Business Model for Smart Grid District Heating

— Master-Thesis —

Gleb Solomentsev

Lin Zhang

Gísli Páll Baldvinsson

Yungwei Tsai

Supervisor: Stein Kleppestø

Project Sponsor: Helen Carlström

School of Economics and Management

M.Sc. Sustainable Business Leadership

Date: May 31st, 2012

Abstract

Title: Smart Grid District Heating Business Model – Smart Energy Management from a Customer and End User Perspective: A case study of smart grid District Heating Business Development in Malmö, Hyllie

Authors: Gleb Solomentsev, Lin Zhang, Gísli Páll Baldvinsson, Yungwei Tsai

Tutor: Stein Kleppestø – Associate Professor, Department of Business Administration, Lund University

Background: The current mass proliferation of information and communication technology ("ICT") has created the ability to communicate with customers and manage energy production in unprecedented ways. With the arrival of "smart" energy meters and wireless communication, a new level of customer interaction is possible. In this scenario, a "smart grid" is created in which multiple energy meters are interconnected throughout the energy network. The constant communication and feedback made possible by this technology, allow for demand side management ("DSM") of energy production, where users at the point of consumption, can set their own usage according to their requirements and the production source can meet the demand as the system requires it. The evolution of this system is still unclear however and how the new energy "products" and energy business will look like is unknown. To test potential variants of this smart system, energy supplier E.ON is testing variants of the system in a local 'green-field' development project, Hyllie, in Malmö Sweden. This report looks at the incentives and barriers for the adoption of such a system in the Hyllie development from a company and customer perspective. The focus of the project is on E.ON Värme, a daughter company of E.ON Nordic.

Purpose: The purpose of this study is to gain an understanding the customer and end users incentives and preferences of E.ON Värme's major customers to implement smart grid district heating. Based on these aspects in the foreground, the authors will further develop a matrix of drivers and barriers for smart grid implementation from E.ON Värme's business perspective, customer perspective and end-user perspective. The final deliverable will be feasible business models with new customer segmentations proposed by the authors.

Method: This study required a mix of quantitative and qualitative data and in gathering that data a variety of methods were used. Interviews with E.ON personnel and customers were conducted in a semi-structured manner and an online end-user survey was carried out to develop an understanding of the end-user. The findings from these methods were supported with existing literature. A workshop with E.ON personnel was carried out to validate the authors' data analysis.

Conclusions: The authors find that the current district heating grid has not yet adapted to smart metering technology. The current business model is limited in in its capacity to meet all the challenges faced in a changing energy industry. The current segmentation does not accurately capture the needs and preferences of the new energy consumer, and cannot fully connect customer incentives, to end-user behaviors. The authors have proposed a new customer segmentation and consequently five different business models focusing on different needs of each segment which can help E.ON Värme to meet future challenges.

Key words: E.ON Värme, District Heating, Smart Grid, Energy Management, Customer and End-User incentives and Preferences, Customer Segmentation, Business Model Canvas, Peak Load Problems.

This thesis has been written as a part of the degree project course in the Masters program "Sustainable Business Leadership" at the School of Economics and Management, Lund University. The course was based on the methodology of action learning and self managed learning. The students were all assigned to an in-company project as consultants. As a part of course the students were responsible for organizing several learning events addressing relevant issues related to the in-company projects. The students continuously documented their learning in learning journals and participated in tutorials on these journals. The assessments of the students are done partly on the written thesis, partly on the consultancy process, partly on performance in learning events and other parts of the course and partly on the ability to document and reflect on the student's individual learning and development.

Nomenclature

BMC	Business Model Canvas
BRF	Bostadsrättsförening (condominium associations)
CHP	Combined Heat and Power
DH	District Heating
DSM	Demand Side Management
ICT	Information and Communication Technology
KWh	Kilowatt hours
MWh	Megawatt hour
SWOT	Strength Weakness Opportunities Threats
TWh	Terawatt hour

Table of Contents

1 Introduction

1.1 Energy Industry Trends and Transformation

Traditional utilities, (e.g. gas, heat and electricity providers) have historically provided these services with little interaction with the customer. The product is generated at a remote source and the customer contact is limited mostly to the billing process. The information and communication technology ("ICT") revolution has begun to put pressure on traditional European utilities providers. A short study by leading global strategy and management consulting firm, McKinsey (Giorgio Busnelli 2011), has outlined the implications of this energy transformation on European Utilities. This pressure comes about as a result of several factors. The first is an improvement in current building materials and practices, which through their quick improvements are close to producing energy neutral homes.(Torcellini, Pless et al. 2006) This reduction in energy consumption is both driven from a customer side, incentivized by a need to reduce energy bills and also pushed onto the industry by industrial emissions targets set by the European Union and local authorities.(EU 2005) The second factor is the improvement in information management. Rapid technical improvements have made information abundant and a vision for 'smart' energy management has come about. Technology, contributes to this pressure in a third way, by the rapid improvement of local energy generation sources, namely heat pumps, solar panels and to a lesser extent wind turbines. These local production sources have also cut the customer demand.

Need for transformation of Energy Industry in Europe

The industry stands on the verge of a transition point. Local energy production, smart demand management, and high energy efficiency homes will cut energy usage.[1] This reduction in demand will reduce the profits of traditional energy manufacturers and in order to stay in business the company will have to change their business models. The McKinsey study[2] indicates that most, but not all of the profitability can be recovered, but the business will have to transition to a new model. The potential for cleaner fuels and reduced costs combined with availability of new products can account for most of the losses occurring from reduced demand.

[1] Busnelli et. al., McKinsey Home of the Future p.6

[2] Busnelli et. al., McKinsey Home of the Future p.6-7

1.2 Swedish Energy and District Heating

The energy needs of Swedish homes are met by four main fuel categories:

- Crude oil and oil products
- Biofuels, peat and waste
- Hydropower
- Nuclear

These energy sources accounted for 616 TWh of energy in 2010 (Energimyndigheten 2011) , 411 of which were used for energy purposes in Sweden (a staggering 152 TWh were lost from energy conversion losses). Of the 411 TWh hours delivered for energy purposes, 60 TWh (15 %) went towards the provision of District Heating ("DH") services.

The DH mechanism system provides heating of homes and hot water by a closed circuit transmission of centrally produced hot water.(Svenskfjarvärme 2012) A central generation facility burns fuel, boils water and uses a massive pipe and pump to continuously cycle hot water through a residential area. Each building (i.e. a node on the network) is fitted with a heat-exchanger, which transmits the heat from the centrally produced source to water circulating through building radiators. The distribution of this energy is handled by a Building Management System ("BMS"). From the generation sided, the flow and production of heat are monitored by three key variables: Outgoing Temperature, Incoming Temperature and Water Pressure.

The system offers several advantages to local generation, one of which is a continuous availability of hot water. However, in this system, end point users have little control of the atmosphere in the house, their only means of regulating temperature are turning radiators on or off and opening of windows.

1.2 Smart Grids

In the smart system, the energy supply source (production plant) and demand points (users) are in constant contact through a network of smart meters and measurement points. The rich flow of information allows for a much more "dynamic" system where users are able to adjust their usage at home based on instantaneous information delivered from the point of production and the point of production can rapidly adjust production to meet demand. While the exact details of what the "smart grids" of the future will look like is unclear, one key feature will be this dynamic ability to adjust for user demand. This Demand Side Management ("DSM") (Freeman 2005) is of interest for both customers and producers.

Financial and Technical Benefits

From a strict financial point of view one survey conducted on the benefits of DSM estimated a cost-benefit ratio on initial investments in upgrading to smart energy management programs of anywhere from 1:1 to 1:20.[3] The financial pay off can arise from several reasons. A more detailed study on DSM lists several benefits for utilities companies (Strbac 2008)

- Reducing the generation margin, i.e. the mismatch between production and demand
- Improving grid efficiency
- Allowing use of intermittent renewables e.g. wind that can not be considered a steady supply

The first point is significant as annual energy usage does not follow a steady profile, and peak problems arise. Peak usage occurs on a daily and annual level. In the day-to-day, peak usage occurs in morning and evening hours when end-users of energy are at home, using appliances and hot water. Likewise, annual peak problems arise from weather conditions. To meet these demands sometimes requires overproduction, which is a cost to the business, to the environment and to the end-user.

The following diagram describes the annual usage fluctuations in Malmö, Sweden for E.ON Värme. It can be clearly seen that usage spikes during the cold months of the year. To meet the energy demand spikes, unfavorable fuel sources such as oil are used.

[3] Freeman 2005 'Managing energy: Reducing Peak Load and Managing Risk with Demand Response and Demand Side Management'.

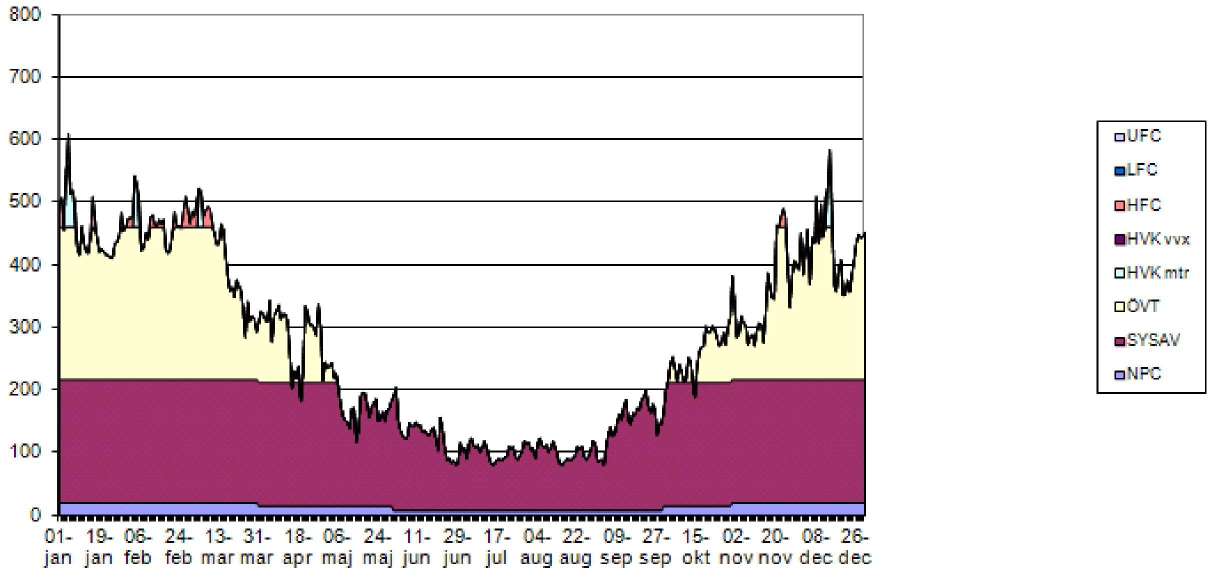

Figure 1.1: Annual consumption pattern for District Heating in Malmo with time along the x-axis. The area under the curve is colored according to proportion of energy generated by different generation sources.

1.5 Statement of Purpose and Objectives

While a clear need exists for energy providers to transform their business, the full details of how such a system will function are still unclear. In order to test the implementation of such a system, E.ON Värme[4] is looking at the 'green-field' development site in Hyllie, Malmö to test smart-grid district heating in newly built residential and commercial buildings. The development of a smart energy management system will transform the way users interact with their energy supplier and will give them a much more active role to play. In order to successfully implement such a system a clear understanding is required of the needs and wants of customers and how E.ON Värme might meet these requirements. The purpose of this project is to:

[4] E.ON Group is the world's largest investor-owned energy utility service provider based in Germany. This research only discusses E.ON's operations in Sweden, which is represented by E.ON Sverige AB who manages E.ON Group's various business sectors in Nordic countries and is the parent company of a number subsidiaries, such as E.ON Värme Sverige AB ("E.ON Värme") and E.ON Försäljning Sverige AB ("E.ON Sales").

