kJ/kg
dT = 23C
1 kWh = 3 600 kJ

Calculations:
15 GWh = 1 000 000 kg
Q_v = 1 000 000 * 1,7 * 23 = 39 100 000 kJ
Q_k = 775 * 1 000 000 = 775 000 000 kJ
$Q_v + Q_k$ = 814 100 000 kJ = 226 MWh

With a efficiency of 80%
0,8 * 226 139 = 181 MWh

[5] http://www.bng.no/om-naturgass/
[6] http://www.technifab.com/cryogenic-resource-library/about-liquified-natural-gas-lng.html

Summery of the Calculations
Savings on cooling with an average price on the electricity of 0,6 SEK/kWh
Saving every year:
180 811 ∗ 0.6 = 108 547SEK
Saving per kWh:
108 547/15 000 000 = 0.01 SEK/kWh

Consumption of LNG = 15 + 11 = 26 GWh
An increase of 11/15 = 73% compared to if only using LNG in the production.

This case, which is quite common in the food industry, shows that it is possible, in this case, to save approximate 0.01SEK/kWh or 100000SEK/year by utilize the cold from the LNG. This has to be considered against the investment cost for utilizing the cold and in the food industry that is in need of cooling year round it might be profitable. This case also shows that by driving the truck fleet on LNG it is possible to increase the volume of LNG with 73%, which is a significant increase. Now it is very hard to say how much cheaper it will be to buy 73% larger volume but it will most likely make a difference. This makes it also possible to achieve a higher volume of LNG, which allows the company to reach the critical volume, as figure XXX bellow illustrates.

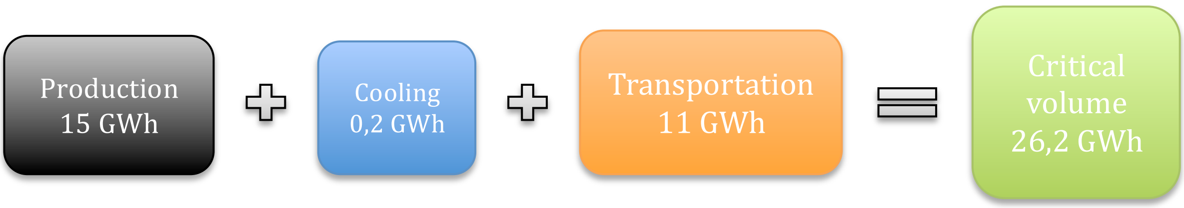

Figure 17 Usage in different applications for case study

5.7 Competitive alternative to LNG

This part will shortly describe alternative fuels and energy sources to LNG that is used on the Swedish market, and these will be compared with LNG.

5.7.1 Oil

Oil is a commonly used fuel in Swedish industries, especially in companies that haven't made any production changes or improvements the last couple of years. The environmental impact of oil is quite larger then the one of natural gas, by using natural gas CO_2-emissions can lower 20-30%, a reduction of NO_x with 80-90% and a 100% reduction of sulphur can be made (AGA magazine, 2011)

5.7.2 Liquefied Petroleum Gas (LPG)

LPG is a popular energy source choice at the companies that was interviewed, and it was noticed that LPG has similar attributes as natural gas. The environmental impact is about the same for the two alternatives and there is no big difference transporting them. The price is quite similar as well, but it differs depending on the distance from the LNG terminal to the factory. A factor that was pointed out by some interviewed companies that natural gas was a friendlier gas to use since it is odorless and light. So from a safety perspective natural gas seems to be preferred. There is one part that differs these two significantly, which is that the infrastructure. LPG has a much more evolved infrastructure and is accessible to major parts of the country.

5.7.3 Pellets

While oil, LPG and other fossil based fuels will have a problem with the CO_2-emission tax increase that comes in to effect in 2015, pellets are in the clear since it is almost CO_2-neutral. This makes pellets an attractive alternative plus it is much cheaper then LNG, LPG and oil. Another reason why pellets are so popular now a day, for companies willing to convert from fossil fuels, is because they can reuse their waste and save a lot of money by producing their own energy.

Although pellets seem like an optimal alternative, it has difficulties in some cases. Pellets can't provide the same amount of energy as LNG, oil, or LPG e.g. three m^3 pellets is equivalent to one m^3 of oil. This is why pellets work well in the food and brewery industry, since they don't have high-energy requirements. In heavier industries, where the production have a higher energy demand, it is not possible to use pellets, instead gas or oil is a much more suiting option. Also pellets can't be used where the energy output is in direct contact with food, since small particles from the pellets can get mixed with the food.

5.7.4 District heating

Most of the companies that was interviewed within the food and brewery industry said if they could get steam delivered directly to their factory then that would be the ideal scenario. This scenario is not an available option for every company, since they need to be located close to a supplier. Two of the companies that were interviewed had this possibility, with one of them already using it and the other was in the process to converting to it. This allows the companies to use a green energy choice, which will save costs for them when the CO_2-emission tax increase takes effect, plus they get a good price for it.

By having low CO_2-emission, a reasonable price, and being a desirable solution it is hard for LNG at the moment to compete against it in the food and brewery industry. An issue that arose during an interview for this alternative was that the company was afraid to be dependent on only one supplier, which would have full control of the supply and price.

5.7.5 Electricity

Electricity is both a competitive and a complement fuel to LNG. The electricity's price can vary a lot during a year, it isn't unusual that the electricity price during the winter months are the double of the price during the summer months. Therefore it is important to have a complementary fuel to use during the expensive electricity months.

One company using LNG as a complementary energy source to electricity is Artic Paper, interviewed in the pre-study. Artic Paper runs their production mostly on electricity since its price has been very beneficial the recent years, but still need a complementary fuel if the prices during the winter is to expensive. For LNG to be competitive to electricity during most of the year, in Artic Paper's case the raw gas price (TTF or GTF price seen in figure 15), which is the price one pays for at the hub, has to go down to around 120-150 SEK/MWh. This price is very optimistic and not transparent so it is most likely different for different companies and might change in the future.

5.8 Choice of fuel

This chapter will map out the interviewed companies by their choice of fuel and future choice of fuel in both their production and transportation. Here incentives for use or conversion to a specific fuel will be highlighted.

5.8.1 Production

	Companies	
Main choice of fuel	**Present**	**Future (By 2015)**
Oil	4	0 *
LPG	4	4 **
Pellets	0	2
District heat	1	2
Natural gas	0	1

* Three companies will use just a small amount of oil as backup.
** One of the companies will terminate the use of LPG in a part of the process and replace it with another energy source. Most of the companies have low energy consumption.

