CHALMERS

The Role of Municipal Energy Companies in Sustainable Local Energy Systems

Master's Thesis within the Sustainable Energy Systems Masters Programme

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Division of Energy Technology
CHALMERS UNIVERSITY OF TECHNOLOGY
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MASTER'S THESIS

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ABSTRACT

When constructing sustainable energy systems the local level of implementation is very important, and yet sometimes neglected. This thesis focuses on the local implementation of Swedish policy for energy and environment. Municipally owned energy companies have a large responsibility in developing sustainable local energy systems as their business lies between local policy, described in the municipal energy plans, and the competitive energy markets for electricity and heat.

The thesis investigates the role of policy, national and local, and how the policy governs the environmental efforts of the municipal energy companies, related to the national environmental quality objectives. A case study of three municipalities in the western part of Sweden shows that the companies are often important actors when developing the municipal energy plan and that the companies have a large degree of freedom when planning future investments. The directives from the owners, the municipalities, are often vague and only sometimes use clearly defined indicators to evaluate the development of the local energy system and its environmental impact. Business areas in which the companies have had great success include district heating which often has achieved a large share of the heat market, whereas wind power seems to be a difficult issue for the companies to engage, even though the companies generally seem to have a large acceptance for their activities locally. Energy plans could further stress the need for evaluation of investments and system development using properly defined indicators, which can easily be adopted from the national indicators in the environmental quality objective system.

Keywords: municipal energy planning, municipal energy companies, environmental quality objectives, local energy systems, environmental indicators

Kommunala energibolags roll i hållbara lokala energisystem

Examensarbete inom masterprogrammet Sustainable Energy Systems
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SAMMANFATTNING

När hållbara energisystem planeras och diskuteras försummas ofta den lokala nivån. Denna rapport fokuserar därför på kommunal implementering av svensk energi- och miljöpolitik. Kommunala energibolag, vilka ofta har en stark ställning på den lokala marknaden för el och värme, har en stor potential för att bidra till hållbara lokala energisystem då de verkar i gränsytan mellan den lokala politiken, som definieras i kommunala energiplaner, och de konkurrensutsatta marknaderna för el och värme.

Denna rapport undersöker den roll som nationella och lokala politiska mål har för kommunala energibolag och hur dessa förhåller sig till de nationella miljömålen. En fallstudie av tre kommuner i Västra Götaland visar att bolagen är viktiga aktörer i de lokala energisystemen och att bolagen ofta har stor frihet i sin utveckling och för framtida investeringar. Formella direktiv och planer från ägaren, kommunen, är ofta vagt formulerade och innehåller endast undantagsvis klart definierade indikatorer för hur utvecklingen av det lokala energisystemet och dess miljökonsekvenser ska utvärderas och följas upp. Bolagen har ofta varit framgångsrika på värmemarknaden med hög anslutningsgrad till fjärrvärmenäten, medan vindkraft verkar vara ett affärsområde som bolagen har svårare att ge sig in på, trots att de ofta har stort lokalt förtroende för sin verksamhet. Energiplanerna kan bli tydligare i sina målformuleringar och ansvarsdelegeringar samt framhålla behovet av utvärderingar av utvecklingen med väldefinierade indikatorer, vilka utan problem kan anpassas från de nationalla indikatorerna utvecklade för de nationella miljömålen.

Nyckelord: kommunal energiplanering, kommunala energibolag, miljökvalitetsmål, lokala energisystem, miljöindikatorer

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List of Abbreviations and Important Concepts

Abbreviation	English	Swedish
CHP	Combined Heat and Power	Kraftvärme
DH	District Heating	Fjärrvärme
EQO	Environmental quality objective	Miljökvalitetsmål
GHG	Greenhouse Gas	Växthusgas
HOB	Heat-only Boiler	Värmeverk
MEC	Municipal Energy Company	Kommunalt energibolag
MEP	Municipal Energy Planning	Kommunal energiplan
RES	Reference Energy System	Referensenergisystem

In this thesis, the Swedish names for all cities and municipalities are used.

Preface

This thesis has been performed with the cooperation of Hållbar Utveckling Väst, the regional energy agency of the Västra Götaland. I would like to thank the staff at Hållbar Utveckling Väst for the opportunity to perform this study together with them for their patience with my many questions. Starting this project I had little knowledge about all the intricacies of municipal organisations and regulations and having access to the experience and knowledge that Hållbar Utveckling Väst has acquired over the years working with municipalities has been important in the work. Many thanks to Therese Näsman who has been the supervisor at Hållbar Utveckling Väst for consultation and help along the way. Also, I would like to thank my supervisor at Chalmers, Mikael Odenberger, who has been vey supportive in the process and helped me focus my sometimes very erratic thoughts.

1. Introduction

Sustainable development is no longer a question of 'if', but it must only be a question of 'how' and, perhaps even more, 'how soon'. The concept has been internationally accepted as describing the way global social and technological systems must follow to ensure that future generations will be able to live on this planet, although the concept has yet to be properly defined. To ensure that current development is in fact sustainable, the use of sustainability indicators has become increasingly common according to the logic 'what is not measured, is not perceived as a problem to be fixed'.

Sustainable development and energy systems are thus related to each other in a European context through the global climate change problem, among others, but sustainable energy system development also implies a new set of problems to deal with such as security of energy supply, robustness of distribution systems, efficient use of energy resources and fulfillment of local environmental goals. Local environmental problems connected to the energy system are of course also important and not to be forgotten; the local effects of coal mines are enormous and deforestation due to too intensive harvesting of biomass are concerns that still have to be addressed and not left in the shadow of the climate crisis. International agreements are implemented in national policy which in turn has to be enforced on the local level. The local action level is thus a very important one, even when the problem really is global, as is the case with energy systems and their long-term effects. In Sweden, mandatory municipal energy planning was regulated in 1977 to ensure an awareness of the problems and opportunities of local energy systems on a municipal level.

This first chapter shortly presents earlier research within the field of local energy and sustainability and thereafter the purpose and method of the study. Chapter 2 sets out the theoretical framework within which the analysis is built, building from both technological research as well as political science. Chapters 3 and 4 give an understanding of Swedish energy and environmental policy and the the local discourse on sustainable development policy. Chapter 5 presents the case study results, chapter 6 contains concluding remarks regarding the results and lastly, some notes on where to go from here is presented in chapter 7.

1.1 Problem Discussion

Although the development of the energy system has been studied thoroughly on a global scale (World Energy Council 2000, 2001; Johansson & Goldemberg (eds.), 2002), also in relation to the sustainability perspective, the local level seems not be as well

explored. As Sweden was one of the first countries to implement municipal energy planning (MEP), this unconventional policy instrument has been studied over the years. From the early 1980s, when the Municipal Energy Planning Act only had been active for a few years, the policy has been criticised as being too weak without effect (Olerup 2000) but researchers have also strived to improve the implementation with models and handbooks for MEP (Stridsman 2000; Rydén et al. 2001), a new approach to MEP called Sustainable Energy Planning (Rad 2011) and new tools for MEP (Ivner 2009).

Prior to the electricity market deregulation in 1996 many municipalities owned their own energy company, which could be used to fulfil local goals. Since then, many municipal energy companies (MEC) have been sold, and a comparison of environmental work in municipalities with and without an MEC has been studied by Lindquist (2000), who concluded that in municipalities with an MEC there was a lack of the connection between energy issues and sustainability. However, how national and local policies together form the rules for these companies seems not to have been studied.