- Understand the main customer (landlord, condominium associations (bostadsrättsförening, “BRF”), single villa owners and commercial buildings) incentives for implementing smart grid district heating.
- Outline short and long term goals for E.ON VärmeDevelop a matrix of drivers and barriers for smart grid implementation from E.ON’s business perspective, customer’s perspective and end-user’s perspective.
- Develop new business models for smart grid district heating relevant for each type of customer.
- Carry out a basic cost benefit analysis (“CBA”) of the new business models.

2 Methodology

This chapter describes the methods used in gathering and analyzing the data needed in the development of our business models, how these methods were selected, their limitations and effects on the reliability of our final deliverables.

2. 1 Data required and choice of methods

The development of our business models required an understanding of incentives from three different perspectives: (1) the end user of district heating, (2) the customers of district heating and (3) the company perspective itself. For E.ON a thorough understanding of the current business model, current business conduct, and their main incentives for implementing smart DH in Malmö and what barriers they face in doing so was required. To understand the company perspective, required the following data:

- Financial data
- Business background info
- Current business model

The most efficient method is to acquire this data was through interviews with key personnel within E.ON regarding DH, for both financial data and business background. A joint workshop was organized with E.ON staff for an understanding of their current business model. Financial data was acquired through quantitative interviews and through available financial data. (A copy of the E.ON Värme Annual report was provided by the company.)

Main customers were identified from company interviews. In order to understand the customers and their incentives we used semi-structured interviews along with a report published by Svensk Fjärvärme on energy services focused on customer preferences in District Heating., Energitjänster – Med Kunden I Centrum. (Svenskfjarvärme 2012)

To understand the end-user preferences and incentives, an online end-user survey was carried out in collaboration with collaborative research group (herein referred to as Group no. 2). The authors, part of larger research project involved in this Project, focused on customer incentives in a transforming energy market. To supplement the end-user survey, reports published by

Accenture(Accenture 2010a; Accenture 2010b) and Ernst & Young (Ernst&Young 2011a; Ernst&Young 2011b) on new smart energy consumers were also analyzed.

2.2 Methods to obtain data and their limitations

2.2.1 Interviews

As mentioned before, the purpose of conducting the interviews was to understand the smart DH industry in Malmö and the preferences, incentives and barriers for different players in that industry. The authors approach to the interviews was a mixed quantitative/qualitative, conducted in a semi-structured way. Qualitative interviews are used to acquire "data on understandings, opinions, what people remember doing, attitudes, feelings and the like, that people have in common"(Arksey and Knight 1999) while the quantitative focus on the collection of numerical data. (Bryman and Bell 2007)

A list of possible contacts was delivered by E.ON of staff willing to help from different departments within the company. In preparation for interviewing these individuals list of questions was prepared beforehand and the interview was carried out in a semi-structured and a flexible way so that important aspects, not present in our question list, were revealed.

Having interviewed E.ON personnel and developed an understanding of their business, E.ON customers were then interviewed. The customers were contacted and interviewed in the same manner as E.ON personnel. Due to time constraints we were not able to contact as many customers and external stakeholders as preferred .Two customers, MKB Fastighets AB ("MKB") and ROTH Fastigneter AB ("ROTH") were chosen to understand the ends of the customers spectrum. MKB was selected because of their sheer size and being E.ON Värme's biggest customer, ROTH because of their pioneering nature and willingness to try out new DH solutions.

We are aware that the low number of external parties interviewed might produce a bias towards E.ON and a single sided approach and the answers of both E.ON and the customer are highly case sensitive. To compliment this limitation the Svenskfjarvärme study was also reviewed. The interviews with the customers were recorded and transcribed.

2.2.2 Available Literature

Several studies have been conducted by global accountancy and consulting firms Ernst & Young[5] and Accenture[6] that both examine the preferences of the new smart energy consumer and how to engage the consumer.

Accenture is a global management consulting, technology services and outsourcing company, with more than 181,000 people serving clients in more than 120 countries making them the world's largest consultancy firm[7]. Accenture has over 40 years of experience in the field of water, electricity and gas and employ over 7500 people in 43 countries, working with over 210 utilities, including many of the world's largest industrial leaders. Ernst & Young is a global leader in assurance, tax, transaction and advisory services with over 14,000 employees. Ernst & Young's global power and utilities center has a team of experts providing these service and work on anticipating trends in the market, identifying implications and developing points of view on relevant industry issues.

The Accenture study was conducted in 17 countries with Sweden being one of the countries. 9,108 individuals partook in the survey. Out of these 9,108 individuals 514 were from Sweden. The survey sample in the study was representative of the general population in terms of gender, age and income in all countries.

The Ernst & Young study was conducted in 13 countries and Sweden again as one of them, with a focus on Stockholm. The discussion revolved around two consumer focus groups: a young family group (children under 10 in the household) and an older family group (children between 10 and 18 in the household).

It is important to consider the implications the sample groups bring with them. Since neither sample group is directly focused on the Malmö area the results of these studies cannot be directly applied to our business models. They can however provide a bigger picture on the current trends in the smart energy market.

2.2.3 End-User Survey

[5] Ernst&Young 2011a; Ernst&Young 2011b

[6] Accenture 2010a; Accenture 2010b

[7] http://biz.yahoo.com/ic/43/43516.html

The purpose of the end-user survey was to collect a large volume of data from end-users in Sweden in order to find out the following information:

- End-user's level of awareness about smart services
- The drivers for end-user to adopt smart services
- End-user's knowledge level regarding peak load usage in terms of environmental and financial influences
- Potential barriers against the adoption of smart services
- Relationship between heating system, way of housing and bill size
- To what extent end-users would like to use green energy
- Where is the leverage for end-user to accept smart service between financial and comfort

The questionnaire used was developed in collaboration with Project Group no. 2 and based on their methodology. It has a dominant focus on preferences for smart services, pertaining to electricity and district heating.

The questionnaire explicitly states that smart service is to control and manage electricity and heat consumption and also gives a brief description on what is implied with smart services. That is done so respondents give congruent and unified answers and are not answering questions based on their own assumptions and beliefs. Questions providing examples of heat and smart service probing further into heat usage preferences were added to the survey and were placed together with questions about electricity to minimize the number of questions, preventing respondent fatigue and leading them to think of smart service as a whole.

There are limitations in conducting an online survey. The respondent cannot be prompted when having difficulties answering questions and therefore questions need to be clear and unambiguous. Probing respondents for elaboration on answers is not an option and the questions must be salient to the respondent. Additional data about the subject is difficult to collect and respondents tend to not want to write a lot. There is also the risk of missing data from partially answered questionnaires. Having the right sample group is also a concern and that they are representative of the research topic[8].

In our case the majority (45%) of participants in this survey were single villa households and that reduces the reliability and validity of the survey, as our targeted customers are renting company

[8] Alan Bryman and Emma Bell (2003). Business Research Methods

such as MKB and BRF for ownership apartment. The sample groups for these types of householder are relatively small. Another limitation is that the majority (25%) of respondents were living in Stockholm and only 14% came from the Skåne area, as our project mainly targets Malmö area and that further reduces the survey's reliability and validity

The fact that this was an online survey where the questions are listed and a limited range of possible answers is given and the only action required by respondents is to mark the appropriate reply gives little freedom for flexibility and the approach is very standardized. Every respondent was given the same questions in the same time frame therefore being uniform. The advantage is that the information is easily quantifiable and allows the responses to be compared. However, due to the lack of flexibility, there is "little room for unanticipated discoveries". (Breakwell, Hammond et al. 2000)

2.2.4 Workshop

As a part the research of E.ON's current business model the authors conducted a joint workshop with E.ON personnel from different departments within E.ON DH. This workshop served to validate key findings and proposals as well as method of getting personnel contribution to the proposed business models. A comprehensive description of its design, implementation, limitations and results are to be found in chapter 4.

2.3 Methods to organize, analyze, validate and present data

To be able to organize, analyze, validate and present the findings in a feasible manner, the following tools and theories served as guidance.

2.3.1 Business Model Canvas (BMC)

In designing the business models the Business Model Canvas was chosen. *Business Model Generation* by Alexander Osterwalder and Yves Pigneur. (Osterwalder and Pigneur 2010)extensively outlines use of the BMC, its key elements, weaknesses and why the BMC was chosen as the preferred method is presented in chapter 3.

2.3.2 Incentive and Barrier Matrix

The Business Model Canvas is lacking when it comes to dealing with possible incentives and barriers for different players in its business models. As a way to deal with these shortcomings of the BMC the authors have organized an incentive and barrier matrix depicting the barriers and incentives for E.ON, customers and end-user in adopting and implementing each of the proposed business models.

2.3.3 SWOT-Analysis

A SWOT analysis is the most common and best known approach to strategy analysis. (Armstrong, Harker et al. 2009) It classifies the various influences on a company's strategy into four categories:

- Strengths
- Weaknesses
- Opportunities
- Threats

Strengths and weaknesses relate to the company's internal environment, opportunities and threats relate to the company's external environment. (Grant 2010)

Strengths include all the internal capabilities and resources that may help the company to achieve its objectives while weaknesses include internal limitations and negative situational factors that may interfere with the company's performance. Opportunities are favorable factors or trends in the external environment that the company may be able to exploit to its advantage and threats are unfavorable external factors or trends that may present challenges to performance. (Armstrong, Harker et al. 2009)

2.3.4 Five Forces Analysis

In an industry there are many factors that determine the intensity of competition and the attractiveness of a market. Porter's five forces of competition framework views the attractiveness of an industry is determined by five sources of competitive pressure. These five forces are supplier bargaining power, buyer bargaining power, industry competitors and the rivalry between them, threat of substitutes and threat of new entrants to the market. [9] This framework was used to address the lack of strategic issues in the BMC.

2.3.5 Financial Analysis

Due to the complexity of the business, a comprehensive financial analysis of the proposed products is not possible in the time frame of the project. Basic calculations provided relied on financial benefits assumed from operational costs reductions and are only meant as suggestive and to prompt further interest.

2.4 Reliability of Results

Despite the above noted lack of reliability, replicability and validity of the results of our study we do believe they can provide E.ON Värme with a case sensitive approach towards a new business model in Malmö city and Hyllie.

[9] Robert M. Grant (2010). Contemporary Strategy Analysis. John Wiley & Sons Ltd.

3. Business Model Canvas

3.1 Background

A “Business Model”, as defined by Alexander Osterwalder, is “a conceptual tool containing a set of objects, concepts and their relationships with the objective to express the business logic of a specific firm”.(Osterwalder, Pigneur et al. 2005) Based on the similarities of a wide range of business model conceptualizations, the “Business Model Canvas” is developed to be a tool that would allow business people to understand their business model and of what essential elements it is composed of. Likewise it would let them easily communicate this model to others and that would let them change and work with it in order to learn about new business opportunities .(Osterwalder and Pigneur 2010)

3.2 Key Elements

Represented by a visual template, the business model canvas is derived from the PhD work of Osterwalder (Osterwalder 2004). It includes four areas that structure a company’s business model. Each area has buildings blocks which are the core of the specific business model:

Product

- Value Proposition: is an overall view of a company’s bundle of products and services that are of value to its customers.

Customer interface

- Customer segments: define the different groups of people or organizations a company wants to offer value to.
- Customer relationships: describe the types of relationships a company establishes between itself and its customer segments.
- Channels: describe how a company communicates with and reaches its customer segments in order to deliver a value proposition.