Table 4 List of all main choices of fuel in the production, and the amount of companies that uses each today and by 2015. The table is based on interviews that were held during this thesis.

In this part the focus will be on the choice of fuel in the production. How many companies use each fuel, the companies future plans regarding their choice of energy source and the incentives to change or stay with the present fuel will be addressed. Table 4 above lists what energy sources are used, how many companies use each energy source, and how it will look by 2015.

Oil
Of the nine companies that were interviewed, five of them use oil today, four of these use it as the main fuel in their production, and one use it as backup. One company has converted from oil, while the rest of the companies are in the process of converting from oil to a renewable alternative or to natural gas. All four companies that are converting from oil expect to start using their new energy source before 2015. All though these companies are moving away from oil, they will still use oil as a backup when the new energy source isn't enough.

The four companies that are moving away form oil have mainly two incentives for their conversion. Namely the tax increase for fossil fuels that is coming up in 2015, which is the major reason for the shift of energy source, and the second reason is the price of renewable energy sources will be much cheaper since the price for fossil fuels will increase with the tax change. A third incentive that was also commonly mentioned was the environmental impact, since the companies converted or are converting to energy sources that are environmentally friendlier. This was an incentive that was less driving then the previous two, but all of the companies saw it as a bonus that followed with the conversion.

LPG (Liquefied Petroleum Gas)
The second most popular fuel among the interviewed companies was liquefied petroleum gas, with four companies that is currently using it. This is an alternative that these companies have converted to in recent years, mainly because they get a better price on LPG, plus because it is an environmentally friendlier alternative then the one it converted from.

Despite the companies have converted for environmental reasons they will face the same problem as oil does, with the tax increase for fossil fuels in 2015 it will become more expensive to use LPG. This is a major reason why three out of the four interviewed companies have taken preventive measures and investigated alternative energy sources with lower CO_2-emission. None of the companies have decided to convert yet, but one company left an impression that they are planning to replace LPG with pellets in one part of their production.

Pellets
Today none of the nine interviewed companies in the food and brewery industry uses pellets. Two of the interviewed companies that use oil today will convert to pellets in 2015 and one company is investigating the possibility to convert. Pellets aren't affected by the fossil fuel tax increase unlike oil and LPG. It becomes much more attractive and affordable since it is not a fossil fuel. An interesting thing to mention is the companies that will convert to pellets are breweries so far, but some food companies have discussed it as well.

This is the main reason why these two companies are planning to convert to pellets, because they wanted to move away from oil at a good price and in addition to this they got an environmentally friendlier alternative. Since the interviewed companies are in the food and brewery industry they have a lot of waste. For one of the converting companies it was important that they could use the waste to produce their own fuel, and this way they would make a pure profit on converting to pellets.

District heat

District heat is commonly used among the interviewed companies for heating of the facilities, but not as common in the production. Of the interviewed companies there is one company that is using district heating in their production. Another company is planning to convert to district heating from oil by 2015; here again the reason is because they want to reduce their use of fossil fuels. For this company it was important to have a good business partner that they can trust and that can supply them with steam directly to the plant. This is also a major reason that they chose to convert to this alternative and also it is vital to be able to implement this.

5.8.2 Transportation

This segment will analyze the choice of fuel for transportation among the interviewed companies.

Own trucks

Of the nine companies in the food and brewery industry that was interviewed, only three of them had their own trucks. One of the companies with own trucks uses them for just short distances, while the other two send their trucks both shorter and longer distances. All of the companies have demands on their own trucks, since most of them are delivering to larger cities; they want the trucks to be up to date with an environmentally friendly fuel.

Coca-Cola is one of the companies with own trucks, and for them it is important to have a sustainable approach for their transportation. Their trucks use biodiesel, which they believe is a transitional solution until a new generation of biofuel, engines and infrastructure is established (Coca-Cola sustainability report, 2012).

All of the companies have a goal to replace their own trucks within a certain amount of years in order to stay up to date with the latest technology and have the lowest environmental impact possible.

Carriers
All of the interviewed companies use carriers to transport the majority of their products. A trend has shown a decrease in having own trucks and an increased use of carriers. Three companies have decreased the amount of own trucks in the last couple of years; with one of them have completely stopped using own trucks.

Of all the interviewed companies there is only one company that has specific environmental demands on their transporting partners, and recommends them to use a specific fuel. The rest of the companies don't have any specific demands on what fuel their carrier should use, just that they should try to have as small of an environmental impact as possible.

A typical contract with a carrier lasts 3-4years, and then a new procurement takes place. Most of the companies have had long term contracts with their business partners and keeps the same contract agreements as before, unless there have arisen new external or internal demands.

5.9 Willingness to convert to LNG

The willingness to convert to LNG within the food and brewery industry is limited due to other alternatives. Because of the tax subsidization for fossil fuel within the manufacturing industry will change the 1st of January 2015, almost all of the companies contacted for this study had recently done an energy analysis of their operations. For this industry that only has a need of producing steam in their production, the alternatives as pellets or district heating is viable choice.

In those cases where district heating is available it seems to be the best alternative both in terms of price and for environmental impact. In all the other cases pellets seem to be a better alternative then LNG; also here both form an economical and environmental aspect. The availability for pellets is good especially in this industry since they often have the possibility to produce their own pellets form their waste, otherwise it is easy to buy pellets on the market.

The possibility to use LNG in a wide range of application in the food and brewery industry is hard. Since more and more companies are outsourcing their transportation to transportation companies as DHL, Schenker etc. and the cooling you get out from LNG is only seen as a plus because its affect on the price is very marginal.

As mentioned before in this chapter there is one area where the companies have shown interest in LNG and it is as a complement for biogas. Many companies within this industry have shown interest for biogas, some have even tried with collaboration with their municipality to build a biogas facility. But this project is very hard to follow through, since it is very expensive and it need allot of cooperation. But when it takes of or if it ever takes of, then LNG is a very good complement and of big interest for this industry.

6. Analysis

The chapter analyzes the empirical findings according to the theoretical framework. One part focuses on the product while the other part focuses on analyzing the customer. By comparing these two there will be an opportunity to find market possibilities.

6.1 Adoption curve

Today there is just a small fraction that uses LNG in the Swedish market, these companies can mainly be found close to a LNG terminal and companies with high-energy consumption. LNG isn't that well distributed in Sweden and there are still a lot of factors that needs to evolve to get more companies to adopt it.