Can municipal energy companies be sustainable? Can it then be measured and implemented as a goal for the work of the company? This thesis aims to focus on the role of the municipal energy company – a key resource in many municipalities' energy and environmental work. These companies invest large amounts of money in advanced technology and also have a direct impact on the inhabitants everyday life, thus they are an important actor in many municipalities. The companies have to follow national environmental legislation, i.e. participate in emission payment schemes, but also local policy.

A generalised municipal Reference Energy System (RES) shows in which areas a municipal energy company is involved in local energy flows and thus how it is a key resource for a municipality striving for sustainability. Using sustainability indicators adapted from the Swedish environmental objectives system the development of the local energy system is studied in terms of sustainability. This thesis tries to connect Municipal Energy Plans and Strategies for Energy and Climate to the actual work of municipal energy companies and the case study points on some areas that are especially problematic and others which are progressing better.

1.2 Aims

This thesis aims to increase the understanding of how municipal energy companies and their work relates to policy for sustainable development, with a focus on the environmental issues. The following research questions form the basis for the thesis.

- In what ways do municipal energy plans relate to the Swedish environmental objectives?
- How can indicators for the environmental objectives be adapted to describe the progression of a municipal energy company?
- In what ways do municipal energy plans further a development of municipal energy companies which aligns with the environmental objectives?

1.3 Method

The thesis consists of two parts, a literature review and a case study. In the literature review relevant research on energy planning, municipal governance and the use of indicators will be presented to give the appropriate background. The development of Swedish national policy within the areas of energy, environment and climate is presented.

The case study is performed to understand how the issues of energy system modernisation are dealt with in different ways. Although the results from a limited case study as this one cannot be generalised and be said to represent how municipalities always handle their MECs and MEP, knowledge from this case study can hopefully be useful in other contexts. The case study uses mainly grounded theory (GT) as methodology, which is further described by Fejes and Thornberg (eds.) (2009). The use of GT enables the researcher to use multiple data sources such as formal documents, letters, statistical data and interviews and relate these to each other in a way that fits the case. Data collecting and analyzing are parallel processes and leads to a deeper understanding of the field as new data can be collected. Thus, the theory is built on the empirical material researched in the case study and the study grows and unfolds as the case study progresses. This method is used, as the area of research in this thesis lies between traditional energy systems engineering and social sciences. GT lets the researcher form the study continuously when analyzing collected data which is a useful approach when the research area is not very well known beforehand. Although the work with thesis started with a different perspective the dynamical methodology has been useful in forming the study along the way.

Sampling for the case study has been systematic, focusing on municipalities owning an energy company with production of heat and power and also with a MEP no more than

ten years old. It was decided that the case study was to focus on three municipalities, a number small enough to handle in a project as limited as this, but still enough to give a picture of how the issues are handled in different contexts.

To find municipalities which in some way use sustainability indicators in their corporate governance a screening of all 49 municipalities comprising the county of Västra Götaland was performed, as Västra Götaland is the county in which Hållbar Utveckling Väst is active. The screening was conducted by retrieving the MEP from the municipalities' websites; in cases where no MEP was available online the municipality was left out of the screening. The MEP (or Strategy for Energy and Climate) was searched for any mention of 'indicator', 'key figure' or similar concepts in the chapters about how the development of the plan was to be evaluated in relation to the MEC, in the cases where the municipality owned an energy company. The municipality of Göteborg was excluded, as Göteborg Energi is the fourth largest energy company in Sweden it is not governed in the same way as the many smaller MECs. Municipalities around Göteborg, such as Ale and Lerum, were also excluded as they are parts of the large Göteborg Energi corporation.

The municipal energy plans that have been accepted by the municipal council provide the frame for the case studies. Further, documents showing the local regulation of the MEC are studied. These documents, the companies articles of association and the owner directives, are the formal tools for the municipality to govern the MEC and they will thus be studied to search for how the MEC should participate in the sustainability work of the municipality. The development of the local energy system will be studied using data from the MECs. The role of the MECs in the municipal environmental work has been studied through municipal documentation and semi-structured interviews with the CEOs of the MECs. The aim was to interview the CEO of the MECs in all the three municipalities in the case study, the CEO of Borås Energi och Miljö AB has however not been able to participate in the study. A semi-structured interview lets the interviewee give his or her view of the issue in his or her ow words and enables a discussion about the topic rather than simply giving answers to static questions. However, there is also always the possibility that the interviewer imposes his or her own view of topic on the interviewee as the conversation progresses. When analyzing the results from interviews, the researcher must therefore be aware that the results will always be biased in some way. By putting the interviews in a larger context with support from other material the interviews can however provide a deeper insight into the processes of system development.

1.4 Limitations

A municipal energy system is a large and complex system comprising electricity and district heating generation and distribution, transports, industry and households. Previous studies have shown that the largest area of success for municipal energy goals are within areas controlled by the local authorities. Thus, this thesis focuses on municipal energy companies as a key resource for the transition to a sustainable local energy system. Municipal energy companies in their present form have existed since the deregulation of the electricity market in 1996 and thus, this thesis does not aim to study what happened earlier than that in the municipalities chosen for the case study. The focus in the case study is on the last ten years. As this thesis project is limited in time, the main results and analysis will be based on a case study comprising only a few municipalities. The results will thus be mostly qualitative. This might seem unusual in the engineering research field, but this can give a possibility to draw important conclusions about the development of this business sector beyond e.g. cost-minimisation.

2. Theoretical Frame

To relate energy, energy planning and the role of municipal energy companies for a sustainable development, a background will be presented in this chapter. First, the view of sustainability which this thesis uses and the role that energy has to play is explained. Thereafter, sustainability indicators and their use in local governance are discussed and finally, the history of energy planning is presented with a focus on Swedish municipal energy planning.

2.1 Energy and Sustainability

Energy is crucial to the modern society and a reliable supply of fuels and electricity is a core issue for sustainable development. A thorough report on the role of energy for sustainable development was conducted by the United Nations Development Programme in 2002 (Johansson & Goldemberg (eds.), 2002). On a global scale it is easy to see the relevance of energy for a sustainable development. Today it is in developing countries still common to inefficiently burn scarce biomass with dramatic consequences for human health, local landscape change and social structures. In the industrialised world the discourse on energy and sustainability has largely been reduced to a technological one about emission rates of various pollutants such as sulphur, NO_x and, naturally, greenhouse gases. Energy security, that is the sufficient reliability and availability of energy resources at affordable prices, is another question that has to be addressed when analysing the sustainability of an energy system (ibid.).

But whereas the issues of energy relating to sustainability has been studied thoroughly on a global scale, e.g. as by the World Energy Council (2000, 2001), less has been written about energy and sustainability from the local perspective in the industrialised world. The discourse on energy and sustainability has thus tilted towards the large and abstract, such as international development programmes and evaluation of different traditional national policies such as subsidies, taxes and legal regulations. The implementation of sustainable energy systems will however be done on the local level, which is why this perspective is important to keep in mind as well. Traditionally, the way to improve the sustainability of energy systems has been to deregulate energy markets in an attempt to create competition and efficiency. This competition would then lead to lower costs and more efficient use of resources, but the market approach is no universal remedy for all the problems that have to be faced (Johansson & Goldemberg (eds.), 2002). Energy companies owned by municipalities thus have a special position on the energy markets; the companies are owned by public institutions and do not necessarily strictly have to follow market logics if the owners, the municipalities, give

other directives. However, the companies still have to compete for customers with other energy companies and thus have to maintain competitive prices for the products that are traded in competition. The electricity grid services that municipal energy companies often provide are a natural monopoly and therefore the prices are monitored and controlled by the Energy Markets Inspectorate (Energimarknadsinspektionen).