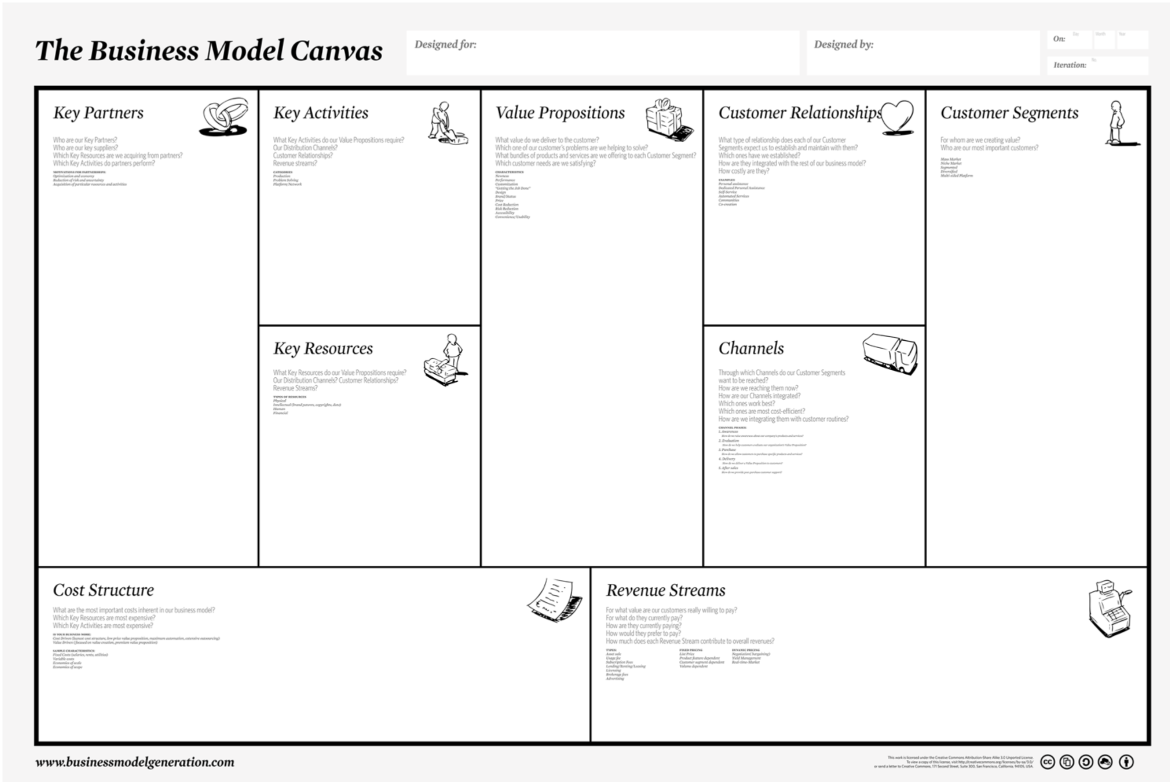

Figure 3.1: A sample of the Business Model Canvas from the book *Business Model Generation*

Infrastructure management:

- Key activities: the most important activities that a company must do to make its business model work.
- Key resources: the most important assets (tangible and intangible) that a company requires to make its business model work.
- Key partners: are the network of suppliers and partners that make the business model work.

Financial aspects:

- Revenue streams: describe the way a company makes money through each customer segment.
- Cost structure: describe all the costs incurred to operate a business model.

3.3 Applying the Business Model Canvas as a research method

This research applies the business model canvas as a method of data collection during the workshop in methodology. The decision is made based on following reasons:

Visual thinking in brainstorming:

The business model canvas can be understood as a canvas preformatted with the nine building blocks. The canvas allows participants to paint pictures and describe new or existing business models (Osterwalder; Pigneur, 2010). The visualization can help participants to think better, see more options and see the interdependencies among all components in their brainstorming.

Simple and easy to understand:

The logic of the nine building blocks is easy to understand and easy to engage people to describe the business model they use. This is particularly important when dealing with a mixed workgroup, whose experience and background may differ.

Customer insights as a starting point and great for creativity:

The business model canvas uses customer insights as a starting point, which is the key factor in understanding value creation. It challenges conventional assumptions with "what if" questions and thus is great to inspire creativity, which is the goal pursued in the designed workshop.

A number of practitioners:

Business model canvas has been used by a number of practitioners in different industries and areas, ranging from Ericsson, Telenor to PriceWaterhouseCoppers[10].

3.3 Drawbacks in application of Business Model Canvas in this research

Despite of the strength of business model canvas, the authors of this research are aware of the drawbacks when applying business model canvas:

Strategy

The nine building blocks of business model canvas do not have a clear representation of a strategy or goals of the business model. This could pose a risk that the business model could lose its directions in a long term perspective. As such, a Five Forces analysis and a SWOT analysis are carried out and presented in chapter 8.

Competition

[10] Information available from http://www.businessmodelgeneration.com/book

The nine building blocks of business model canvas have not covered the issue of possible competition. However, in the case of E.ON Värme, since it is in monopoly position in providing district heating, this drawback has a minor impact on the workshop result. Also, though there are other alternatives than district heating to provide heating, such as heating pumps or solar panels, as the percentage of the usage is far low compared with district heating, the competition issue appears to be less important.

Incentives and barriers

The business model canvas does not take into account the incentives and barriers that potential customers might have towards the business model. This is an important aspect in order to get customers on board with the business model. An incentive and barrier matrix was developed to meet these shortcomings and it is presented in chapter nine.

4 Joint workshop with E.ON staff

A joint workshop with E.ON staff was conducted on May 21st at E.ON Sverige's headquarters in Malmö. The participants represented a wide variety of cross functions including engineering, finance, production, product management, business development and the E.ON project coordinator from within E.ON Värme, as well as an external consultant and an E.ON sales representative.

The workshop served four primary purposes:

- First, to validate the key findings from the team's background research.
- Second, to create a sense of urgency by proposing the business challenge for the future.
- Third, to validate the team's proposal on the new customer segmentation
- Fourth, to get E.ON's staff to contribute new ideas on innovating future business models.

4. 1 Advantages and limitations

The main motivation for choosing the workshop format was that the format allows a quick and effective means of sharing and expressing ideas across the different business functions. Ideas presented in the workshop can be immediately validated or negated by other members as being feasible or not. The format however presents a problem as participants may feel overwhelmed by other members of the workshop and the idea flow is stifled. A too broad representation of the company also limits the discussion as all participants do not share business focus, i.e. engineers would not be expected to immediately understand the business concepts discussed. To take into account this variation in background a pre-set agenda was followed and participants were introduced to concepts and models discussed. The format is outlined below.

4.2 Format

4.2.1 Introduction

Different participants had different experience levels on the use of the business model canvas and business models in general, prior to this workshop. In order to get everyone on the same level in a short amount of time, with the session began with a short video introduction of the business model canvas from the developer of the canvas, Alexander Osterwalder., A second brief video introduced participants to be best practice of using the canvas method.

4.2.2 Introductory exercise Silly Cow exercise

To introduce the use of the canvas and the suggested best practice, participants were taken through an introductory exercise; the ‘Silly Cow’ in which a business based on a cow is mapped onto the canvas. A classroom white-board with a pre-formatted business canvas was used as the template. Ideas relevant to the business were added to the canvas using post-it notes which were later saved for documentation purposes. 4.2.3 Mapping out current business model.

4.2.3. Mapping out current business model

The main activities of the workshop started with a task to E.ON staff of “mapping out the current E.ON DH business model” on the business model canvas. The E.ON staff was divided into two groups and worked separately.

Two goals were expected to be achieved by this activity; firstly, to increase familiarity with the business model canvas way of thinking and secondly, to use the results of the session as a validation of the authors’ understanding of the E.ON Värme Business. The workshop served a tertiary purpose, for generation of new input that potentially had been overlooked in the prior research.

In order to get a comprehensive result, this task was not given a time limit. While the E.ON groups were working, the authors served as consultants to answer questions regarding the terminology and concept of business model canvas, but not interfering with their discussion. To prevent the phenomena that a single participant in the E.ON groups is too dominating to let the others express their view freely, E.ON staff was also encouraged to use color coding if within a group there was something that they cannot agree on.

The result of this activity is shown in the figure below. The bullets on post-it were explained and discussed between the authors and E.ON staff right after. All the post-it were collected and kept for documentation and later discussion.

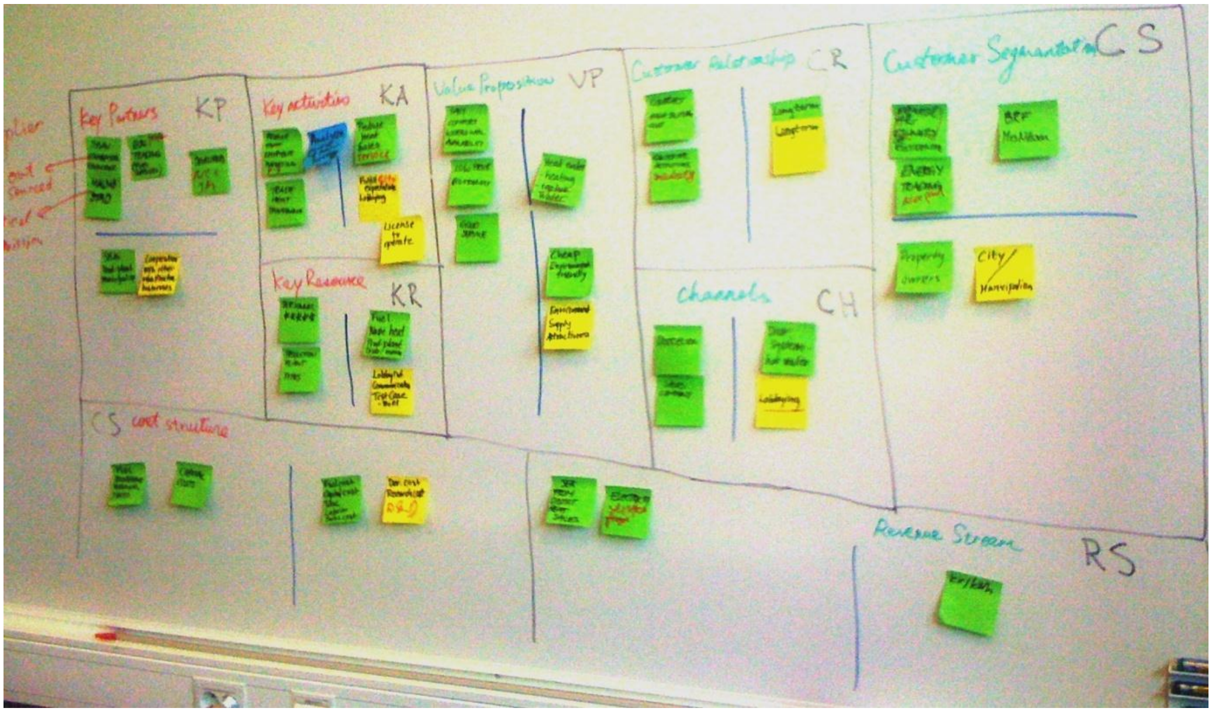

Figure 4.1: BMC Canvas from E.ON workshop, mapping out current business structure

4.2.4 Challenge for the future

After the activity, as part of the agenda of this workshop, we presented the future business challenge for E.ON Värme, to introduce the general focus of the brainstorming session to develop novel business models.

Customer Interviews and literature surveys, discussed in the following chapter revealed that a financial incentive was the strongest motivator for engaging customers in the use of smart technology. A rough financial calculation however, also presented in the following chapter, showed that only marginal savings are to be seen by customers if smart methods can reduce peak load problems in the system. This exercise served as an introduction to the focus of the brainstorming that novel ways, outside of financial incentives would have to be the basis for future business models.

4.2.4 Future business and new customer segmentation

This analysis was followed by presenting the proposed strategy for E.ON Värme's future business models i.e. to “turn economy of scale into economy of scope”. The new customer segmentation was explained and reasons behind it.

4.2.5 Brainstorming for the future

E.ON staff was again divided into two groups whereas this time, members of the research group also participated in the brainstorming. There are three considerations behind this arrangement. Firstly, a direct participation allowed for an improved understanding of the business ideas generated by the participants. Secondly, the research group members served as facilitators to aid in the discussion this included positive re-enforcement of ideas and guiding the discussion from points of stoppage.

The results of the brain storming exercises are shown in the following pictures.