Initiating adopters

Innovators & Early adopters: In this thesis the suppliers of LNG are considered to be the innovators. These are Skangass and AGA, which are the two main LNG suppliers in the Swedish market today. These are the main contributors to bringing LNG in to the Swedish energy market, when they built the two terminals in Fredrikstad (Skangass) and Nynäshamn (AGA) in 2011. So it is in their interest to get more companies to adopt LNG, and to see the LNG usage increasing in Sweden. These two will have an important role for the expansion of LNG, in terms of building infrastructure and attracting new companies.

Skangass and AGA can't promote LNG all by themselves; instead companies that have adopted LNG are going to work as a confirmation that LNG is a good energy choice. The interviewed companies in thesis that have converted to LNG can be considered as the early adopters, since they are among the first to adopt LNG. These companies saw a potential in the product, e.g. one company converted because they believe in cheaper fuel over time. Most of the companies saw also big potential in it since it is a relatively environmentally friendly fossil fuel, which can project a positive image outwards. For these companies it is important to be a step ahead and show that they are environmentally aware and act accordingly.

Today there isn't a big company that has adopted LNG, but SSAB is expected to convert to it at the end of 2014. With a large company like this, it is likely that more companies will be aware of LNG and lower the uncertainty of the fuel. This may attract other companies to adopt LNG.

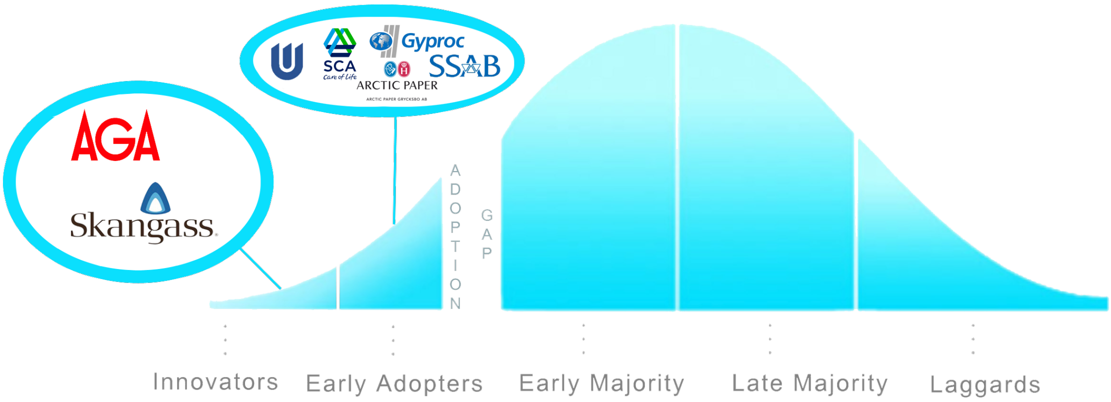

Figure 18 Initiating adopters at the Swedish market

Mainstream adopters

Early majority, late majority, and laggards: LNG hasn't reached the major part of its' potential users yet. One reason can be because it has only been on the Swedish market a short period of time. But mainly it is because the infrastructure isn't broadly developed and the prices are to high for those companies that isn't near the LNG terminals.

The food and brewery industry falls into the majority adopter category, since they are quite price sensitive and waiting for a fully developed concept before they consider adopting it. Another industry that falls into the majority segment is the carrier companies. If these companies chose to switch over to LNG it would provide an opportunity for collaboration with other companies that are using LNG. This collaboration would mean that the LNG-using companies could order larger volumes and divide the cost with the carrier companies, which would lead to lower additional costs.

It is hard do determine exactly who will be an early majority and who will adopt it later. But companies that have a higher energy demand are more likely to take the first step among the majority adopters. At the moment LNG is facing the question weather it will get adopted to a majority of users or not. The uncertainty of the product is still high and the benefits of it aren't widely displayed yet. Main barriers to leap over this gap are the price, infrastructure and attitude towards the fuel.

The price is something that is hard to control, because it is dependent on larger forces as mentioned in the macro factors segment. But the price of LNG needs to go down to attract the companies that are far away from the LNG terminals. To build out the infrastructure in more parts of the country is a way to make it more accessible to a larger amount of companies. This is also a way to lower the prices to some extent. Today there are a few companies that can consider converting to LNG, but the infrastructure isn't good enough around them to make it a profitable choice. The third barrier is the attitude towards LNG because it is a fossil fuel.

6.2 Lock-in

Lock-in effect is a powerful tool, by trying to get your customers to use your product in different areas, will make them less flexible to switch from your product. By using LNG in different applications as suggested in this study a lock-in effect can be achieved. The trend today is however that more and more companies outsource their transportation, which makes it harder to combine LNG in the production and transportation. Many of the food and brewery industries' has a too small consumption of fuel in their production, to make it profitable to transport LNG to the facility. As seen in the empirical findings, having a typical food industry's amount of trucks that are in need to transport its goods, and if they run on LNG will increase the yearly consumption of LNG with 75%, which is a significant amount. By giving the possibility to build a tank station for LNG on the facility, a lock-in effect is possible, both through a cheaper fuel for the trucks, and in the production through a higher turnover of LNG.

The other area that is, utilizing the cold form LNG has a less potential lock-in effect. Since the energy that is possible to get from the cold is marginal, and does not make much difference. The cold will most likely give the food and brewery industry a saving but the savings isn't of that big of a sum, so it raises the switching cost and creates a lock-in. By looking at these two areas additional of using LNG in the production, the transportation has the biggest potential to create a lock-in effect to LNG. Since the same fuel will be used in two of the most energy consuming areas, and switching fuel within one of the areas will be hard.

Teece et al. (1997) claims that lock-in effect will most likely decrease the elasticity of demand, which may lead to price increase. In this situation a lock-in effect will not create a price increase instead the opposite. By using it in the different applications it will hopefully press the prices down and make LNG competitive against the other alternatives. This will in the same time create a lock-in effect on the facility using LNG.

Path-Dependencies

Unruh (2000) claim that the energy sector has been locked-in into fossil fuels through a path-dependent process driven by technology and institutions. This is true in many ways in the Swedish market as well. The Swedish government has for a long time given tax reductions to the industry on up to 70% of the fossil fuel tax to attract industries to the country by having good energy prices. This was the start of the path-dependent process that created dominant designs, standard technological architecture, industry standards, and customer-supplier relations creating a lock-in effect to fossil fuels.