2.2 Sustainability Indicators, Local Governance and Legitimacy

An introduction to the use of sustainability indicators is presented in the dissertation of Rad (2011) and an analysis of the development and use of indicators in local governance is presented by Mineur (2007). Palm (2004) discusses local policy processes and how to understand the complexities of municipal governance and the role of municipal companies in policy implementation. Palm stresses the view of policy as an on-going process in which the actors and decisions interact and throughout the process change the ideas that are the base for the policy.

Planning as a policy instrument must thus be viewed as something which is never complete but rather an ever on-going, iterative operation. A simple model for an iterative planning operation consists of analysis of the present situation, goal-setting for the future, policy decision, implementation and follow-up as described by Palm (2004). This model with its separated, well-defined phases has its disadvantages, but can be useful to illustrate important parts of the process.

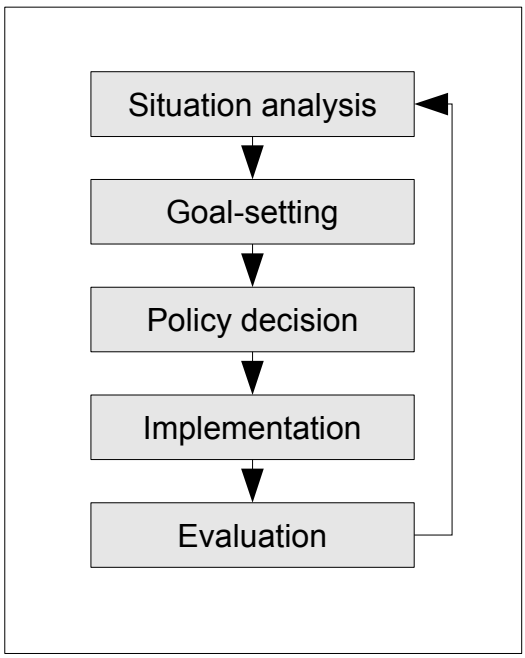

Figure 2.1 A simple model of the iterative planning process. Adapted from Palm (2004).

Modern governance theory focuses on stakeholder participation and earning legitimacy rather than the historic way of how a government body should simply set regulations for other actors to follow. Modern theory describes society as a web rather than a pyramid which is the traditional view. The traditional way of producing municipal policy is to develop the policy within the municipal organisation and thereafter send it for referral to local business and other actors which will be affected by the policy. Local actors are thus allowed only to have opinions on an already formulated policy proposition and they are not part of forming the proposition. When producing a MEP today, the municipalities are encouraged to seek partners within industry, business and others who can have an effect on the local energy system already in the early stages of planning.

3. Energy Policy in Sweden

A comprehensive introduction to energy policy in Sweden can be found in Silveira (ed.) (2002). The specific role of the municipalities in Swedish energy history and policy is descibed in Palm (2004). Below is presented a brief introduction of Swedish energy policy to set MEP in a wider perspective.

3.1 A Brief History of Swedish Energy Policy

Sweden developed hydropower in the large rivers in the northern inland very early. Vattenfall, the Swedish State Power Board, was established in 1909 to manage the exploitation of rivers and waterfalls and to build the long distance electricity transmission grids. Local electricity systems were also built in the 1920s, many times by the municipalities themselves or in cooperation with local industry. In the middle of the 20th century Sweden started investigating nuclear power. At the same time, district heating was introduced in the first areas of the country. At this time oil was cheap and available and thus the district heating plants were mostly oil fired. When nuclear power expanded in the 1960s and 1970s electricity generation capacity increased rapidly, beyond the actual demand at the time. Thus, trying to make use of all the capacity, electrical space heating was advocated, as it would be clean and easily installed. This is the reason why Sweden still has rather a large share of electricity heated houses. (Kaijser in Silveira (ed.) 2002; Stenlund 2006).

After an advisory referendum in 1980 it was decided that nuclear power in Sweden was to be phased out and all nuclear reactors were to be shut down before 2010. The decade also included large investments to reduce the dependance of imported oil, an issue that had become pressing after the oil crises in the late 1970s. In 1977 the Municipal Planning Act was passed, and in 1985 it was enforced with demands on local oil reduction plans. During the 1980s district heating grew and the fuel supplied to the heat plants changed, from almost only being oil fired in the early 1980s, today biomass fuels account for the largest heat supply in district heating systems (Vedung in Silveire (ed.) 20002; Olerup 2000). This is also largely due to the tax on fossil carbon that was introduced in 1991, the first tax on carbon dioxide in the world. The first part of the 1990s saw a large restructuring of the energy sector in preparation for the deregulation of the electricity market, which was enforced in 1996. Electricity generation, transmission and retailing are since separated activities (Haegermark in Silveira (ed.) 2002) and the generation companies sell the generated power on the power market Nord Pool, which is an international market for Sweden, Norway, Denmark, Finland and Estonia. The 1990s also saw the first decommissioning of a Swedish nuclear power

plant when Barsebäck 1 was shut down in 1999. Barsebäck 2 was kept active longer, but was finally shut down in 2005 (Barsebäck Kraft, 2012).

Energy was recognised as a key sustainability issue in the energy policy that was presented to the Swedish parliament in 1997 "A Sustainable Energy Supply" (Government Bill 1996/97:84). The three main goals identified for energy policy were a secure energy supply, competitive energy and a low negative impact on human health and the environment. Since then European policy has become increasingly important for national policy and thus in 2009 the government presented "An Integrated Climate and Energy Policy" (Government Bill 2008/09:162, 2008/09:163) which builds on the same three pillars as the EU policy: ecological sustainability, competitiveness and security of supply. An agreement in the parliament also opened up for the construction of new nuclear reactors, thus changing the phase-out policy from the 1980s radically (Government Bill 2009/10:172). New nuclear reactors will however only be allowed to replace old reactors, keeping the number of reactors constant. Governmental funding for new reactors is still prohibited, thus it is questionable if any new reactors will actually be built. The new Swedish energy policy goals relate to the European 2020 goals – 20% reduction in GHG emissions, 20% renewable energy and 20% increase in energy efficiency – but with more ambitious goals for Sweden – 50% renewable energy, 10% renewable energy in the transport sector, 20% increase in energy efficiency and 40% reduction of GHG emissions (Government Bill 2008/09:163). The newest addition to national energy policy is the introduction of four electricity price areas in Sweden, a policy which aims to stimulate new electricity generation units to be built in the southern part of the country and to increase the electricity transmission capacity from the northern to the southern parts of the country (Svenska Kraftnät 2011).

Table 3.1 Goals for Swedish energy policy. Adapted from model in Stenlund (2006).