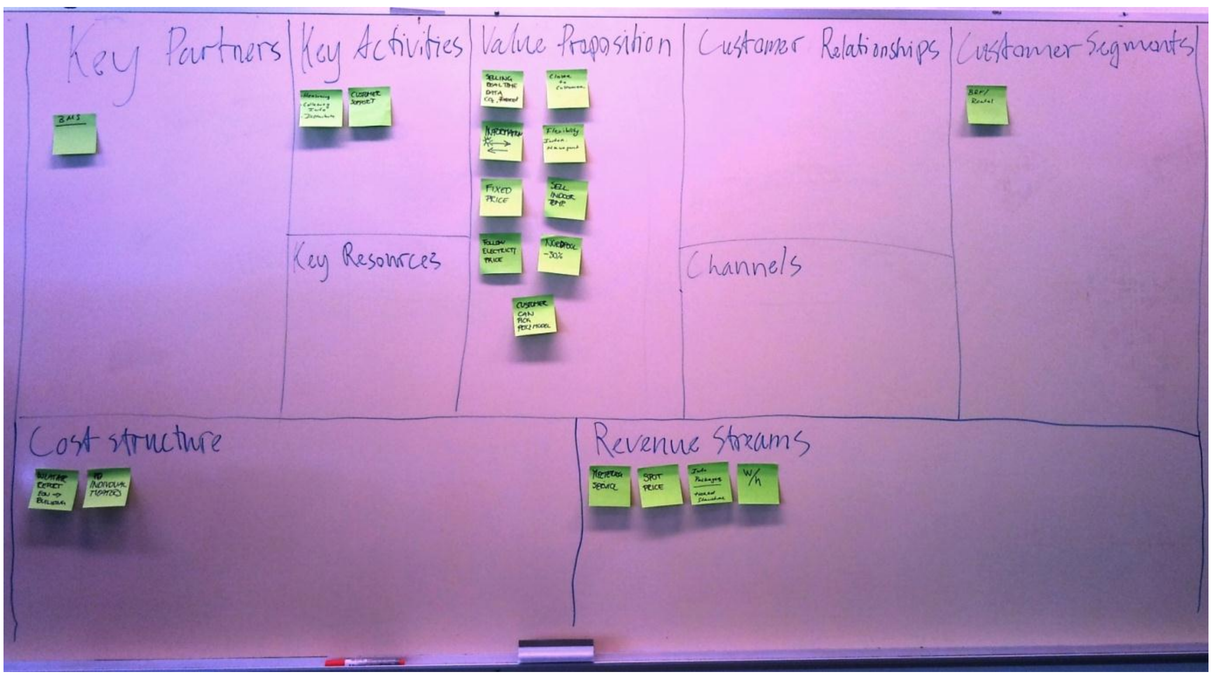

Figure 4.2: Results from E.ON Workshop brainstorming group one

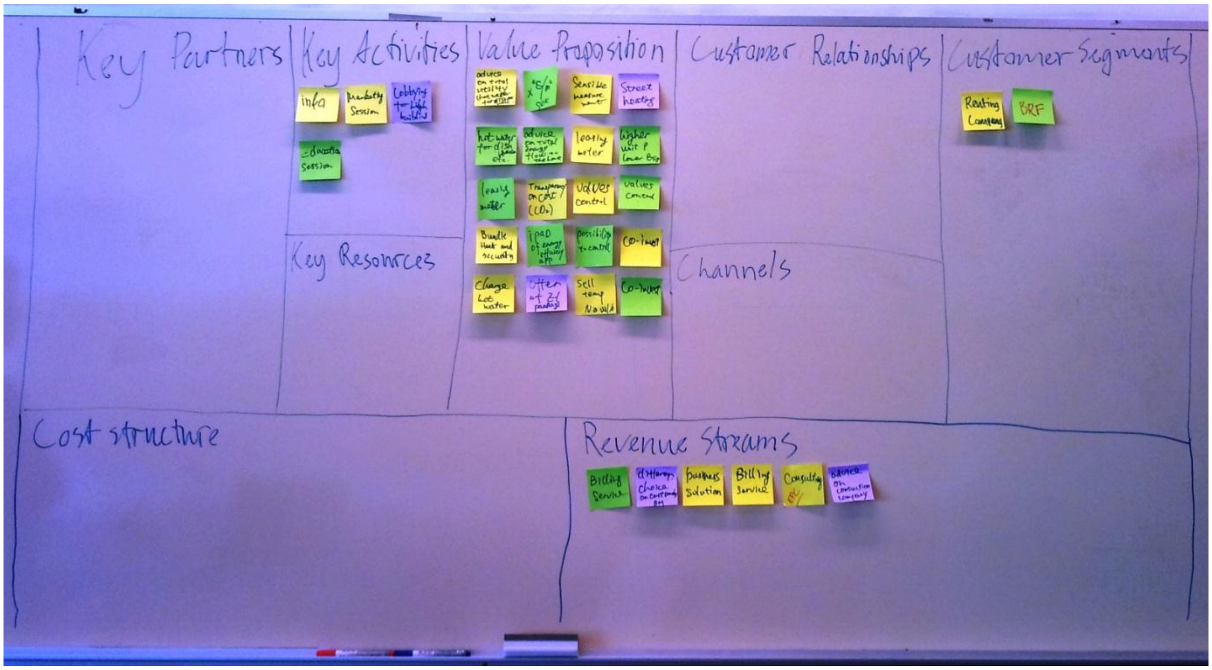

Figure 4.3: Results from E.ON Workshop brainstorming group two

4.3 Discussion

In the last part of this workshop, each group presented all their post-it ideas from their brainstorming and explained the main thinking behind it. All post-in notes from both groups were collected for documentation purpose to be used to further develop and refine the author's proposed business models.

After the workshop, a debrief session was conducted among the team members. Observations and insights from the workshop were shared. From this discussion, the team identified the key components for the next steps in the business model development and refinement.

5 Key findings on current business structure

5.1 E.ON Värme

The main heating energy provider for buildings in Malmö is E.ON Värme, one of E.ON Nordic's 23 daughter companies in Sweden. The city is serviced heat through a large water pipe that runs through the city of Malmö. There are 8 points of heat generation. (See Figure 1 below) The majority of the heat production occurs in one geographic part of the city (points 1-5 of the Figure 1.) The most important points are:

(2) Evonik – An industrial rubber manufacturer that sells by-product heat to E.ON Värme.

(3) Öresundsverket ("ÖVT") – This is a newly built facility that burns natural gas. This plant is a combined heat and power ("CHP") facility and produces district heat and electricity.

(4) SYSAV – This is the company in charge of collection trash in the Malmö, which it then burns and sells the generated heat to E.ON Värme. This heat accounts for the majority of the annual production in Malmo.

(7) Limhamns Fjärrvärmecentral ("OFC") – This site and site number 5 are used in extreme weather conditions, when the rest of the network can't produce the heat needed by the system. This runs on oil, the most expensive fuel.

(8) Heleneholmsverket ("HVK") – A CHP plant that runs on natural gas and oil. Because of the complexity of the Swedish electricity market, this plant is often chosen as a key source of heat generation, despite it being less efficient than ÖVT.

Current Customers

The District heating mechanism of ideally suited for population dense areas and residential apartment buildings are a target for the system. Thus property owners and rental agencies are they key customer of the E.ON Värme business. The end-users (at the household level) are customers of the property owner or of the rental agency, with the exclusion of single villa owners.

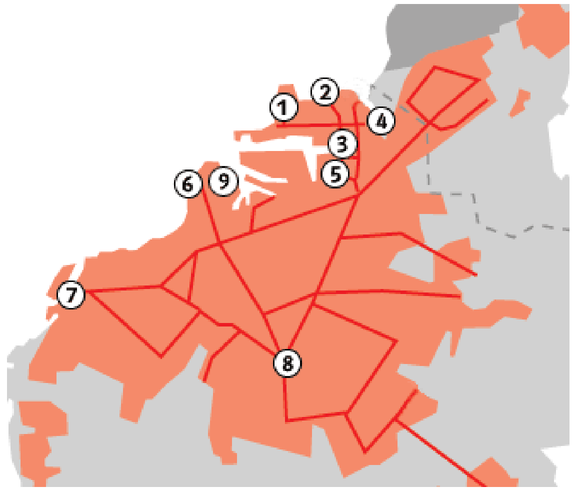

Figure 5.1 E.ON Värme's district heating generation points. Figure and data provided by Sofie Lagerblad of E.ON Värme Planning. (Personal Communication)

The total annual production of 2500 GWh for all of the production points suffers a 10% loss from inefficiency in the system. Taking the loss into account, the E.ON Värme business sells approximately 2250 GWh of District Heating annually, at an average price of 600 SEK/Mwh. The district heating generation facilities also produce a small fraction of electricity, accounting for approximately 10% of the total revenue.

5.2 Usage Fluctuations

As mentioned earlier, energy usage fluctuates on a daily as well as annual level. Daily fluctuations give rise to a *behavior peak* and arise from daily peak usage periods, i.e. mornings and evenings when residential customers are using hot water for showering. Annual fluctuations arise from weather conditions, which give rise to an annual *weather peak*

Type	Produced (GWh)	Lost (GWh)	Sold (GWh)	Unit Sale Price (SEK/MWh)	Total Rev. (MSEK)
District Heating	2500	250	2250	600	1350
Electricity	300	0	300	450	135
Total	***2800***	***250***	***2550***	***1050***	***1485***

Table 2.1: Revenue figures for E.ON Värme provided by Mats Renntun of E.ON Värme. (Personal Communication)

A typical annual energy consumption pattern for E.ON Värme is shown in Figure 2. The 'Duration' diagram shows the energy demand (y-axis) per day for all the days of the year. It can be seen that approximately 14 days of the year account for peak consumption, i.e. days that require above 500 MW) and expensive fuel sources are used to meet this demand. The duration diagram is split by color to show sources of the energy production, and again ÖVT and SYSAV account for the bulk of the production.

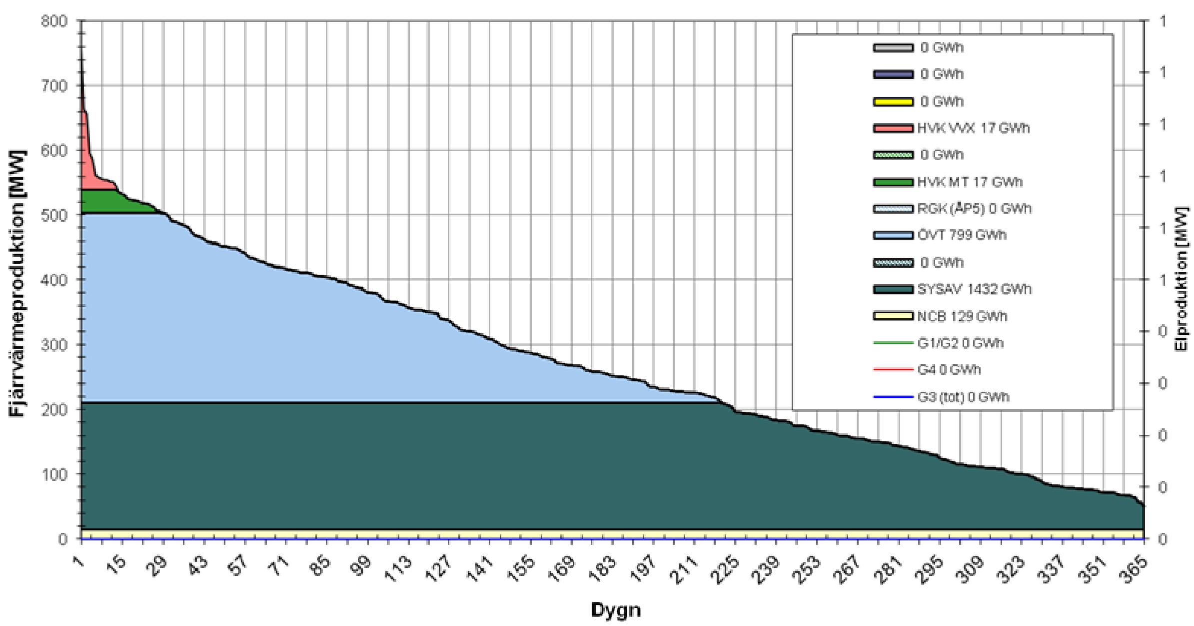

Figure 5.2: E.ON Värme duration diagram. Data made available courtesy of E.ON Värme. (Personal Communication)

Source	Fuel	Units (GWh)	Unit Cost (SEK/MWh)	Total Cost (MSEK)
Evonik	Industrial Heat	150	200	30
SYSAV	Waste	1400	200	280
ÖVT	Natural Gas	800	300	240
HVK	Natural Gas	100	450	45
OFC	Oil	50	850	42.5
Total		***2500***	***2000***	***637.5***

Table 2.2: Main sources of E.ON Fjärrvärme heat generation including, source, fuel type, quantity, per unit price and total cost. Data made available by Mats Renntun of E.ON Värme. (Personal Communication)

Oil, by far, is the most expensive fuel source to be used in the production of district heating. Though it is only used for 14 days out of the year (see Figure 2) it accounts for 6.6% of the total annual production cost. Likewise, Natural Gas based energy production at HVK, an old generation site that is more expensive to run and of a lower capacity than the newly built ÖVT, accounts for an additional 7% of annual production costs.