Now the Swedish government is changing it's policies and has as a goal to be fossil fuel free in the future. The decision to reduce the tax from 70% to 40% on the fossil fuels has changed the view on fossil fuels. Companies have become accustomed with the price level on the fuel and isn't ready to start to pay more for energy, and if the technical improvements can't take away the price increase from the tax change. Companies are going to start to look in other directions to get the cost down and when alternative sources of energy are getting more viable, especially for the food and brewery industry, it will reduce the lock-in effect on fossil fuel. This will most likely create a new path-dependent process where new technologies and organizations are going to be created and lock-in new energy sources. This study has shown tendencies that the path within the food and brewery industry is going towards using fossil free fuels since there are already tendencies of new fossil fuel free dominant designs and industry standards are been created. This shows that government policies have very big impact on the energy market and both can create lock-in effect and change the rules on the market fast.

6.3 Successful innovations

For an innovation to be successful it need to be able to communicate its benefits in an understanding and visual way. Rogers (2003) brings up five characteristics that can help with that, one of the characteristics will not be used because it isn't applicable to a new energy source. This chapter will analyze the applicability of the four characteristics for LNG on the food and brewery industry.

Relative advantage: In this area LNG has a very good relative advantage compared to oil. LNG is often cheaper and is more environmentally friendly, which are two of the key factors when it comes to choice of energy source. As long as LNG will be able to compete on price it will have a relative advantage against oil in almost all industries. LNG also competes against LPG in many areas, but here it doesn't have the environmental aspect as an advantage since LNG and LPG within the industry is seen as they have the same environmental aspects. Here LNG and LPG will compete through price and availability. LNG has a relative advantage against LPG where it is most available, which is near the LNG terminals. The companies that have converted to LNG is often companies located near the LNG terminals and some of them is converting because of that they think it will give them a cheaper fuel then LPG.

But within the food and brewery industry LNG isn't competing against oil and LPG any more instead it has to compete against renewable and here is the only way to compete is through lower price and higher profitability. Today LNG doesn't have the infrastructure and the price level to do so, which makes LNG to not have any relative advantage against renewables for the moment. One way that LNG has relative advantage against e.g. pellets is that companies can both use it in the production and for transportation. If companies see that as an advantage it might have a chance against pellets but this study haven't shown any tendencies of that.

Compatibility: LNG's compatibility is very good, natural gas is a very easy energy source to handle and can fulfill the same need and value as oil, LPG, pellets or any other energy source used in the food and brewery industry. The only difference with LNG is that it needs a storage tank that requires a higher level of security then most of the other energy sources.

Complexity: Since natural gas is easily flammable and LNG need to be stored in a tank that keep it cooled on the facility, which leads to a lot of security measurements has to be taken when building the tank on the facility. Because LNG is quite new in Sweden the authority don't have any developed methods to ensure the security measurements, which makes it take long time and can complicate the process to get LNG.

Observability: LNG's observability is hard to tell, it is easy to observe its performance in the production it is only natural gas and it have been tried before. On the other hand it is hard to observe the price situation, which often is the most important thing when it comes to energy sources. When buying LNG in Sweden the price will depend on shipping transport, bunkering, and land based transportation in addition to the price at the hub. This makes it hard to get a good picture of all the processes and it will differ from case to case so it will be hard to compare it to another facility.

When summarizing the four characteristics, LNG has some improvements possibilities to reduce the uncertainty. LNG is very compatible to "old" technologies like oil and LPG but its observability isn't so good because it is hard to get a good picture over the price. Its relative advantage is really good compared to oil but there it is a lot of different energy sources that are competing to replacing the oil. LNG's relative advantage against LPG depends on the availability and location of the facility and when the infrastructure for LNG will expand it will be able to compete against LPG to a greater extent. When it comes to complexity there is safety issues that have to be dealt with, which many other energy sources don't have to, otherwise LNG isn't so complex.

6.4 The competitive power of LNG compared to other alternatives

Since LNG is a quite new alternative on the Swedish market it haven't reach that many companies or industries. So far none of the contacted companies in the food and brewery industry has converted to LNG and as the study shows they will not choose it in the near future. But it is still an industry that has potential to convert to LNG if the availability of the energy source increases.

6.4.1 Macro forces

LNG is a fossil fuel and is highly affected by major forces, which needs to be considered when analyzing LNG's competitive position on the market. The four forces that are considered in this analysis are described further here:

Political factors

Fossil fuels isn't so popular among politicians today, despite the fact that natural gas is one of the environmentally friendlier fossil fuels it still has a negative ring to it. The energy market is very sensitive and highly dependent on governmental approval. A fossil fuel can be displaced by a simple taxation policy if the government does not desire it.

Since the Swedish government has decided to make the tax change from 70% to 40% that will come in to effect the 1st of January 2015. This will have large influence on companies' future choice of energy, and it will affect the fossil fuels negatively. Despite the fact that LNG has a low CO_2-emission compared to other fossil fuels, it will still be hard for LNG to compete with energy sources that are almost CO_2-neutral.

Economical factors

The manufacturing industry is very sensitive to changes in the economy. Since the recession in 2008 the energy demand haven't grown as fast as before. The global LNG trade has declined for the first time in 30 years, especially in Europe. A combination of the economical crisis in Europe, and the high LNG oil-linked prices, has lowered the energy demand. Also with Japan increasing their demand of LNG since the Fukushima accident the prices have raised, which has affected the prices in Europe as well. Although the prices are still little lower in Europe, the prices can come up to the same level as in Asia in the future. It is not as attractive for suppliers to put their business in Europe, when they can get much higher prices in Asia.

A trend that is spreading to major parts of Western Europe is the hub based pricing, which has been cheaper the last couple of years compared to oil-linked pricing. Single pricing mechanism in Europe is a very popular topic, where it is believed that it would benefit the European market if the prices would be set in the same way. This trend is a positive sign that could contribute to lower LNG prices in Europe. The high Asian prices have been a contributing factor that it is more common today to see spot pricing of LNG, it is a good chance that this will increase even more in the future, which can have a positive effect on the LNG prices.

Today there is a significant difference between the prices in the US and the rest of the world. The extraction of shale gas has lowered the prices in the US where it is about four times cheaper then in Asia. Eventually these prices are expected to even out and be balanced between the different markets.

Social factors

Natural gas has a bad reputation among people and companies, since it is a fossil fuel. But according to some experts and through observations during the study, it is believed that people can have a better attitude towards LNG since it is not as a familiar term as natural gas.