1977 – 1984	**1985 – 1997**	**1997 - 2009**	**2009 -**
Oil use reduction	Phase-out of nuclear power	Climate issue	Renewable energy
Increased electricity use	Renewable energy sources	CHP generation	Energy conservation
Efficiency in buildings	Integration of energy planning	Renewable energy subsidies	Fossil fuel free vehicle fleet
	Rational use of energy	Closing of nuclear reactors	Replacement of nuclear reactors

3.2 Municipal Energy Planning

Palm (2004) shows how the municipalities for a long time have been an important actor in the energy sector in building heat and power plants and distributing energy to the customers, from the mid-19th century when municipalities started building gas grids for use in street lighting to today. With the Municipal Energy Planning Act (SFS 1977:439) the importance of municipalities in the execution of national energy policy was stressed and the focus of energy policy shifted to increased energy efficiency (Palm 2004, Rad 2011). After the second oil crisis in 1979 the law was changed and a more specific goal to reduce the dependence of oil was introduced, the so called oil reduction plans were made mandatory (Olerup 2000).

As shown by Stenlund (2006) municipal energy plans often state a series of reasonable goals, for which the local authority and/or private actors are responsible. The work performed by Stenlund shows that the goals which are owned by the local authority are more often fulfilled than those owned by private actors. In MEP there has often been a lack of methods to follow up on the achievement of the plans. In the program *Uthållig kommun* (approx. *Sustainable Municipality*) one of the goals was therefore that all participating municipalities should write a Strategy for Energy and Climate which should be assessed each year with methods to show improved energy efficiency and the development of renewable energy (Swedish Energy Agency 2011).

Despite the fact that MEP has been mandatory for more than 30 years there are still municipalities which have not fulfilled the requirement (Rad 2011). The act has been criticised for not being clear in what is expected from a plan or how to engage the planning project. However, methods for strategic energy planning have been developed both by the Swedish Energy Agency in the MILEN projects (Stridsman 2000) and in a thorough handbook which was published in 2001 (Rydén et al. 2001). The handbook is a Swedish adaption of the *Guidebook for Advanced Local Energy Planning* which was the result from an IEA project that was finished in 1999. Stridsman (2000) points to the fact that the multiple revisions of the energy plans in Jönköping was one of the success factors for the future validity of the plan. The Municipal Energy Planning Act is under revision by the Swedish Energy Agency, as the agency was instructed by the government (Ministry of Enterprise, Energy and Communications 2010).

The controversies that can arise between a municipal authority which aims to promote sustainability and the MEC are described by Olerup (2000, 2002). In Uppsala the local authority started the work with a new energy plan for a sustainable energy system, in which renewable fuels was promoted. At the same time the MEC wanted to expand their

combustion of fossil fuels, mainly coal and peat, an expansion which was alter denied by the environmental court. The MEC was apparently not an integral part of the municipality's sustainability work and thus had a completely different focus in their investment plans. Later in the process of creating the new MEP the MEC was included.

How MEP is performed varies a lot between municipalities (Stenlund 2007; Ivner 2009; Länsstyrelsen 2010). The planning process can be led by a political delegation appointed by the municipal council, it can be part of the tasks for the local Agenda 21office (thus focusing on the participatory aspect) or it can be done by consultants. There is not one way to perform MEP as there are no clear directions in the Municipal Energy Planning Act on what a MEP really is. As Ivner (2009) points out, there are however obvious pros and cons with some of the common ways of performing MEP. To let a consultant do the job may seem appealing at first as the technical competence thus can be guaranteed. Further, letting an external expert develop the plan may be argued to be the most economically efficient solution. However, as Ivner discusses, it may be harder to implement a plan that has been developed by consultants as there might be a knowledge gap between the planner and the implementer, if for example methods used in the plan are perceived as too difficult to use by the implementer. As consultants become free to develop the whole plan, other parts of the local authority become less engaged in the work and risk to feel excluded. If the goal is to naturally include the energy plan as a guiding document for all activities within the municipality, as it should be, then the consultant approach may lead to a useless plan, although technically perfect. (Ibid.)

3.3 Municipal Energy Companies

Although municipally owned companies have been around since the late 19th century, it is not until the last few decades that municipalities have transferred many activities from public offices to companies. The main reason for this transfer is to improve the economic efficiency. In fact, almost any task for which the local authority is responsible can be delegated to a company. Some tasks have however been proven to be especially advantageous to delegate to a municipally owned company instead of a public office. Commonly, companies have been succesfully used to run operations that are financed via direct fees rather than the municipal tax, and operations with a high demand of capital (Gunnarsson & Johansson 2003). How municipalities and regions actively can be active owners of their companies is a recent issue in Sweden and the Swedish Association of Local Authorities and Regions (SALAR) have developed guidelines for active ownership in a report that was published in 2006 (SALAR 2006).

Although informal communication between the municipal council, which is the legal owner of a municipal company, and the company board in many smaller municipalities is easy and efficient, there are formal ways that the council can influence the company's work. The municipal council is responsible for electing the board members of a municipally owned company. The board members are either chosen for political reasons (often corresponding to political majority in the municipal council), professional skills or a combination of these two.

The company's Articles of Association dictate the municipality's reason for running the company, and it is thus the most important document in governing the company. However, the Articles do often not contain detailed information relating to the activities of the company, apart from stating which business sectors the company is engaged in (such as energy generation and distribution). Owner's directives are issued from the municipal council and are more detailed instructions for the company board to relate the company's activities to, but in fact only decisions from the annual general meeting (AGM) are binding for the company board to fulfil during the next year. Thus directives from the municipal council must always be stated by the AGM, even when the municipal council is the only shareholder. Decisions from the AGM are documented in the minutes which are public. (Gunnarsson & Johansson 2003; SKL 2006)

According to Statistics Sweden, in 2009 there were 409 registered municipally owned companies within the energy sector (comprising electricity, gas, heat and water delivering enterprises), employing 15 660 persons and generating a revenue of more than 80 billion SEK making a net profit of about 1.3 billion SEK. Total revenue in municipal companies was in 2009 about 170 billion SEK and the total net profit 10.4 billion SEK. (Statistics Sweden 2010). District heating, which is the main business sector for many MECs, heats 92 % of all apartment buildings in Sweden, 80 % of all premises and 15% of detached houses in Sweden. 63% of the district heating in Sweden is delivered by MECs. (SOU 2011) Energy is thus not a small business sector for Swedish municipalities but rather an important one. With the deregulation of the Swedish electricity market in 1996 the MECs had to be split into two separate companies; one to own and manage the local electricity grid and one to produce electricity and district heating. This was done to ensure that the MECs should not have advantages on the electricity market compared to other companies. Many municipalities sold their generation capacity to larger energy companies and today only have the local grid management and sometimes an electricity retailing company. There are however still quite a few municipalities that saw the opportunity in keeping the production, and these are the focus of this thesis. The MECs are either operating only the distribution

grid for electricity or they can also be a producer of electricity and district heating. Some have also expanded their activities into business areas close to the traditional energy sector such as biogas production for vehicle use and others. The key areas of activity for MECs are however still production and distribution of heat and electricity to private and public customers. A simplified generalised reference energy system showing important flows of energy and energy sources is presented in Figure 3.1 with the key activities for MECs marked.

Municipally owned companies are regulated in law both by the Local Government Act (Kommunallagen SFS 1991:900) and the Joint-Stock Company Act (Aktiebolagslagen SFS 2005:551). A municipal company thus have to fulfil not only a public service, as any public office, but also have to make economic profit, as any private company. The companies are regulated by the same type of documents as any other joint-stock company, but it is the municipal council which decides the purpose of the company. The council is also responsible for appointing board members and for directives and policies for the companies owned by the municipality. Palm (2004) refers to several reports which all show that the municipal councils seldom give clear directives to their companies for how to develop the companies.