5.3 Lack of heat exchanger crosstalk

The current technical solutions of providing hot water for consumption and climate control for buildings in the DH system are two separate heat exchangers in the basement of buildings. One heat exchanger heats up the cold tap water supply from the water company before it goes into the apartments, the other heat exchanger warms up the air through radiators or floor heating. These heat exchangers operate separately and have no communication between each other.

Hot water consumption due to daily behavior generates heats and in addition to radiators warming up the atmosphere, the resulting steam also heats up the apartment. The net result is that a double heating effect occurs in the apartment. The results are an overheated climate in the apartment with questionable benefit to the user. (The user does not presumably benefit from the warming of the apartment as they soon leave the home for work.) The unnecessary double heating is a system inefficiency and thus the buildings require a larger amount of hot water flow. This is suboptimal from all three perspectives as this requires extra generation from the E.ON side, and unnecessary costs from the customer and end-user side.

A potential solution for this problem is installing smart heat exchangers that communicate with each other so they can control the flow of hot water to apartments and shut down flows when they are not required. The smart system would then analyze the total energy flow into the building and apartments and make the necessary flow adjustments.

5.4 Heat efficiency issues with old buildings

Interviews with both E.ON personnel and customers revealed there is a problem present in older buildings. The source of this problem is a lack of insulation between apartments resulting in unwanted heat transfer between them.

The problem with heat transfer between apartments is that a conveniently located apartment consumes less heat from the grid to get the same temperature as its neighbor apartments. Vice versa, it is very hard to keep different temperatures in different apartments. As E.ON DH product manager Wilhem Scånberg put it this way: "If you don't mind having 2 °C less than your neighbors, you can turn off your heat all the time". According to E.ON's biggest renting company customer MKB, this is exactly the reason why they are not planning to let their tenants to pay for his actual usage of heating the air for the indoor climate. (Interview, Customer MKB) Newer buildings however do not face this problem as insulation has become far better through the years and that trend will only continue. Heat transfer between apartments in new buildings has become negligible. Therefore there is a need to distinguish new buildings and old buildings in for future business models if indoor climate is involved.

5.5 New DH price model

Just over five months ago a new price model was introduced by E.ON Värme as a solution for usage fluctuations in the DH system. The price model was supposed to create incentives for customers to level out their usage and thus solving peak load problems. This price model is made up of the three sections as follows:

- *Power section*: The power charged is the highest recorded daily average power consumption during the month. The power consumption is then multiplied with the unit cost for kW[11] which is 83,47 kr/kW. The 'peak' pricing model is show in Figure xx.

- *Flow section*: The flow is the measured volume of heating water that has passed the substation in the consumption month. Volume demand is in part dependent on the flow temperature. Since the flow temperature varies in the DH system E.ON Värme corrects throughout the year the metered flow delivery. The correction means that all customers' cost of the flow section are revised with a correction factor so it is dependent on the average flow temperature for the consumption months. The formula for the flow correction factor is:

  Correction Factor = 0.02 * (monthly average flow temp. in °C – 60) + 0.2

  The cost is then calculated as flow multiplied with the corrected flow price. The unit flow price is 2,27 kr/m^3.

- *Energy section*: Energy is the measured amount of energy delivered during the consumption month. Energy prices vary throughout the year, depending on the season as follows:
  - December – March: 54,49 öre/kWh[12]
  - April – May; October – November: 36,12 öre/kWh
  - June – September: 15,72 öre/kWh

To this price model there is also a price guarantee that the total cost of power, flow and energy cannot exceed 80 öre/kWh in the year 2012.

[11] kW: A unit of power, 1000 Watts. Measures rate of energy transfer

[12] kWh: Power(kW) multiplied with time (h, hours).

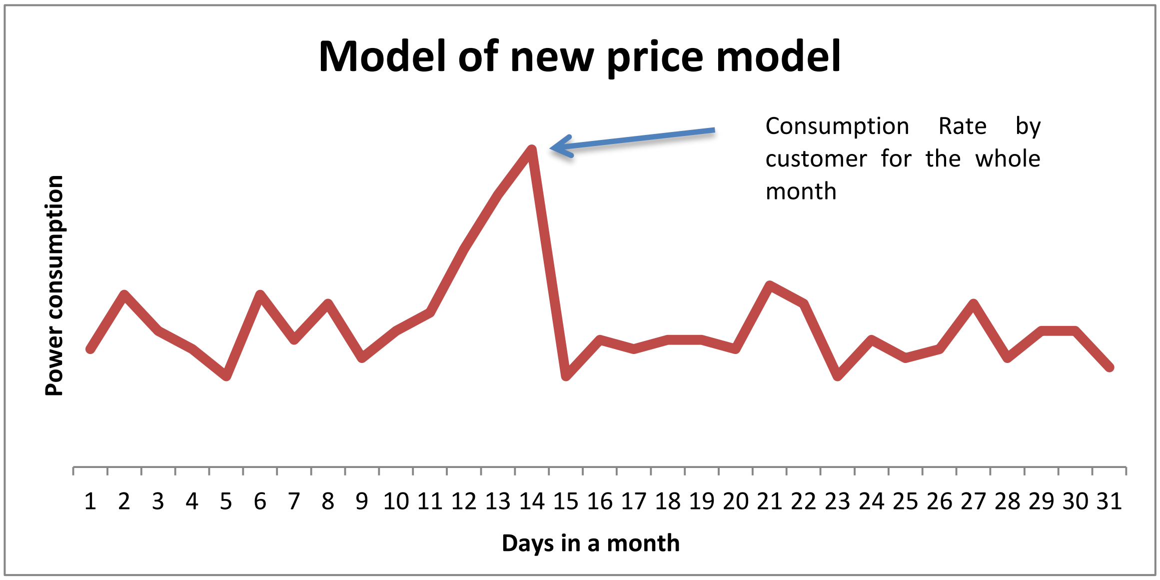

Figure 5.3: Model of recently implement peak pricing model

This new price model removes all fixed costs and grid fees and customers are only charged based on their actual usage. The model thus provides incentives for energy savings with the customer and property owners as fixed costs used to be up to 40% of the charged bill. The costs are now divided roughly 25% for power, 5% for flow and 70% for energy[13].

The new price model also encourages a flat usage with the customer with peak pricing. According to E.ON product manager for heating and cooling, the customers were satisfied with this new price model that gives them increased flexibility, control and only having to pay for their actual usage. However, customer interviews with Rikard Roth, the CEO of Roth, revealed that, even though they were aware of the new price model, did not fully understand it and were unaware of the peak power charges. MKB, E.ON Värme's largest customer, was aware of the model, but was not actively using it.

Although this price model provides incentives for energy savings and encourages flat usage with the customer, there are problems in achieving that. The customer does not have information on his usage, and therefore can only guess which activities contribute to his peaks in energy usage. As mentioned earlier, the customer is not always the end-user and that creates another problem. Even if the customer knows how to reduce his peak usage, the price model provides no incentives for the end-user to change his behavior if he is not billed separately for his usage. Therefore, a transparent

[13] Interview with Wilhelm Schånberg, April 16th, 2012.

flow of information from E.ON to the customers and end-users is required for this price model to reach its full potential.

5.6 Current business model of E.ON Värme DH

5.6.1 Customer segmentation

Currently, E.ON Värme divides their DH customer base according to the different type of the buildings they serve.

The following table shows the total usage in Malmö of each segment in a normal year of average weather condition and the number of connections. (DH product manager, E.ON Försäljning, April 27, 2012) and calculated percentage of usage of each segment accordingly.

Rank	Customer Segment	Normal year usage (kWH)	Number of connections	Percentage of usage
1	Multifamily dwellings	1447583540	2430	60.54%
2	Privately owned villas	170193444	7114	7.12%
3	Group connected house	1017962	14	0.43%
4	Industry building	46845938	106	1.96%
5	Public facilities	223059286	323	9.33%
6	Other properties	438032801	1025	18.32%
7	Others	55162369	93	2.31%
	Total	**2 391 055 340**	**11105**	**100.00%**

Table 5.3 . E.ON Värme DH customer segmentation data

As mentioned in the introduction, the trend of the future DH business with smart grids is to understand and focus on the customer and end-user perspective. The current way of dividing the customer base, within segment one, multifamily dwellings, is unaligned with the relationship between customers and end user.

Segment one currently lumps together both rental companies and BRF residential buildings. The organizations are the customers for E.ON Värme and the end-users are the tenants of the buildings. In a BRF, who legally owns and runs the ownership apartment, the customer and end user are essentially the same group of people. Because the BRF is run by representatives of the owners of the apartments in one apartment building or a few apartment buildings nearby, it is financially linked to owner of each apartment directly. Therefore in this case, the end users which are the owners of the apartments have the same interest of the customer which is BRF of all the end-users. This is not the case for rental agencies and their incentive structure differs.

5.6.2 Channels

Customers are reached through the E.ON Försäljning sales force. Heat is delivered via the current distribution and measurement network, i.e. grid.

5.6.3 Revenue Streams

For E.ON Värme DH business, there are three types of revenues streams: (1) the sales from heat usage directly.(2)income from selling electricity generated as by-product of heat and (3) a small customer maintenance service As the nature of Combined Heat and Power mentioned earlier, the amount of electricity the company produces and sells is directly linked to the amount heat it produces. Thus the main revenue stream is the total amount of heat usage sold. Given the size of the market share in DH for the city, extension of product scope is a natural focus for the business, as scale can hardly be increased.

5.6.4 Cost Structure

Among all the costs, the biggest part is production cost which is variable and mainly comes from the fuel. Besides this, there is development cost for the grid, and new plant investment, R&D cost including test case development, and O&M, which is partly related to the production.

5.6.5 Customer Relationship

Lock-in.

Due to the fact that E.ON Värme is the only provider of DH in Malmö, the customer does not have a choice if they want DH, the only alternative they have is to revert to substitutes such as heat pump or gas heating.

High switching cost.

This high switching cost of E.ON Värme DH customers does not come from switch another supplier, but the initial investment of switching to substitutes.

Long-term

Due to long development period of the system including grid, plants, building construction itself, customers usually start initial talking with E.ON Försäljning two to five years ahead of the real heat delivery. (Personal Communication, Laila Jonsson of E.ON Försäljning)

On the other hand, once E.ON Värme loses a customer who has chosen a heat pump, it can take up to ten years to bring them back because of the return on investment time (approximately 10 years) for current heat pumps.