In the Swedish market it is very different attitudes, in some industries LNG is considered a green choice while in other, like the food and brewery industry where they can use pellets and district heat, it is not.

Technological factors

A lot have happened the last couple of years in the technology development for extracting gas. The US is able to extract shale gas, which has lead to an increase in their gas reserves and much lower prices. For the domestic market this have been very profitable, they have decreased their import of gas and are expected to become a net exporter in a close future. Before they can become competitive exporters of LNG they need to build up their infrastructure. An issue for the US to build out their LNG liquefaction terminals is the approval of the government. If the new proposed liquefaction projects in North America will be approved, then they have a good chance of becoming a major exporter of LNG. This could have a big impact on the global LNG supply and prices, where they can offer their low prices to the rest of the world as well.

Some potential shale gas reserves have been found in Europe as well, but it needs to be investigated even further. If some countries in Europe manage to find shale gas reserves and extract the shale gas as in the US, then the prices can sink in Europe as well.

6.4.2 Competitive industry forces

The use of natural gas in the food and brewery industry is not that unusual, but this is mainly for companies that are connected to the pipeline system.

Competition from substitute products

From this thesis there are mainly two substitute alternatives identified, which are pellets and district heat. District heat is used in one case already, but considered a substitute product in this thesis since it isn't that widely used. In the food and brewery industry pellets and district heat is a possible choice since they mainly need steam for their production, but for heavier industries that require higher energy consumption it is not possible to use pellets and district heat.

When it comes to energy sources then customers are very price sensitive and go for the alternative that offers them the best solution. A trend among the interviewed companies is to go from fossil fuels to these substitute products. Two companies are going to convert to pellets, one is looking in to that alternative and one company is going to convert to district heat. This popularity of the substitute products is mainly because of the fossil fuel tax reduction that is coming in to affect 2015, which makes them a cheaper alternative. With the cheap prices that the tax reduction brings it will be hard for LNG to compete against them. Besides the price, a lot of the interviewed companies found more value in pellets and district heat. With the district heat the companies will get steam delivered directly to their facility, which is desirable because they don't need to produce it themselves. For the companies that are converting to pellets it was a plus that they could use their waste to produce own pellets, which will save them a lot of money. This was some attributes that were appealing to the interviewed companies, which LNG can't offer.

District heating isn't an available option for every company, because the facility needs to be close to a heat plant in order to get the steam. So district heating isn't a direct substitute product to LNG in every case. Pellets have a high investment cost, but it is still very profitable for the companies in the food and brewery industry, and probably the biggest threat from the substitute products.

Another energy source that can be considered as a substitute product is electricity. This was only used in one case in this thesis as a substitute product, where they shifted between LNG and electricity. To use electricity as the only source of energy is risky because the prices can rise quickly depending on climate change. Since it is such a risky option it will probably only serve as a complement to another energy source, and be used if the price is at the right level.

All and all the competition from substitute products is quite high, and in the food and brewery industry it is becoming more and more popular with these instead of fossil fuels.

Threat of entry

LNG is seen as a threat of entry since it is not used in the food and brewery industry. Some companies have considered LNG and others haven't. Those that have considered it doesn't see it as profitable at the moment because of high prices, or because they get a better solution from other product. For those that haven't is the main reason that they are far away from the LNG-terminals and don't see it as an alternative for them.

Another threat of entry is renewable energy, where one company has looked at solar energy and others biogas. Between these two alternatives, bioenergy is more likely to become a competitive alternative. Biogas is widely supported by the government, since several municipalities in Sweden have plans to build bioenergy plants. But most of these projects are put on hold or cancelled because it isn't profitable at the moment. The cost is too high in regard to the volume that can be produced, and the volume isn't enough to be the only source of energy for the production. Since LNG and biogas are compatible, no new investments needs to be done. This could be favorable for LNG, since companies could choose to adopt LNG and use it as a complement to biogas or the other way around.

In the food and brewery industry there is a lot of potential for biogas, since they can produce it with their own waste. This production volume is often limited and only covers a small part of the energy demand. Although biogas has much potential, it isn't a big threat today since the entry barriers are too high at the moment. If the infrastructure would evolve for LNG and biogas, then a combination between them can become a more attractive choice and a more serious threat of entry.

Jockeying for position

The most common energy sources that are used among the interviewed companies are fossil fuels, and these will be considered as the main competing forces. Oil is the most widely used alternative, and was used by more then half of the interviewed companies. But oil is also the alternative that most companies are moving away from, since it has a high level of CO_2-emission. Because of the high level CO_2-emission and the tax reduction in 2015, it will become very expensive to use oil.

Of the interviewed companies in this thesis that have converted from oil has mainly chosen LPG, and companies that are planning to convert have chosen the substitute alternatives pellets or district heating.

LPG is beside oil one of the most commonly used energy sources, and has in some cases replaced oil because of its lower price and because it has lower CO_2-emission. But in some cases LPG seems to suffer the same fate as oil, where companies are looking to replace or reduce the usage of it because of the price increase the tax change will bring. Companies consider LPG and LNG very similar and don't see a big difference between them except the price.

It is safe to say that companies in the food and brewery industry are looking to change and improve their energy choice, especially when it comes to oil. It is cheaper to use alternative solutions like pellets, and more and more companies are looking in to that.

Bargaining power of buyers and suppliers
In the food and brewery industry there is a lot of substitute products, that serve an as good purpose as LNG does. At the moment these alternatives are preferred to convert to, because of their lower cost and lower environmental impact. The buyers have a lot of bargaining power when it comes to choosing what energy source to use. But after a buyer have invested into a new energy source the bargaining power can be reduced depending on what the company have invested in. For instance in one case a company were considering converting to district heat and getting steam delivered directly to the factory. But the reason that they didn't choose this alternative was because they were afraid that they would be locked to one supplier, and then they wouldn't have much bargaining power since the supplier could regulate the prices without competition. But those that choose to convert to pellets aren't locked in to one supplier; instead there are a lot of different suppliers to choose from plus that the food and brewery companies can produce their own pellets through their waste.

In the case that a company would choose to convert to LNG, then the buyers have a low bargaining power since there is little supplier competition on the market. Also the switching cost to another alternative is expensive, which is also a factor that lowers the buyers bargaining power and increases the suppliers bargaining power.

6.5 Collaboration

Collaborations between companies with the same interest can be very affective. LNG is growing within two areas right now, transportation and the production industries. The infrastructure within both the areas need to expand to make LNG viable alternative to the majority of the potential costumers. Collaboration here would most likely speed up the LNG infrastructure.