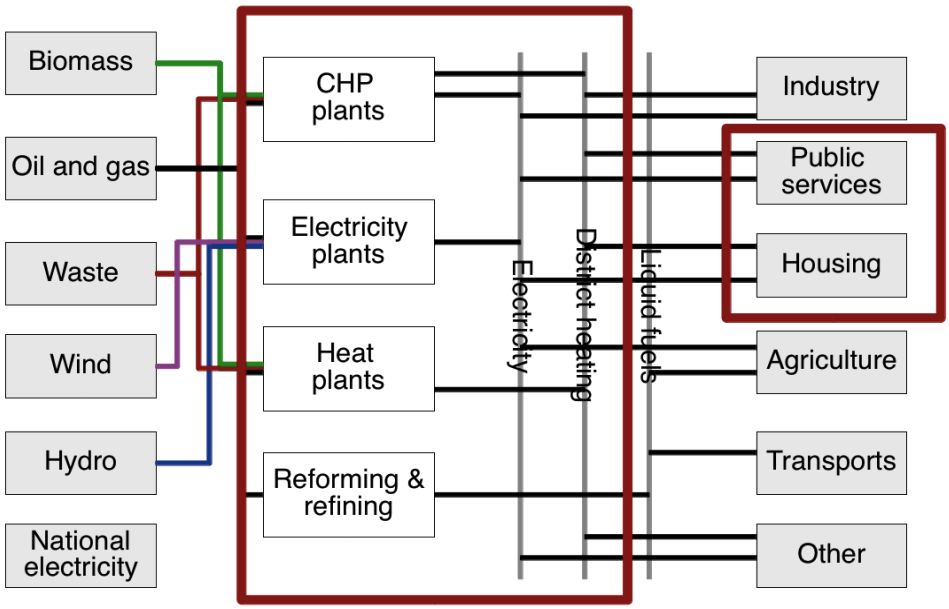

Figure 3.1 A generalised municipal RES. Processes in which MEPs are commonly active are marked with a red box.

4. Environmental Policy in Sweden

This chapter introduces the environmental policy of Sweden today with a focus on the national environmental quality objectives, a policy which was introduced in the late 1990s.

4.1 Environmental Policy for a Sustainable Development

The last decade climate change has been given a major part of the attention to environmental concerns, as it is viewed to be the most pressing environmental issue. Preventing climate change is however only one of the goals for the Swedish policy for environmental quality. The overarching national policy for environmental issues is the environmental quality objectives (EQOs) which are part of the national policy for sustainable development. The EQOs and the system around them will here be briefly presented with a focus on the municipal level and the connections to the energy sector. A thorough description of the EQOs is found on the official webportal Miljömålsportalen (miljomal.nu).

The 16 EQOs describe goals that have been set for Sweden to fulfil so that the next generation will not have to deal with the environmental problems caused today. The EQOs were defined in a proposition by the government in 1998 (Government Bill 1997/98:145). The EQOs are presented in Table 4.1 with the objectives especially relevant for the energy sector boldfaced.

Table 4.1 The Swedish Environmental Quality objectives

1. **Reduced Climate Impact**[1]	9. Good-Quality Groundwater
2. **Clean Air**	10. A Balanced Marine Environment[2]
3. **Natural Acidification Only**	11. Thriving Wetlands
4. A Non-Toxic Environment	12. Sustainable Forests
5. A Protective Ozone Layer	13. A Varied Agricultural Landscape
6. A Safe Radiation Environment	14. A Magnificent Mountain Landscape
7. Zero Eutrophication	15. **A Good Built Environment**
8. Flourishing Lakes and Streams	16. A Rich Diversity of Plant and Animal Life[3]

1. To be reached by 2050.
2. Full name of the objective is “A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos”
3. Added in the revision in 2005.

First 15 EQO were defined to be reached within in one generation, setting the date for fulfilment to about 2020. Since then the system has been revised several times and a 16th objective has been added (Government Bill 2004/05:150). The last revision of the system was launched in 2010 (Government Bill 2009/10:155) in which three of the objectives were changed.

The EQO system consists of several parts. The EQOs themselves describe the state of the nature that is intended. The rather vague EQO is therefore expanded in several interim targets, all in all there are 72 interim targets for the 16 EQOs. The interim targets define more clearly what has to be fulfilled to reach the EQO and set out the path to fulfil the objective. Several of the interim targets were to be reached until 2010 to give a mid-period indication on how the work is progressing. To measure the progression of the work with the EQOs a large number of indicators are used, both quantitative and qualitative. To handle the work with the EQOs on a national level eight authorities are designated to evaluate and follow up the progression, although the main responsibility lies on the Swedish Environmental Protection Agency.

4.2 Environmental Quality Objectives and the Energy Sector

The energy sector has been pointed out as having a special responsibility for four of the EQOs as the activities of companies in the sector have a large impact on the emissions and resource use that are threats to the environment. The four objectives that thus should be in focus for energy companies are *reduced climate impact, clean air, natural acidification only* and *a good built environment* (Swedish Energy Agency, 2007). A more thorough description of these objectives and the impact the energy sector has is given below.

Reduced climate impact is defined as follows

> *"The UN Framework Convention on Climate Change provides for the stabilisation of concentrations of greenhouse gases in the atmosphere at levels which ensure that human activities do not have a harmful impact on the climate system. This goal must be achieved in such a way and at such a pace that biological diversity is preserved, food production is assured and other goals of sustainable development are not jeopardised. Sweden, together with other countries, must assume responsibility for achieving this global objective." (Swedish EPA 2012)*

Sweden has ratified the Kyoto protocol and the first interim target for the objective aligns with the Kyoto protocol, i.e. emissions of GHGs in Sweden should by 2012 be reduced by 4% compared to 1990, measured as an average over four years. The

objective is to be achieved to 2050 and thus the second interim target is set for 2020, stating that by then the GHG emissions should be reduced by 40% for activities that are excluded from the EU ETS.

Clean air is defined as

> *"The air must be clean enough not to represent a risk to human health or to animals, plants or cultural assets."(Swedish EPA 2012)*

The objective is further described by boundary levels for nine compounds, levels which may not be exceeded in order to say that the objective is achieved. There were also six interim targets for the objective (regarding sulphur oxides, nitrogen oxides, ground-level ozone, volatile organic compounds and benzo(a)pyrene), the first five of which should have been fulfilled by 2010 and the last by 2015.

Natural acidification only is defined as

> *"The acidifying effects of deposition and land use must not exceed the limits that can be tolerated by soil and water. In addition, deposition of acidifying substances must not increase the rate of corrosion of technical materials located in the ground, water main systems, archaeological objects and rock carvings."(Swedish EPA 2012)*

The objective is further described as that the deposition of acidifying substances does not exceed critical levels, unnatural acidification is counteracted and a land use which respects the sensitivity to acidification. Four interim targets that were to be fulfilled by 2010 existed to the revision in 2010 (sulphur oxide emissions, nitrogen oxide emissions, acidification in lakes and streams, acidification of forest soils).

A good built environment is defined to be

> *"Cities, towns and other built-up areas must provide a good, healthy living environment and contribute to a good regional and global environment. Natural and cultural assets must be protected and developed. Buildings and amenities must be located and designed in accordance with sound environmental principles and in such a way as to promote sustainable management of land, water and other resources." (Swedish EPA 2012)*

4.4 Indicators for the Environmental Quality Objectives

The indicators that are used to follow up the progression of the four EQOs related to the energy sector are presented in Table 4.2, with the objective that is the main target for the indicator and objectives that the indicator also is used for. The numbers refer to the number of the objective as presented in Table 4.1.