5.6.6 Value Proposition

As validated by the workshop and customer interviews, District Heating key value proposition aspects are:

- Price advantage
- Convenience of use
- High reliability

5.6.7 Key Resources

The key resources of the current business model can be divided in two sub-headings: tangible and intangible. The tangible resources are the DH distribution grid and E.ON Värme's heat generating plants. The intangible resources lie within their employees and their know-how.

5.6.8 Key Activities

The key activities that E.ON Värme must undertake for this business model to work are few. First there is the operation of the plant. Running the plant is essential in order to meet the second key activity: delivering the heat to the customer. Third is the prediction of expected usage and production is in accordance with predictions. The final key activity is sales of DH to customers.

5.6.9 Key partners:

Key partners in this business model are: Malmö city and fuel suppliers. E.ON Värme requires an operational permit from Malmö city to dig and extend the current District Heating network. E.ON Värme’s suppliers are also crucial as E.ON Värme buys more than half the heat they sell. (See production sources described earlier in the chapter)

6. Customer Incentive and Preference

E.ON Värme's customers are composed of rental companies, BRFs, independent villas and commercial buildings where rental companies and BRFs together contribute 61% to overall heating usage (Personal Communication, Wilhelm Schånberg, E.ON Sales) As such, investigations on the two segments, rental companies and BRF can efficiently find out the most representative customer incentives and preferences. To identify customer preferences two on-site interviews were conducted for the segment of rental companies and a report prepared by Svensk Fjärrvärmes, the Swedish District Heating Association, for the segments of rental companies and BRFs was survey.

6.1 Analysis on data collection from onsite interviews

6.1.1 Interview questions:

The on-site Interviews were conducted with MKB, the largest customer of E.ON Värme's district heating business and Roth, an E.ON Värme customer who also takes part in the Hyllie development project. Interview questions are designed to focus on the following subjects:

- Energy strategies and reasons to choose district heating over other alternatives.
- Response on E.ON Värme's new price model which charges based on a peak load usage.
- Incentives and impacts of the new price model.
- How to motivate tenants to change their user behavior.
- Barriers and opportunities.
- View of green energy and vision on smart grid of district heating.

6.1.2 Key findings from interviews[14]:

Customer incentive and preference:

Both MKB and Roth have the sense of urgency to change towards a more environmental friendly and efficient energy strategy. The major forces are based on the facts that: energy prices are rising,

[14] Interview transcriptions are available upon request.

environmental policies are becoming stricter and demands to modernize existing old buildings are strong. Opting for district heating is a green option and meets the requirements set by their goals. This is particularly important to MKB since it is majority owned by Malmö City, and has strict demand for energy neutral targets by the ear 2020.

Both financial and environmental concerns are strong incentives for MKB and Roth. For E.ON Värme's new price model which charges based on a peak load usage, MKB and Roth take an open view on it. They believe with a good peak load management, they can save money on heating costs. However, at the same time, they demand transparent data and compatible electronic information service which can help their invoicing system to handle individual bills and avoid overhead expenses.

Individual meters on hot water are preferred by both MKB and Roth since they can force tenants to control their heating usage and change user behavior and consequently brings substantially financial benefits back to MKB and Roth. Currently, MKB and Roth suffer from financial losses from tenants' over usage on heating- the rent charged to tenants includes water and heating which means heating is a fixed cost to tenants. This will be changed with the installation of individual meters- from then on; MKB and Roth can separate the hot water bill and thus charge according to the actual usage of each tenant. Also, they believe providing transparent information to tenants is very important in terms of keep their financial incentives and environmental awareness.

Customer barriers

Both MKB and Roth believe the barriers would mostly be present in old buildings as they have practical problems in adapting and installing smart technologies in such buildings. Also, there is no way to put on individual meters on climate heating due to financial costs and the complexity of each flat of buildings.

The interviewers questioned that the actual financial savings from smart service could be so little that it can hardly become an incentive from tenants' perspective. But both MKB and Roth believe that the money saved from installing individual meters on hot water can be a strong incentive since currently tenants have overused hot water so much that the difference could be significant.

Trust and transparency on information

When it comes to energy efficiency services provided by E.ON, MKB, as the largest customer of E.ON Värme, has a high degree of trust in E.ON Värme. Roth, however, appears to be suspicious on the role E.ON Värme plays since the main revenue stream of E.ON Värme comes from selling heat. However, as long as E.ON can provide transparent information sharing, Roth would be willing to partake in E.ON's energy efficiency services.

6.2 Analysis on Svensk Fjärrvärmes' report:

6.2.1 Svenska Fjärrvärme

Svenska Fjärrvärmes, the Swedish District Heating Association, is the trade association for the Swedish district heating companies, who produce and/or distribute district heating and cooling. The organization has more than 60 companies linked, including contractors and consulting firms in the district heating sector. The association represents the industry in dealings with government and parliament in various actions, such as responses to investigation and consultation[15]. As such, the association can be regarded a reliable resource for district heating studies. The report, "Energitjänster–med kunden i centrum", (*Energy Services with a focus on customers)*[16] *commissioned by* Svenska Fjärrvärmes in 2012 is thus chosen for research on customer incentives and preferences.

6.2.2 Key findings from Svensk Fjärrvärmes' report:

Customer incentive and preference

Rental companies have strong incentives toward installations of individual hot water metering which brings the possibility to charge tenants for their actual use of hot water. Reports on raw data, an increase in the number of measure points and more frequent measurements can enable them to facilitate forecasting. From feedbacks they could find anomalies in the consumption and consumption that could be regarded unnecessary, which makes it easier to know where to put in actions that could lower the consumption and better align their energy use to the price components in their utilities' pricing models such as charge for flow or peak load consumption, which helped the real estate companies to save money.

Many old BRFs need advices of renovation and redevelopment. They are interested in better feedback of their energy use, especially values enabling them to compare their usage with others or

[15] Information available in English: http://www.svenskfjarrvarme.se/In-English/District-Heating-in-Sweden/

[16] Available on line: : http://www.svenskfjarrvarme.se/

with energy usage patterns from earlier periods. Individual metering had been discussed with all interviewed BRFs but none had actually made any decisions to install such systems.

Customer barriers:

Some rental companies had relatively little experience with load management and some of them worried about how load control would affect the tenants' comfort. Some rental companies did not like the idea of losing control, while others had no problems to outsource the energy efficiency service operation.

BRFs lack knowledge in load management and pricing models with flow or peak load components were considered difficult to understand. The customers demanded a simpler invoice without intricacies. Also, very few of BRFs knew how to care for and adjust the heat exchangers.

Education on energy efficiency

Rental companies emphasized that the utilities have an important role to disseminate information on its activities to the tenants, that is, to the customer's customers. They also showed interest in education or information about new energy technologies and providing information to tenants on how to save energy in daily life.

BRFs are interested in getting more information on how to adjust the district heating substation. However, they are hesitant when it comes to letting the energy company come and visit them and educate them on how to save energy in daily life. They were also interested in courses on how to run housing and how to think strategically about economic issues.

6.3 Observations on customer incentives and preferences

From customers' point of view, the best business model should be able to present a win-win situation with E.ON Värme, both in terms of operation costs and environmental concerns. This is also the goal that smart services pursue. Compared to its alternatives, district heating has proved to be less expensive for customers. However, this is not enough. As the energy efficiency improves, the demand of district heating declines. As such, E.ON Värme's district heating business should no longer be "to sell as much energy as possible" but to work out a more suitable business models in response to different segments of customers and a changing industry. Also, services with transparent information is needed and can be profitable, such as load management, service on the district heating substations and education or information that aims to explain how the energy system works and is affected by changes in the customers consumption.

7 Key findings: End-user incentives and preferences

7.1 End User Survey

It can be seen from the results of the end-user survey that the end-user is generally not well informed about smart services and what is implied with smart services with 43% of respondents with no knowledge of the matter and 34% with limited knowledge. Only 4% of respondents felt as if they had a strong knowledge base regarding smart services. 70% of the end-users also did not know whether their heat supplier utilizes any kinds of smart services and 22% percent replied that they had no smart services. However, after a short introduction to smart services and its possibilities their answers show that they generally have a positive view towards increased smart services and environmental aspects as well. Their answers also show that they are hesitant about increased smart services and environmental benefits if it implies added costs for them. According to question 7 regarding heat generated solely by renewable power sources 46% of respondents would not accept any increase in their bill and 26% accepting 1%-5% increase and numbers declining for higher increases. Question 12 reveals that the factors that weigh heaviest in affecting the end-user to use smart services are reduction in energy usage with 65% of respondents classifying it as very important. More controllability over their usage was regarded as very important by 40% of respondents and 30% regarded environmental benefits as very important.

When it comes to the peak load problem for energy suppliers in question 14 the end-users' knowledge seems to vary and is evenly distributed. 25% have no knowledge of the problem, 33% have limited knowledge and 29% with moderate knowledge. That leaves 13% with a strong knowledge base of the peak load problem. The end-user also seems to be indifferent towards a possible solution of spot pricing in question 15. With available answers varying from 1-5 with 1 being unlikely and 5 being very likely, 15% consider themselves unlikely to choose spot pricing over the fixed price and 19% consider themselves very likely. 29% are right in the middle and the rest is evenly distributed in between. Respondents contradicted themselves however in question 19. When asked which factors would encourage them to do energy intensive housework on off-peak hours, 43% replied that a reduction of 11% - 25% in off-peak hour rates was very important. 5% - 10% reduction was not considered as important but still showed considerable numbers with 17% selecting very important and 24% considered them important but a ratio of 32% was neutral. The respondents preferred lower prices in off peak hours, suggesting that they did not understand the spot-pricing concept asked in the earlier question.

Positive environmental effects and smart devices that operate on off-peak hours also can also act as drivers with the majority considering it important or neutral. Educating the end-user, as well as key customers about peak problems is a fundamental part in developing new business models and achieving the desired results of decreasing peak loads.

When looking at the responses to question 16 the respondents see themselves rather likely to adopt smart services such as supervised use of electricity, smart appliances that operate on off-peak times and the remote suspension of room temperature to allow minimized heat usage with over 50% selecting options 4 and 5 on the scale of 1-5 where 1 is unlikely and 5 is very likely. They are not as receptive to the remote control of home appliances through phones or computers with 28% selecting 3 on the same scale and a uniform division around that.

According to the survey energy suppliers also face some trust issues from the end-user. Question 18 shows that the biggest barrier for smart services is that 65% of end-users identify as their biggest fear that they could be charged unfavorably based on their usage. 47% also fear that their energy use information could be used as a marketing tool for unwanted personalized marketing. They also fear that outsiders can monitor their usage so they can commit crimes when the end-user is away.

7.2 Previous Studies

Two recent studies carried out separately by Ernst & Young and Accenture went after the preferences of the new energy consumer. The studies carried out globally found a general consensus on the current relationship between energy suppliers and consumers. In general utilities companies were perceived to be distant from the customer. Customers had a generally low perception of the company and lacked *trust*. The 13 nation study of Ernst & Young[17] found that customers were either negative or ambiguous in their relationship with their energy supplier. When asked which organization you would trust for energy usage optimization, only 29% found utilities companies to be a reliable source of information. Sweden was particularly low with only 16% of respondents expressing trust in the utility company.[18]

[17] Ernst & Young 2010a,b

[18] Accenture 2011a,b

The awareness of what exactly smart services were was also rather low. Only four nations were familiar with 'smart' concepts: Australia, Canada, Italy and Sweden. Only 28% of respondents in the Accenture survey knew what smart electricity management programs are. Customers were unaware of smart energy management and what services, if any, their energy provider offered. After having received information on smart energy management, respondents to the global survey were generally optimistic about the potential of the technology, but adoption was motivated mostly by financial gains. By order of importance, respondents in the Accenture study, users listed 'impact of your electricity bill' and 'utility control' as the two most important in decisions regarding smart service adoption. Factors such as green energy and environmental considerations were the second priority with increased control of energy usage as third. Users in Sweden followed the same response trend.