Here collaboration between the industry and the transportation companies would give a more diversified infrastructure. By building LNG tank stations for LNG trucks at the production facilities both the quantities transported of LNG to the facility will increase and there will be more LNG tank stations in the country. It is a win-win situation for both parties if a collaboration decision can be taken around this, but it is a lot that has to match for it to be successful.

Within the food and brewery industry one company did a similar attempt as mentioned above. Here collaboration between a transportation company and a production industry discussed to increase the LNG turnover to make it viable. This plan was never completed due to the production industry found a different, and according to them, a better solution to its energy supply.

The collaboration between transportation companies and different facilities is hard since the transportation companies transport goods to many companies and their trucks need to be flexible. If the transportation companies would have handful customers where they can tank their LNG trucks, their flexibility will be larger and it can create a small network between these facilities. This will create a larger demand from other production companies to join this network and the LNG infrastructure will thereby grow. The difficult part in creating this kind of network is to get it up and running by finding the handful companies and the transportation company that is ready to collaborate.

By looking at this study the food and brewery industry might not be the right industry to approach first with such a proposal since the interest for LNG in the production is very limited. But if a network would be created and operational there isn't impossible that a food industry or a brewery industry will join at a later stage, but they are most likely not innovators or early adopters it comes to this.

6.6 Dominant design

If a product has the possibility to be the dominant design it will most likely be very profitable, but if the product looses dominate design to another product it risks to be locked out from the market. According to Schilling (2010) a products total value consist of the products technological utility, the install base, and complementary good available. There are not many complementary products for different energy sources thereby that category isn't so important for deciding the product total value.

The technological utility is often not so big between the different energy sources, since it is often similar technology used in the combustion of the energy source. Of course the different energy sources have different characteristics and energy value but the technology don't change so much.

Thereby the installed base becomes very important when it comes to get increase return and reaching dominant design within the energy sector. To begin with, it is important to have the energy source available on the Swedish market to competitive prices otherwise the technical utility has to be much larger then its competitors. Within the energy sector it is often through the installed base that it is possible to get the competitive advantage. The energy sources often compete through price, and with a large installed base it is possible to press price down. Especially for LNG, which has a larger transportation cost then its competitors, which makes the installed base critical to make LNG competitive.

Schilling (1999) also mentions three different sources for increasing returns; scale effect, learning effect, and network effect. All these three has been touched upon in the previous chapters and will not be repeated here but Schilling (1999) also mentions that in some industries government regulations can have a big affect when coming to picking the dominant design. The energy sector is one of those industries where the government has big impact. By reducing the tax reduction on fossil fuels the government has had a major impact on the energy choice at least within the food and brewery industry. The changed tax rule has made almost every food and brewery industry to consider other energy alternatives. It went from that the majority of the food and brewery industries using oil or LPG to almost all considering changing to another energy source. Those that can, want to partner up with heating plants to get the majority of their energy needs from them and for those that don't have that possibility are mostly considering pellets as their energy source. This has lead to the possibility that pellets might emerge as a dominant design within the food and brewery industry in a very short period of time.

Hartigh & Langerak (2001) have a similar approach to Schilling (1999) to understand the sources of increasing return, Hartigh & Langerak (2001) mentions five challenges that have to be dealt with to be able to compete on the market with a product. Many of those challenges have been raised before in the analysis but one challenge hasn't been mentioned and that's avoiding lockout situations. How to lock-in customers and how to collaborate to be successful has been mentioned, but it is as important to avoid lockout situations. LNG within the food and brewery industry is in a situation where it risks to be locked out from the industry, since it is a fossil fuel and thereby have very hard time to compete with fossil fuel free alternatives today. However here it is important to keep on working with exploiting and increasing the installed base and shaping new networks. At the end it is a very price sensitive industry and increasing the installed base and creating new networks can press price and new markets that LNG has been locked out from can be possible to enter again.

7. Conclusion

The purpose of the main study was to explore the findings from the pre-study through a case study at a targeted industry to identify the targeted industry's capabilities and willingness to convert to LNG. The pre-study identified a potential for LNG within industries that can use LNG in a wide range of applications.

To fulfill the purpose of the main study the purpose was broken down to the following three research questions:

1. What are the targeted industries attitudes towards LNG?
2. Does LNG usage in other applications, beside in the production, create a higher value proposition?
3. What are the competitive choices of energy within the targeted industry?

The industry that was believed to have the possibility to use LNG in a wide range of applications and chosen to do the case on was the food and brewery industry.

The interest for LNG within the food and brewery industry is limited because of new tax regulations, which makes it hard to get competitive prices and a good range of other alternatives. The governmental decision to reduce the tax reduction on fossil fuel from 70% to 40% in 2015 has had a major impact on the industry's choice of fuel. Since the food and brewery industry is in need of an energy source mainly for producing steam there is many alternatives to choose from. Because of these fossil fuel free alternatives that can produce steam, and since the tax changes, those alternatives becomes economically viable for the food and brewery industry. Due to LNG is an inferior fuel, from an environmental perspective, compared to its fossil fuel free competitors; it can only compete through price produced per kWh. But with the tax changes and the political climate it is and will be very hard to compete.

It is difficult to really determine if usages of LNG in other applications, beside in the production create a higher value proposition. It is a lot of parameters to take into account. But what can be determined is that by using LNG in the trucks, transporting the goods for a normal food or brewery industry in Sweden increases the volume of LNG usage with about 73% than only using LNG in its production. And by extracting the cold from the LNG in the same industry will save approximately 100 000SEK every year in energy costs. This has to be compared against investment costs and savings in a higher usage of LNG etc. another problem is that many food and brewery industries is outsourcing the transportation of their good, which makes it harder to implement.

The competitive energy choices for LNG within the food and brewery industry are mainly oil, LPG, pellets, and district heating. LNG has better prices and smaller environmental impact then oil and thereby it's often viable to change. LPG and LNG have approximately same environmental values and thereby compete on price. Since LNG is transported by truck in Sweden the price goes up the further away the factory's facility is from the LNG's import terminals. This makes LPG cheaper then LNG in some parts of the country, but when the infrastructure for LNG expands the transportation price will go down and LNG will be able to compete in the whole country.

Due to the upcoming tax changes on fossil fuel the majority of the food and brewery industry have recently done an energy inspection and the conclusion of the inspections have mostly ended in an decision to switch to district heating if that is possible otherwise to switch to pellets. This is since both alternatives are fossil fuel free and can be used to produce steam, but the fuel that have been used before, which often has been oil or LPG, remains as a backup fuel. This makes it hard for LNG to enter the food and brewery industry because it competes mainly against oil and LPG and those fuels will only be used in very small volumes within the food and brewery industry.