Table 4.2 National indicators for the four EQOs related to the energy sector. Objective numbers refer to the numbers in Table 4.1.

Indicator	**Unit**	**Primary Objective**	**Secondary Objective(s)**
Energy use	MWh/cap	1	2, 3, 15
GHG emissions	Tons CO_2-eq	1	-
Wind power	MW installed	15	1
VOC emissions	Tons	2	-
Particle emissions	Tons	2	-
SOx emissions	Tons	3	2
NOx emissions	Tons	3	2
Energy planning	Municipalities with MEP	15	-

These are all possible to scale down from a national level to company level. Further, the county of Västra Götaland (which is the focus of this thesis as the municipalities chosen for the case study are all situated in Västra Götaland) has set regional goals which have the national EQOs as base. Most of these goals are however not applicable on at company level, except for the indicator “renewable energy” which of course is important for the goal to reduce climate change.

4.4 Environmental Quality Objectives and the Role of Municipalities

The proposition for the latest change of the EQO system (Government Bill 2009/10:155) strongly points out the role that municipalities have in the work to achieve the environmental objectives. Municipalities can define local environmental objectives, based on the national system. The municipalities do however also have tools that are important for the national objectives, such as environmental impact assessments, local planning and building permits. Further, the municipalities are often responsible for activities such as public transport, municipal waste, housing and energy, which are all important business sectors for several of the EQOs.

The role of municipalities is also stressed in the proposition when regarding the objectives reduced climate change, clean air and natural acidification only, which also are three of the four objectives where the energy sector has the largest impact. It is stressed that the emissions which lead to the problems that these objectives deal with are interlinked and that there are large synergy effects when dealing with their causes.

4.3.1 Municipal Environmental Objectives

Many municipalities in Sweden have stated local environmental objectives, for which the municipal administration has a special responsibility. As the objectives pointed out for the energy sector are of regional or even global character, these municipal environmental objectives are not further discussed in this thesis.

5. The Case Study

Here some general results from the screening process which was performed to find appropriate municipalities for the case study are presented and thereafter a short introduction to each of the three chosen municipalities is given.

5.1 Results from the Screening Process

The screening of MEPs of the 49 municipalities in Västra Götaland showed that many municipalities do not use proper sustainability indicators to follow up on the development of their MEP, but simply state goals to become 'better', 'climate neutral' or 'environmentally friendly'. In some cases proper indicators are used but seemingly only for energy balances for the whole geographic region of the municipality, such as 'petrol and diesel consumption' or 'total energy use per capita'. Others focus on the activities within the municipal organisation itself and follow up on 'energy use per square meter and year in municipal buildings'. Data for high-level indicators are available through official statistics and is thus relatively easy to handle, but may also be misguiding. For example a small municipality with a petrol station close to a motorway may have an unreasonably high consumption of petrol and diesel as the fuel is reported as sold in the municipality although all of it is actually not used within the municipal borders. The focus on the municipal organisation itself seems to have increased over time as it has shown to be an area that can be governed properly. This may however lead to a focus on only the internal development and that the municipal administration misses chances to support the development of other actors, such as industries and other companies in the municipality. Another general comment is that many MEPs give a very thorough historical description of the local energy system and the present situation, whereas the actual planning for the future is emphasised less.

Borås and Kungälv were municipalities using indicators in relation to their MEC and these municipalities were thus chosen for a more thorough investigation. As a comparative case, Uddevalla was chosen as the MEP does not promote the use of sustainability indicators. The geographic location of the chosen municipalities is shown in Figure 5.1

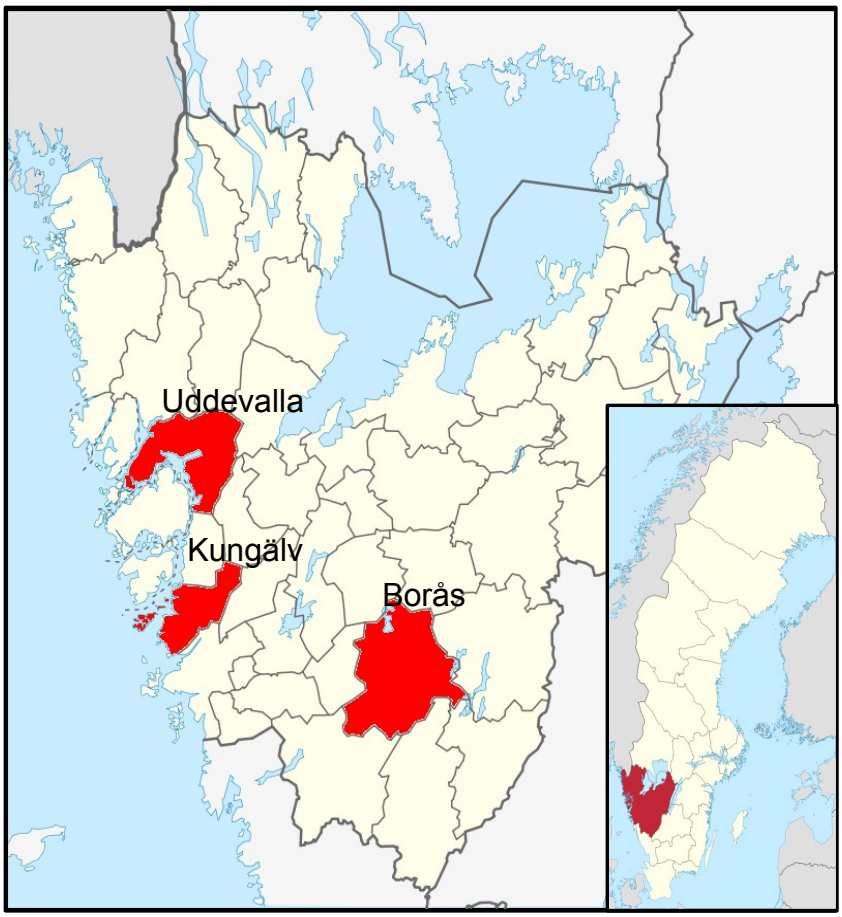

Figure 5.1 The three chosen municipalities and their location in Västra Götaland County. Map from Wikimedia Commons.

5.2 The Municipalities in Brief

5.2.1 Borås

Borås is a municipality located in the inland of Västra Götaland. The municipality has about 103 000 inhabitants, of which 66 000 live in the city of Borås, the rest in other localities or in the rural area. Borås is thus a rather large Swedish municipality, as the national municipal average is about 30 000 inhabitants. Borås was former the heart of Swedish textile industry, an industry sector which suffered from a deep crisis during the 1960s and 1970s forcing most of the companies to close their production sites in Sweden.

Borås has been participating in the project Uthållig Kommun (Sustainable Municipality) since the start in 2003, is a member of Sveriges Ekokommuner (The National Association of Swedish Eco-municipalities) and has also joined the Covenant of

Mayors. Borås is thus not the average Swedish municipality when regarding sustainable development but one that has engaged the issue in several aspects.

Borås Energi och Miljö AB (BEMAB) is a company dealing with energy, municipal waste and water treatment in Borås municipality. The first district heating system in Borås was constructed in 1959. It is thus one of the older DH systems in the country. The company in its present form was founded in 1995 as Borås Energi AB, just prior to the deregulation of the Swedish electricity market. Since, the company's responsibilities have been expanded with handling of municipal waste in 2007, when the company also changed name to the present Borås Energi och Miljö AB and responsibility for the municipal water and sewage treatment was added in 2011, partly due to the possibility of producing biogas from the sewage.