7.3 Survey Agreement

The responses from previously carried out studies and the survey described in Section 7.1 shows general agreement. The current climate-customer relationship is dominated by a lack of transparency. Customers distrust their current energy supplier and are poorly educated on what smart energy management can do for them. The Accenture global survey reported a 28% awareness level which is in close range to the local survey, at 23%. The general mistrust is dominated by a fear of bill increase and what user information will be used for and potential misuse of data by third parties.

In terms of factors that would influence adoption, both the global and local surveys rank Money, Control and Environment in that order, money being the most important.

8 Discussion: Strategic Position and Challenges

To analyze E.ON Värme's current strategic position and their position in the market place a SWOT and Five Forces analyses were carried out. The results from these analyses are presented in this chapter.

8.1 SWOT Analysis

	Type of Factor	
	Favorable	**Unfavourable**
Internal	***Strengths*** • Monopoly position in the market. • Owner of the district heating grid. • Strong power plants. • Strong partnerships with suppliers. • Levels of integration. • Cheaper reliable and convenient	***Weakness*** • Limitations on business activities. • Limitations on price decision. • Defective customer segmentations. • One main revenue stream
External	***Opportunities*** • Green energy provider. • Energy efficiency services. • Information sharing. • Knowledge sharing	***Threats*** • Stricter environmental policies. • Fuel price increase. • Climate change. • No further market share to grow into

Figure 8.1: SWOT Analysis of current E.ON Värme Business position

The main strength of the company comes from its monopoly position on District Heating provision in the city. There are few alternatives to home heating. The business however is limited in scope, the company provides one main service and the segmentation of its customer base may not accurately capture the wants and needs of its customers. With the shifting trend in energy consumers, towards more tailored and interactive products, this becomes an issue as clients demand more and the current service cannot provide a variety of products.

The main opportunities for the company come from shifting their business to a larger scope. The availability of ‘smart’ services and information for increased transparency and improved customer relationships is a key motivator for change. The company is threatened by shifting legislation on European environmental standards and by the price of primary energy sources (i.e. fuel such as natural gas).

8.2 Five Forces Analysis

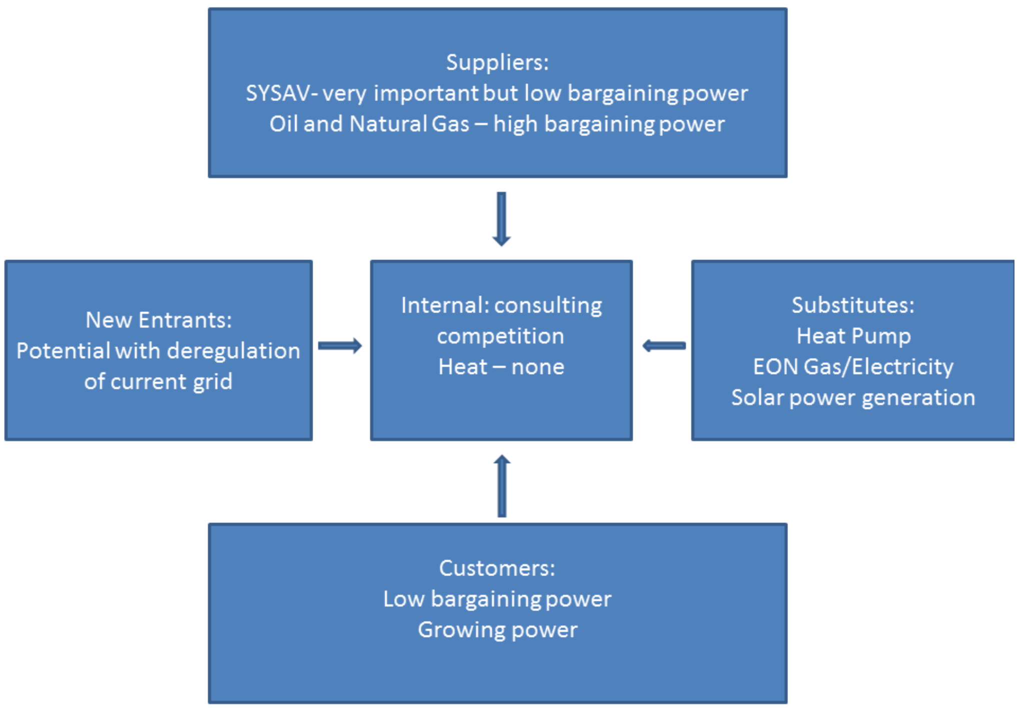

Figure 8.2: Five Forces Analysis of current E.ON Värme Business position

The position in the market place is summed up in the Five Forces analysis. With a lack of reasonable alternatives the company is most sensitive to supplier demands. The company is heavily dependent on SYSAV for a large portion of its DH energy and in general its suppliers have a high bargaining power. The costs of operation depend heavily on the fuel source and cost. The customers, with a lack of reasonable alternatives currently have low bargaining power.

The general shift in the energy industry, towards alternative and clean fuels, puts the company at risk. While substitutes, like heat pumps are still a very minor player in the market, they are a growing threat. Potential deregulation of the current grid and opening it up to new companies will increase the competitive pressure.

8.3 Challenges

Strategically the company finds itself in a strong position in providing District Heating Services in Malmö. Overall it offers customers a cheap and reliable source of heating and there are few alternatives. The company has a monopoly position on the operation of the grid and no strong competitors. The strength of the position is in some ways the main threat to the company. The business is in a 'comfortable' mode of operation and if it does not shift to meet the changing demands of its customers, will loose market share.

The rapidly advancing technology is both a challenge and an opportunity for the business. Home usage efficiency will cut average user-demand but an increase in number of services (revenue streams) and properly used smart technology will allow increasing the company product scope. The strength of this position allows for exploration of new technologies and the company has the resources and network to adapt to the shifting market place.

9 Proposed New Business Models and Segmentation

This chapter delivers the final results of the research. An new customer segmentation is proposed along with five different business models for smart DH.

9.1 New customer segmentation

We believe that the most important strategy for E.ON in the future smart Grid business is to develop its business around customer and end-user interests. In line with the nature of the relationship between E.ON's customer and end-users, a new way of segmenting the customer base is proposed and the new business models are developed based on this new customer segmentation.

Segment one: renting companies that own and rent out apartments

In this segment, customer and end-user are different. E.ON's customer is the renting company while the end user is the customer's customer, the tenants living in the property. The key to develop a business model for this segment is to create value and incentives for both parties.

Segment two: BRF who legally owns and runs the ownership apartment

As opposed to rental the customer and end user are essentially the same group of people. The focus for this segment is to lower their cost.

There could be a corner case of subletting, meaning that the owner of the apartment rents out the apartment, which makes the customer and end user different. Due to Sweden's strict regulation on subletting ownership apartments, it is not a prevailing phenomenon and the authors exclude this case in this research.

Segment three: Single Villa Owners

Customer and end user are the same in this segment. Shown in table (**usage table**), in this segment, the total yearly usage accounts for only 7.12% despite the fact that the number of customers is nearly 70% of the customer base. Therefore the contribution to peak usage from each customer is very small compared to the customers in segment one and two. As a result the team did not prioritize this segment in new business model development.

Segment four: Commercial buildings and public facilities including office buildings, shopping malls, libraries and schools.

In this segment, the customer and end user relationship is a bit more complex. Both cases exists, for some buildings, customer is end user, for others, they are not. Due to the fact that this segment has relatively low total usage, their daily usage is relatively stable and that these building consume heat in working hours, they do not contribute to the behavior peak usage the same way as the previous three segments. Therefore they are not a prioritized segment for the development of a new business model.

9.2 Business Models

9.2.1 Consulting service on Energy Performance Contract

Targeting segment: Rental companies

This service will expand the currently small revenues generated by consulting on energy efficiency to business customers (segment 1,2,4) on how to reduce their bill size according to "new" price model (the current one, started in 2012 and thus it's relatively new to the customers.) The price of the service can be set as a percentage of the savings brought to customer. Functions could include change recommendation, implementation and could include assisting with upgrading to a newer heat exchangers, installing intelligent heat exchangers with 'crosstalk'

The service will expand a currently small revenue source, but at the same time it might bring short term costs, especially when E.ON also conducts the recommended upgrade as well. Short term costs might include implementation of the actual service but long term gains could be eliminating peak usage spikes and improving customer relationships.

9.2.2 Smart service of Load Management

Targeting segment: BRF

As the result of this research, both customers and end-users care about the environment and want more transparent information on their usage and the link to their environmental impact. The selling point of this model to end-user and customer is "go greener without added costs"

In this business model, E.ON subscribes an iPad to end-user over two year at a better than market price, for example half price. This iPad will be the carrier of E.ON's smart energy service through an application, which will monitor usage, manage load, control indoor climate and push information on the carbon footprint generated by their usage. After the subscription period of iPad, the smart service itself, especially load management, can potentially become a new revenue stream.

E.ON's most direct incentive for this model is to reduce the peak by managing the heat usage load under the favorable temperature.

However the true value of this business model is to develop much closer customer relationship by having a direct way to communicate with each end-user that will serve as knowledge platform to shorten the time from the awareness to adoption for other future services such as total energy flow analysis which can lead to revenue from smart appliance or future business model such as charging for spot price. This business model can also give E.ON means of integrated solutions for smart grid of electricity and heat.

The customer's and end-users in this case incentive is have possibility to do real time monitoring and control over their own usage and cost.

The barrier to this model is three fold.

Firstly, it requires a large amount of initial investment from E.ON, the options of solutions include co-investment with BRF, co-investment with telecom operators on 3G version of iPAD or co-investment with home internet service providers

Secondly, this requires behavior change and trust from the end-user. Therefore, the key to the success of this model is to provide honest and transparent information on users' usage, their savings and E.ON's cost and carbon footprint from the heat usage. The information should be communicated in a meaningful way, which will become the direct incentive for them to more actively limit their usage, decreasing peak loads and increasing environmental benefits.

Thirdly, this model brings a substantial change and cost increase in either the customer’s billing system or E.ON’s billing system as each end-user will be charged separately on their usage.

9.2.3 Selling Indoor Climate

Targeting segment: renting companies, primarily their new buildings.

In this model, the customer is sold a comfort temperature instead of being charged for usage. This business model is primarily targeting the customer segment of renting companies, specifically their newly built buildings due to the issue of heat transfer between neighbor apartments in older buildings. This business model requires substantial changes on how heating services should be priced.

E.ON's incentive here is to bypass the hard to get a "yes" question, "Can I turn off your heat for a while when you don't need it?" to the end user when their heating bill is included in the rent already.

One of the reasons why it is a hard to get "yes" question is that people are unaware that the indoor temperature will not drop substantially if heat is off for a couple of hours due to the slow reaction time of buildings, and having a constant flow of heat does not increase the comfort level.

Another reason why it is a hard to get "yes" question is that the common end-user has limited understanding of the current pricing and measuring unit "SEK/kwh" and how it relates to their everyday life, such as indoor comfort level and the bill size they pay.

If it is changed into "SEK/°C/m^2", it would be much easier for end-user to establish the link, because they are already familiar the concepts of degree and square meter. But it is hard predict the cost for this change, and E.ON might not have sufficient information and knowledge to develop such pricing scheme, cooperation with renting companies is foreseen as required to achieve this change.

To achieve the maximum effect of this business model, EON's customer might need to change their business model too.

For example, renting companies could charge the tenant a rent of 3000 SEK per month with guarantee of 21 °C with a small fluctuation range. If a different temperature is requested the variable part of the heating bill will go down -200 SEK if you only 19 °C are required or go up +300 SEK if 23 °C are required. The total rent for the tenant would then be 2800 SEK or 3300 SEK depending on what temperature the tenant chooses.

The value this business model brings to EON is that it allows EON to turn off the heat as long as the temperature is within range. For EON's DH customer, they can get the increased the flexibility that they can provide to their tenants on contracting different temperature. This will not only increase the comfort level for the end-user of DH, it will also bring financial gain and incentive for potentially reducing the heat loss from open windows when they want a cooler climate. In that case, the tenant could request a lower temperature from the landlord and lower his rent.