8. Discussion and Recommendation

Expansion of LNG in Sweden is occurring gradually since LNG is a good replacement to oil, which has better environmental values and often a better price, thereby it will keep on expanding in the country and replacing mainly oil. LNG will grow in the high consuming oil sectors because fossil fuel free alternatives can't or is too expensive to replace the oil. But within the food and brewery industry, fossil free alternative is viable and thereby is in direct competition with LNG and other fossil fuels. Therefore, for LNG to be competitive in the food and brewery industry it has to compete through price and reliability and the only way to achieve that is to have a developed, reliable, and effective LNG market and a product that meet the needs and demands from the customers.

As mention in the analysis the suppliers is seen as the innovators and the high oil consumers e.g. the iron and steel industry as early adopters. What is harder to predict is where in the majority adopter category the food and brewery industry are going to be or even if it is going to be a consumer of LNG. A possible scenario is that the heavy transportation sector converts to LNG as one of the early majorities and thereby the food and brewery industry follows, since they have a lot of transportation and collaboration possibilities between the two sectors may occur.

Another possible scenario is that the fossil free fuels will keep on growing within the food and brewery industry, which could lead to that LNG never will be a option in the food and brewery industry and just a few will convert to LNG as laggards when the market is develop and stagnated.

A third scenario is that biogas expands and becomes more profitable, which would make it an option within the food and brewery industry since they have their own waste. Because biogas is hard to secure in large quantities and LNG is very compatible to biogas, it will make sense to start using LNG backup fuel. The problem with this scenario is just that LNG needs to be used in larger amounts to get the transportation cost down. In order for this scenario to work there is in need of collaborations either with nearby located industries that also use LNG or as in the first scenario where collaboration between transportation companies and the industry will increase the usage and thereby make it possible for the industry to use LNG as a backup fuel.

Since LNG will get it hard to compete against fossil fuel free alternatives, because today it isn't enough competitive on price and many food and brewery industries has taken the decision to convert to a fossil fuel free alternatives, it will be very hard for them to motivate a switch back to a fossil fuel if it do not give a direct and significant return. Thereby LNG is risking a lockout situation within the food and brewery industry, therefore it is important to continue to improve the image of LNG both within political and social contexts to increase learning effect. The political attitude has a big impact on the energy market and by getting them to show a belief on LNG and its expansion, companies will get more interested.

By adopting the product to the customers' needs and demands, LNG will be able to expand in a faster and wider range. Since the energy sector is very price sensitive it is important to create incentives for LNG in different ways, in this study the incentive to be able to use LNG in a wide range of application has been discussed and explored. It has shown that the market isn't ready yet to collaborate with different actors and create a higher value proposition because there is to few users and supplier, and the indications is that the customer chasm between the early adopters and the early majority hasn't been passed yet. When LNG starts to target the adopting majority we will most likely start to see different collaborations occur between different actors in the value chain.

9. Reference

Aaker & David A. (2001) Developing business strategies, sixth edition. New York: John Wiley & Sons.

AGA Gas AB, (2011). *AGA magasinet.* Number 1, 2011.

Anderson, T., Varnhagen, & Campbell, K. (1998). *Faculty adoption of teaching and learning technologies: Contrasting earlier adopters and mainstream faculty.* The Canadian Journal of Higher Education, 28 (2/3), 71-78.

Arthur, B., (1989). Competing technologies, increasing returns and lock- in by historic events. Economics Journal 99, 116-131.

Bendapudi, N. & Berry, L. (1997). Customers' Motivation for Maintaining Relationship With Server Providers. New York: Journal of Retailing 73(1).

Bergen Energy (2011). Small Scale LNG Economics. Retrieved 1 November 2013. http://www.glmri.org/downloads/lngMisc/Small%20Scale%20LNG%20Economics-Bergen%20Energi-20%20Sept%202011-%20II.pdf

BP, (2013) *BP Statistical Review of World Energy 2013.* http://www.bp.com/content/dam/bp/pdf/statistical-review/statistical_review_of_world_energy_2013.pdf

Bryman, A., & Bell, E. (2011). *Business Research Methods.* Oxford: Oxford University Press.

Cepeda, G., & Martin, D. (2005). *A Review of Case Studies Publishing in Management Decisions 2003-2004.* Emerald Group Publishing Limited, Vol. 43 No. 6, pp. 851-876.

Coca-Cola Enteprises Sweden, (2013). *Coca-Cola Sustainability Report 2012.* http://cceansvar.se/wp-content/uploads/2013/07/CCE-Hallbarhetsrapport2012.pdf

Day, G. (1990). *Market Driven Strategy: Process for Creating Value* (Vol. 163). New York.

Duan, W., Chen, Z. (2007). Systems Engineering- Theory and practice: Key Factor to Drive Success of New Product with Network Effects: Product Quality or Installed Base?. China: Systems Engineering Society of China.

Eisenhardt, K. M. (1989). *Building Theories from Case Study Research.* The Academy of Management Review, Vol. 14, pp. 532-550.

Forza, C. (2002). *Survey Research in Operations Management: A Process-Based Perspective.* International Journal of Operations & Production Management, Vol.

22 No. 2, 2002, pp. 152-194.

Furr, N., Ahlstrom, P. (2011, p. 35) Nail it then Scale it, First Edition
Ghauri, P., & Grønhaug, K. (2005). *Research Methods in Business Studies.* Edinburgh: Pearson EducationLimited.

Grant, R. (2010). *Contemporary Strategy Analysis*. Chichester: John Wiley & Sons Ltd.

Göteborgs hamn (2013). LNG-Terminal i Göteborgs Hamn. http://www.goteborgshamn.se/Om-hamnen/Hallbar-hamn/Flytande-naturgas--LNG/LNG-Terminal-i-Goteborgs-Hamn/

Gävle hamn (2013). http://www.gavle-port.se.

Hartigh, E. & Langerak, F. (2001). Managing increasing returns. Great Britain: European Management Journal

International Gas Union (IGU), (2011). *World LNG Report 2011.* http://www.igu.org/gas-knowhow/publications/igu-publications/LNG%20Report%202011.pdf

International Gas Union (IGU), (2013). *World LNG Report 2013.* http://www.igu.org/gas-knowhow/publications/igu-publications/IGU_world_LNG_report_2013.pdf

Jacobsen, D. M. (1998). *Adoption patterns of faculty who integrate computer technology for teaching and learning in higher education.* Proceedings of the ED-MEDIA AND ED-TELECOM 98: World Conference on Educational Multimedia and Hypermedia & World Conference on Educational Telecommunications, Freiburg, Germany, June 20-25.