Table 5.1 Active plants belonging to Borås Energi och Miljö AB.

Plant	**Type**	**Main Fuels**
Ryaverket	CHP	Wood chips, waste
Hulta	Hydropower	-
Haby	Hydropower	-
Axelfors	Hydropower	-
Häggårda	Hydropower	-

5.2.2 Kungälv

Kungälv is a coastal municipality with approximately 41 000 inhabitants. About half of the inhabitants, 22 000, live in the city of Kungälv, which is located just where Nordre älv begins in Göta älv, approximately 15 km north of Göteborg. Another important city in the municipality is Marstrand, an island city which historically has been an important harbour and today is very popular for tourists. Today the largest business sector is trade and communication.

Kungälv communicates a rather strong sustainability focus, the municipality is a member of Sveriges Ekokommuner and for planning the new city quarter Kongahälla an ambitious environmental programme has been established, e.g. stating that the quarter is to be self-sufficient on solar electricity and that all energy used within the quarter should be renewable.

Kungälv Energi AB (KEAB) is a municipal energy company active within district heating and electricity production, electricity transmission and retailing and broadband internet access services. The company has a history spanning a 100 years, from 1911

when the first electricity plant was constructed in Kungälv to deliver electricity to the local bakery industry. The company was separated from the municipal administration in 1992, in preparation of the deregulation of the electricity market a few years later, and today the company has one subsidiary, Kungälv Närenergi AB.

It was not until 1997 that district heating was built in Kungälv, but today district heating supplies heat to a large number of industries and residential areas. The district heating grid is also connected to the grid in Göteborg, to be able to transfer heat when the local production capacity is insufficient. Projections show that production capacity will be needed before 2017, as the city is expanding rapidly due to its proximity to Göteborg. (Kungälv Energi, 2011). Data about the company's present plants are summarised in Table 5.2.

Table 5.2 Active plants belonging to Kungälv Energi AB.

Plant	**Type**	**Main Fuels**
Munkegärde	CHP	Wood chips, bio oil
Munkegärde	Heat only	Solar
Kode	Heat only	Wood pellets, oil
Kärna	Heat only	Wood pellets, oil
Stålkullen	Heat only	Wood pellets, oil

5.2.3 Uddevalla

Uddevalla is a municipality on the west coast of Sweden with about 52 000 inhabitants, of which 31 000 live in the city of Uddevalla. The municipality itself is the largest employer with manufacturing industry as the most important business sector. The city of Uddevalla was the home of Uddevallavarvet (Uddevalla Shipyard) a large Swedish business sector which had its peak in the 1960s before the recession which forced most of the shipyards to close during the 1970s and 1980s, including Uddevallavarvet. The loss of the large industry led to a loss of inhabitants, but the last 25 years the development has been slow but positive. Uddevalla is a member of Sveriges Ekokommuner and was the first Swedish municipality to implement the environmental management system EMAS.

Uddevalla Energi AB (UEAB) is a company dealing with energy, municipal waste and water treatment owned by Uddevalla municipality. UEAB is one of Swedens oldest energy companies, being founded in 1857 together with the wool industry Kampenhofs Aktiebolag as Uddevalla Gasverk (Uddevalla Gasworks) to provide gas for street

lighting in the city of Uddevalla. In 1899 the municipality became the sole owner and soon thereafter started to provide electricity generated from hydropower at Strömbergsfallet. In 1965 the delivery of district heating started in Uddevalla at Hönseberget. Throughout the 20th century generation capacity for electricity and district heating was expanded and the fuels used changed from fuel oil to electricity and solid fuels. (Uddevalla Energi 2011a)

UEAB in its present form was founded in 1994, before the deregulation of the electricity market in Sweden, when the municipal administration for energy was fully incorporated with the company. Today UEAB has three subsidiaries, Uddevalla Energi Elnät AB, Uddevalla Energi Värme AB and Uddevalla Kraft AB, which are responsible for electricity transmission, district heating and power generation. (ibid.)

UEAB has six electricity generating hydropower plants in operation, plants which were constructed between 1920 and 1964. UEAB has four heat plants for generation of district heat. These heat plants use wood chips, wood pellets and bio oils as their main fuels. The largest plant is Lillesjöverket which is a waste incineration CHP plant, burning municipal and industrial waste. Basic data about the plants are summarised in Table 5.3.

Table 5.3 Active plants belonging to Uddevalla Energi AB.

Plant	**Type**	**Main Fuels**
Lillesjö	CHP	Waste
Hovhult	Heat only	Wood chips, peat
Brattås	Heat only	Bio oil, electricity
Långedal	Heat only	Wood chips, bio oil
Aröd	Heat only	Wood chips, bio oil
Strömberget	Hydropower	-
St Anna Äng	Hydropower	-
Kollerö	Hydropower	-
Fossumsberg	Hydropower	-
Groröd	Hydropower	-

5.3 Municipal Energy Planning and Environmental Objectives

The proposed list for a municipal energy company relating to the national EQOs is presented in Table 5.4. The indicators here proposed are adapted from the national indicators presented in Table 4.2 but with a focus on production instead of consumption, with the addition of the indicator *renewable energy share* as this includes more than just wind power and relates strongly to the DH system as many renewable fuels are used for DH production, and *system losses* which relates to the performance of the system today.

Table 5.4 Proposed indicators for MECs relating to the national EQOs.

Indicator	**Unit**	**Primary Objective**	**Secondary Objective(s)**
Energy production	GWh	1	2, 3, 15
Renewable energy share	%	1	-
System losses	%	15	1
Wind power	MW installed	15	1
GHG emissons	Tons CO_2-eq	1	-
VOC emissions	Tons	2	-
Particle emissions	Tons	2	-
SOx emissions	Tons	3	2
NOx emissions	Tons	3	2
Energy planning	Development according to MEP	15	-

This is a list of indicators for which most of the data should be easily accessible for the MECs. Energy production is of course measured as that is the main objective for the companies. Renewable energy share is easily calculated from fuel composition in the production. System losses may no be measured but is an important figure as it can say many things about system efficiency. Wind power capacity is easily reported. CO2 emissions must have permits according to the EU ETS and are thus carefully managed. VOC emissions may not be measured today, and the relevance of this indicator can be less than that of the others as it mostly is important for fossil fuels. Particle emissions is regulated and thus measured already. Emissions of NOx are already in a payment scheme and are thus carefully measured. Sulphur content of fuel is taxed and therefore measurements are done. Finally, system development according to the MEP must of course be evaluated in more than a single word but it is important to return to the plan continuously during expansion.

As many of these things are already regulated nationally the companies have to fulfil regulation. More interesting to look at are the points where the MECs have more freedom when making investments. Thus, the results that are presented here focus on how the companies have developed with regards to renewable energy (and thus GHG emissions), wind power production and what they are imposed to do in the energy plans.

5.3.1 Energy Planning in Borås

There was no MEP in Borås until 2003. No explanation as to why no MEP was developed within the first 25 years after the Municipal Energy Planning Act is given in the MEP or by the municipal energy advisor. The MEP focuses on the key issues of supply and distribution of energy within the municipality. Indicators for how the plan is to be evaluated are mentioned in the end of the plan. The indicator that is directly relevant for the business of BEMAB is the one describing the fuel mix for DH production. Goals from the MEP and the indicators used to evaluate these goals are summarised in Table 5.4. In the MEP it is stated that the activities described in the plan are to be evaluated every year and that the MEP should be revised every four years, an intention which obviously has been neglected.