However, besides changing their own business model, there are some other barrier for the customers to adopt this business model, such as the overhead costs on handling their own billing service to tenants might increase simply because there is a lot more information that needs to be kept track on if every tenant has their own preference for temperature.

9.2.4 Charge Hot Water

This business model is both targeting BRF and renting company

As mentioned in chapter 5.4, there are two different heat exchangers in apartment buildings. Currently, E.ON only measures and charges for the total heat usage through one single bill. From a end-user point of view, most of the cases both in segment renting company and BRF, the end-users' monthly pay includes both water usage and heat usage. This leaves no incentive for end-user to actively limit their hot water usage.

By measuring and charging for hot water according to real usage, the hot water consumption is foreseen to be lower, which will lead to lower heat usage, at least the part used to heat up hot water, which is a main contribution of behavior peak.

This business model requires an initial investment in individual meters that measure hot water usage for each apartment from the property owners. To help lowering down the entrance bar for customers, E.ON co-invest with them is one option, or install for them and leasing to customers who will let them take over the ownership of the meters over a few years.

From E.ON's perspective the aim is to reduce the amount of heat required for heating water in order to reduce peak load problems. This however not only affects the peak load usage but the overall usage as well, resulting in lost revenues and lower demand that should be offset by cost savings. For customers, naturally this model will bring them a small heat usage bill. However both renting company and BRF needs to pass on this way of charging to the end-users which will bring them more control over their own usage and financial incentive to reduce it. There are various way of doing it, such as BRF can really pass the expense according to the actually usage, renting company can still charge their tangent a fixed chunk for hot water, but with a cap usage amount. Anything above the cap, tenant will have to pay more according to the real usage number.

However, this will increase overhead costs for customers with added vase amount of information from measuring hot water usage separately and the billing of such information. To resolve this problem, the authors propose another business model as 9.2.5.

9.2.5 Billing System— Information based revenue

This model primarily targets renting company, can be adopted by BRF and other commercial customers.

The transition to a smart energy system will generate a significant amount of information. Therefore the most logical extension of E.ON's current business is the generation, processing, management and distribution of energy usage data. This model can be used stand alone or in support of the previously described models.

With increased measuring points and reporting points the system should have two way communication i.e. users will be able to send and receive data to the central system. The information flow and the information itself then are part of the value generated by future business, as it can track various aspects of a user's consumption. Measuring and visualization was one of the services the Svenskfjarvärme survey reported as being a desirable service and the need for clearly presented and easy to work with data was mentioned explicitly by one of out interviewee's

”They must give us the inputs so that we can do this. We are very depend[ant] on the data they give us. It should be a digital format so that we can use it in a simple way” Roth

In this case, the word user covers both end-point and higher level users and is relevant for all customer segments. The level of information 'sold' will depend only on customer preferences.

The handling of this information will require an infrastructure development and a natural extension is to take over the billing service for the company. Usage reports and statistics can be directly coupled to the billing of customers. A large customer like MKB currently handles these statistics and forsees that if the system grows, an increased workload to deal with this information:

"Yes, we will have to hire more people to handle the energy information, and we regard E.ON as a good partner on this." (Interview MKB)

Taking over the billing service can be beneficial to both customers and E.ON.

9.3 Incentive and Barrier Matrix: proposed business models

The following pages sums up the previously described business models and the key incentives and barriers for company customer and end-user.

Business model	***Consulting service on Energy Performance Contract***	***Smart service of Load Management***	***Selling Indoor Climate***	***Charge for hot water***	***Billing service***
Targeting customer segmentation	Renting company	BRF	Renting company, new buildings	Renting company & BRF	renting company, BRFs
Eon's incentive	New revenue stream from know-how	reduce peak load	reduce peak load	reduce the heat used for heating water to reduce the peak load	New revenue stream from information
	Increase the adoption rate among customers for new business model, price model and new solutions	information flows to end-user with direct way of communication			low down the barrier to customer when they adopt other new business service
	Develop customer relationship into partnership				Develop customer relationship into partnership
					giving customer flexibility on
Eon's barrier	Trust issue	large amount of initial investment	customers need to change their Business model to achieve the max impact	peak load, overall usage will be reduced as well. Property owner might not want to invest in individual meters.	Might need potential cooperation with DH control center unit manufactory and/or maintenance company
		trust issue	development of new price scheme	initial investment needed for the individual meters	IT challenge
		potential bring in overhead cost on billing system			
Customer incentive	reduce energy bill	possibility to monitor and control energy bill size	reduce energy bill	reduce energy bill	reduce the increased overhead brought by adopting new business model to reduce energy bill
				controllability of the control own usage and bill	
Customer's barrier	Solutions might bring in overhead cost	potential overhead cost on billing system	change price model	initial investment needed for the individual meters	potential complexity due to the DHC unit is bought
		vase amount of information to handle	increased overhead cost	vast amount of information to handle	
End-user incentive	N/A	get an iPAD	flexibility in choosing temperature	have the possibility to control own usage	N/A
		possibility to control and monitoring energy usage	increased comfortable level		
End-user barrier	N/A	behavior change needed	new way of thinking needed	behavior changing needed	N/A

9.4 Financial Analysis and Future Work

The present report is not an exhaustive evaluation of future business alternatives or revenue streams for E.ON Värme. To properly evaluate these proposals, a complex model is required to predict the impact of decreased energy generation on the cost side of the business. The complexity is necessitated by the complexity of the company and is derived from both the supply as well as demand side.

Supply Side

Supply side considerations must take into account the source of the power produced and the fuel used to produce it. Energy prices, as shown in Chapter 5 depend on the source of production and some fuels are more expensive. The more expensive fuels are subject to higher taxes and CO2 allowances must also be purchased to match production. The bulk of the district heating sold by E.ON Värme, is purchased from SYSAV, whose waste fueled generators are not subject to the same taxes. Thus fuel dependence is a key variable to monitor and more difficult to predict. The change in usage must also take Carbon credits into account.

The key generation sites are combined heat and power (CHP) facilities and produce electricity alongside district heating. The electricity is sold in on a regulated market and electricity price dictates if a production site is in operation or not. The complex model thus must take into account electricity pricing and the impact on which generation sites will be used to match the new demand in the city.

Demand Side

Demand side complexity arises from the wide range of customers that E.ON Värme serves. As our research showed, a wide variety of building standards are present in the city and while newly developed homes will be highly energy efficient, older homes will not be. Thus different products are targeted to different building types. With renovations taking place, rebuilding's, it is difficult to predict the adoption rate. Likewise, given the diverse range of clients and building owners, it is more difficult to give a reasonable estimate of future adoption trends. Adoption rates from different target segments are also unpredictable and would need to be modeled.

Given this complexity we have been unable to carry out a through analysis of the proposed business models as we have intended. A rough financial calculation based on available numbers is presented in the Appendix 2.

Future work should include an extension of the calculation to take into account the variables mentioned earlier in the section.

References

Accenture Understanding Consumer Preferences in Energy Efficiency (2010a)

Accenture Engaging the New Energy Consumer (2010b)

Arksey H. and P. Knight (1999). Interviewing for social scientists: An introductory resource with examples, SAGE Publications Ltd.

Armstrong G., M. Harker, et al. (2009). Marketing: an introduction, FT Press.

Breakwell G. M., S. Hammond, et al. (2000). Research methods in psychology, Sage Publications Ltd.

Bryman A. and E. Bell (2007). Business research methods, Oxford University Press, USA.

Energimyndigheten Swedish Energy Agency: Energy in Sweden 2011 (2011)

Ernst&Young The rise of smart customers: What consumers think (2011a)

Ernst&Young The rise of smart customers: What the sector thinks (2011b)

EU Thematic Strategy on air pollution (2005)

Freeman R. (2005). "Managing energy: Reducing peak load and managing risk with demand response and demand side management." Refocus **6**(5): 53-55.

Giorgio Busnelli V. S., and Alice Vatta (2011). "Home of the Future." McKinsey Quarterly.

Grant R. M. (2010). Contemporary strategy analysis, Wiley.

Osterwalder A. (2004). "The business model ontology: A proposition in a design science approach." Academic Dissertation, Universite de Lausanne, Ecole des Hautes Etudes Commerciales **2**.

Osterwalder A. and Y. Pigneur (2010). Business model generation: a handbook for visionaries, game changers, and challengers, Wiley.

Osterwalder A., Y. Pigneur, et al. (2005). "Clarifying business models: Origins, present, and future of the concept." Communications of the association for Information Systems **16**(1): 1-25.

Strbac G. (2008). "Demand side management: Benefits and challenges." Energy Policy **36**(12): 4419-4426.

Svenskfjarvärme Energitjänster – med kunden i centrum (2012)

Torcellini P., S. Pless, et al. (2006). "Zero energy buildings: a critical look at the definition." Preprint. ACEEE Summer Study Pacific Grove. California, USA, August: 14-18.

Appendix 1

Interviews with E.ON staff

Time	Interviewee	Job function
Multiple interviews from April 2nd to May 21st, 2012	**Helen Carlström**	Project Coordinator, E.ON Värme
April 11st, 2012	**Thomas Garhem**	Production Leader, E.ON Värme
April 11st, 2012	**Håkan Hylén**	Production Planner, E.ON Värme
Multiple interviews from April 16th to May 21st, 2012	**Wilhelm Schånberg**	Product Manager of Heating and Cooling, E.ON Sales
April 27th, 2012	**Sofie Lagerblad**	Planning & Stratigic Analysis, E.ON Värme
April 26th, 2012	**Mats Renntun**	Financial Responsible, Technical Department, E.ON Värme
April 27th, 2012	**Per Rosén**	Senior Engineer, Technical Department, E.ON Värme
May 9th, 2012	**Laila Jonsson**	Sales, E.ON Sales

Interviews with E.ON District Heating Customer

Time	Interviewee	Job function
May 16th, 2012	**Rikard Roth**	CEO, Roth Fastigheter AB
May 16th, 2012	**Ulla Janson**	Energy strategy responsible, MKB Fastighets AB

Transcripts of these interviews are available upon request.

List of participants of joint workshop

Name	Job function
Helen Carlström	Project Cordinator, E.ON Värme
Wilhelm Schånberg	Product Manager of Heating and Cooling, E.ON Sales
Per Rosén	Senior Engineer, Technical Department, E.ON Värme
Mats Renntun	Financial Responsible, Technical Department, E.ON Värme
Laila Jonsson	Sales, E.ON Sales
Marie	Business Development, E.ON sales
David Lillienberg	Project coordinator, E.ON Värme
Tomas Ranstorp (External consultant)	Specialist in real estate communication, (External consultant)
Håkan Hylén	Production planner, E.ON Värme

Appendix 2. Sample Calculation

Sample calculation of break-even point for E.ON consulting service business model.

Customer: MKB who has 23000 rental apartments.

Assumptions: MKB annul usage is around 285GWH/year

Selling price of heat from E.ON is 600sek/mWH,

Average number of apts/building is 40

Usage reduction from cross talk exchanges 6.5%

In this scenario, MKB has contracted E.ON for an energy management consultation. After an analysis of the MKB buildings E.ON suggests an upgrade to smart, cross-talking heat exchangers. The upfront cost of the substitution is paid by E.ON.

MKB stands to benefit a 6.5% reduction in water usage. E.ON charges half of the savings passed on to MKB.

Given MKB's yearly total usage is 285GWH, they buy it at 600sek/MWh, and 6.5% reduction in heat usage gives an MKB savings of:

285*600*1000*6.5% = 11115000 sek

E.ON's service is half of potential savings, which is thus 5557500sek.

We assume that the cost of the upgrading heat exchanger is the same for all MKB buildings, so the cost E.ON can take for each building is 5557500/23000*40 = 9665sek

So at the average cost of upgrading heat exchangers around 10000sek per building, E.ON can make this investment even in one year, which means at year one, their actually revenue of consulting service is off-set by the cost, but they still have the financial gain from the reduced peak load from year one and onwards.