Kjärstad, J. (2013). *The Role of Unconventional Gas in Global Gas Supply*. Energy and Environment, Energy Technology Chalmers University of Technology, Göteborg, Sweden.

Liljemark, S., Losciale, M. & Petterson, A. (2006). LCNG-Studie – Möjligheter Med LNG I fordonsgasförsäljningen i Sverige. Stockholm: Rapport SGC 167.

Melling, J. A. (2010). *Natural Gas Pricing and its Future – Europe as the Battleground.* Carnegie Endowment for International Peace

Moore, G. A., (1999). *Crossing the Chasm, Marketing and Selling High-Tech Products to Mainstream Customer (revised edition),* HarperCollins Publishers, New York

Nyteknik, (2010), http://www.nyteknik.se/asikter/debatt/article2440370.ece

PEST Analysis. A Level of Achievement Business Studies A Level Resources, Issue 3, Sept 2004

Porter, M. E. (1979). *"How Competetive Forces Shape Strategy."* Harvard Business Review, March-April 1979.

Ram, S. & JUNG H.S., *"Innovativeness in Product Usage: A Comparison of Early Adopters and Early Majority."* Psychology and Marketing. 11, 1, (1994): 57-67.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press

Sahin, I. (2006). *Detailed Review of Rogers' Diffusion of Innovations Theory and Educational Technology.* The Turkish Online Journal of Educational Technology Vol. 5.

Schilling, M. (1999). Winning the standards race: Building installed base and the availability of complementary goods. Great Britain, Boston University: European Management Journal

Schilling, M. (2010, p.77, 157) Strategic Management of Technological Innovation, International Edition

Slater, S. F., & Narver, J. C. (1994). Market Orientation, Customer Value and Superior Performance. *Business Horizons , 37* (2), 22-28.

Stenkvist, M., Paradis, H., Haraldsson, K., Beijer, R & Stensson, P. (2011). Förutsättningar för utbyggnad av landbaserad infrastruktur för flytande gas (LNG/LBG). Stockholm: Rapport SGC 236.

Stern, J. & Rogers, H., (2011). *The Transition to Hub-Based Gas Pricing in Continental Europe.* Oxford Institute for Energy Studies.

Teece, G., Pisano, G. and Shuen, A. (1997). Dynamic capabilities and strategic management, Strategic Management Journal 18(7): 509–533

Unruh, G. (2000). Understanding carbon lock-in. Energy Policy 28

U.S. Energy Information Administration (EIA), (2013). *International Energy Outlook 2013*. http://www.eia.gov/forecasts/ieo/pdf/0484(2013).pdf

Woodruff, R. B. (1997). Customer Value: The Next Source for Competitive Advantage. *Academy of Marketing Science , 25* (2), 139-153.

Yin, R. (1984). *Case study research*. Beverly Hills, CA: Sage Publications.

Yin, R. K. (2003). *Case study research: Design and methods (3rd ed.)*. Thousand Oaks, CA: Sage Publications.

Zayim, N., Yildirim, S. & Saka, O. (2006). *Technology Adoption of Medical Faculty in Teaching: Differentiating Factors in Adopter Categories*. Educational Technology & Society, 9 (2), 213-222.

10. Appendices

10.1 Appendix 1 – List of interviews

Interview No	Position	Type of Source
1	LNG Expert	Security and Technology
2	Sales and Marketing	LNG supplier
3	CEO	LNG converted company 1
4	CEO	LNG converted company 2
5	Head of LNG	LNG converted company 3
6	Project Manager LNG	LNG converted company 4
7	Site Manager	Plasterboard company
8	Technical Director	Food company 1
9	Technology and Maintenance Manager	Food company 2
10	Environmental and Quality Manager	Food company 3
11	Transport Manager	Food company 3
12	Environmental Manager	Food company 4
13	Site Manager	Food company 5
14	Environmental Manager	Food company 6
15	Technical Manager	Food company 7
16	Environmental Manager	Brewery 1
17	Transportation Manager	Brewery 1
18	Director of Properties	Brewery 2
19	Logistic Manager	Brewery 2
20	Environmental and Quality Coordinator	Brewery 3
21	Site Manager	Brewery 4

10.2 Appendix 2 – Generic interview guide pre-study

This is a generic interview guide that has been used during the pre-study. However the guide has been adapted to each interview and follow-up questions have been asked.

- Can you please describe your job?
- What kind of fuel did you use before?
- Why did you choose to convert to LNG?
- How big was the investment and how long was the payback plan?
- Was there any competing fuel that was discussed?
- What are the disadvantages with LNG?
- Do you have any plans to expand the usage of LNG within your company?
- How long did/will it take to convert to LNG?
- What are the maintenance expenses compared to oil?
- How did you choose supplier?
- What is your LNG supplier's task?
- What is your flexibility with your supplier?
- What was/is the biggest barriers/problems/obstacles for you in the transition to LNG?
- What changes do you think is required to get LNG competitive?
- By converting to natural gas the possibility to convert to biogas will be easier. Is it something you had in mind when you invested in LNG?
- Is there anything that could be done better from your side or the suppliers when converting to LNG?

10.3 Appendix 3 – Generic interview guide main study

This is a generic interview guide that has been used during the main study. However the guide has been adapted to each interview and follow-up questions have been asked.

- Can you please describe your job?
- What fuel do you use today and how long have you been using it?
- Are you looking at any new fuel today?
- What are the most important factors for you when you make your choice of fuel?
- Which environmental requirements do you have today?
- How do your environmental request look like in the future?
- What is your energy need?
- How is your energy need distributed?
- How big is your energy cost today?
- How do you see on your energy needs in the future?
- What is your cooling need?
- How do you cool your facility today?
- What transportation do you have?
- What kind of transportation agreement do you have?
- What transportation routes do you have?
- What do you use for fuel for the transportation?
- Have you considered using LNG?
- What image does LNG have to you?
- What do you see as the biggest obstacle for LNG?
- What does LNG have for benefits?
- At what prices would you see LNG profitable?
- Are there any industries located nearby and how do you pose to collaborate with other companies in order to reduce fuel cost/build infrastructure?
- Do you see any advantages with using the same fuel in different parts of the operation?