Table 5.4 Goals from the 2003 MEP which are directed at or related to BEMAB.

Directed at BEMAB		**Related to BEMAB**	
Goal	**Indicator**	**Goal**	**Indicator**
85% renewable fuels for DH production	Share of renewable fuels	Investigate increased use of waste heat	-
Municipal waste incineration	-	Municipal plan for wind turbines	-
Expand district cooling in the city of Borås	-	Biogas fuel production from municipal waste	-
Construct local DH systems	-		

The MEP states that the high-level goals for energy planning are to “further the transition to a sustainable energy and traffic system”, “reduce climate impact of the energy system”, “improve air quality” and a “further a reliable, economic and environmentally adapted energy supply”. Two of these goals (air quality and climate impact) are well defined and relate to EQOs important for the energy sector. It is also clearly stated that the municipality should partake in reducing the emissions of VOCs, nitrogen oxides and sulphur dioxide.

5.3.2 Energy Planning in Kungälv

The first MEP in Kungälv was adopted by the municipal council in 1998. Before that there was no coherent strategy for local energy, although the Municipal Plan from 1990 stated that provision of energy was to be dealt with in a separate, detailed plan. In fact, the MEP was a part of the local Agenda 21 work which started in 1994, more than a result of the Municipal Energy Planning Act. The planning process started in 1996 when district heating was under consideration and was finished in 1998, when the district heating grid had been activated. Thus, the years 1996-1998 can be seen as a breaking point for the municipal energy work and for KEAB.

The MEP was followed by a report on the internal energy use of the Kungälv municipality in 2002, which included an action program for the years 2003-2010. In 2007 the energy plan was evaluated and it was decided that a climate strategy and a new energy plan were to be developed. The climate strategy was finished in 2007, whereas the energy plan was not finished until 2009. In 2011 a new strategy for energy efficiency within the municipal organisation, to replace the strategy from 2002, was developed. It is now awaiting approval by the municipal council.

The first MEP from 1998 explicitly states goals for KEAB, and also some goals which are related to the business activities of KEAB (Kungälvs kommun 1998). The plan was developed by a work group comprising civil servants and a representative from KEAB. Indicators are presented in the MEP in relation to the follow-up of these goals. However, indicators are used mostly for the more general goals for the municipality as a geographic region and only for one goal in which KEAB is directly stated as the most important actor. The goals and indicators from the 1998 MEP that are related to KEAB are summarised in Table 5.5. Wind power plant construction is classified both as a direct goal for KEAB and a general goal related to KEAB as it is stated that both private actors and KEAB are expected to invest in wind power.Many of these goals directly or indirectly to the the EQO of reduced climate impact, no eutrophication,

Table 5.5 Goals from the 1998 MEP which are directed at or related to KEAB.

Directed at KEAB		**Related to KEAB**	
Goal	**Indicator**	**Goal**	**Indicator**
Conversion of HOB to CHP plant	-	50% reduction of heating oil between 1995 and 2005	GWh of heating oil used per year (temp. corrected)
Construction of solar heat panels for DH production	-	Increase share of renewable energy for heat (excl. el.)	Percentage of heat delivered by renewable energy
System for returning of ashes from DH plants	-	Reduce use of electric heating	GWh of electricity used for heating
Construction of wind power plants delivering 30 GWh per year in 2005	GWh produced per year	Construction of wind power plants delivering 30 GWh per year in 2005	GWh produced per year
Expansion of DH	-		

When the MEP was revised in 2009 it was expanded and divided into two parts, one information part and one action part (Kungälvs kommun 2009). The new MEP has a more explanatory approach, it seems to be more directed at citizens and not only intended to be an internal planning document. The MEP was developed by the municipal ecologist, environmental investigator, civil servants and representatives from KEAB. The goals are in the new MEP clearly related to the national environmental quality goals. Some goals are kept from the 1998 MEP, some are revised and some are new. An improvement is the new appendix on follow-up where the indicators, which are to be used for each goal, are listed and explained. The goals from the 2009 MEP are summarised in Table 5.6.

Table 5.6 Goals from the 2009 MEP which are directed at or related to KEAB.

Directed at KEAB		Related to KEAB	
Goal	**Indicator**	**Goal**	**Indicator**
Increased DH	GWh DH produced	Fossil free heating	CO2 emissions per capita from heating
Construction of district cooling system	-	Self-sufficienct on renewable electricity	GWh of renewable electricity produced
Construction of wind turbines		Eliminate oil use for heating	-
		Eliminate electricity use for heating	-

5.3.3 Energy Planning in Uddevalla

The MEP from 2005 seems to be the first MEP in Uddevalla. The MEP is largely a documentation of the historical and present local energy system but does also present plans for actions to be taken in the future. The goals are however set without assigning a proper indicator to evaluate them, which leads to difficulties when assessing the success of the plan.

The plan has a strong focus on energy efficiency measures to be taken, both within the municipal administration and to communicate the importance of energy efficiency to households, companies and also in education. The MEP refers to the regional and municipal environmental objectives, the main focus of which is on efficient use of fuel and electricity in the municipal organisation. The municipality has also worked with the national EQOs and focuses its environmental work on five of the EQOs but also relate to the others that are specified as important for the energy sector.

For UEAB the most important goal in this MEP is the construction of the new waste incineration CHP plant that was being planned. The plant, Lillesjöverket, started producing electricity and heat in 2009. UEAB was also named responsible for revising the fee system for DH to ensure the competitiveness of DH when heat pumps became an increasingly popular alternative for heating for house owners. Other goals in the MEP directed at or related to UEAB are presented in Table 5.7.

Table 5.7 Goals from the 2005 MEP which are directed at or related to UEAB.

Directed at UEAB		Related to UEAB	
Goal	**Indicator**	**Goal**	**Indicator**
Construction of MSW fired CHP plant	-	Increased use of DH in municipal buildings	-
Regional strategic cooperation	-	Municipal plan for waste heat	-
Efficient fee system for DH	-		
Local DH in Ljungskile	-		

A new MEP should have been accepted in Uddevalla during the autumn of 2011 but the process has been delayed. The new MEP could therefore not be included in the material for this thesis as was originally intended.

5.4 Development of Owner Directives

5.4.1 Owner Directives in Borås

The municipality of Borås published proper owner directives for all the municipal companies in 1993 after realising that simply owning the companies would not solve the problems that the companies were to handle. These early owner directives did however not include any proper goals for the companies, or what societal services the municipality expected that the companies should deliver. When BEMAB was founded in 1995 a partly new form of owner directives was written and it was stated that the object for the company's activities was to "further a good energy supply with good delivery security and optimal use of resources" and that "production and distribution shall affect the environment as little as possible". No clear directives on the development of the company are given, neither how the company should prioritise for example environmental effects from the activities. The directives focus on the financial and organisational management of the company rather than the reason why the municipality owns the company. However, the directive states that the company board in the annual report is to describe "how the activities of the company have been managed and developed in relation to the municipal objectives".

When the directive was changed in 2003 the reason for the municipality to own the company was formulated clearly as to "secure important infrastructure for the inhabitants" and "further a good energy supply according to good technical customs and with optimal use of resources". A more thorough revision of the directive was

performed in 2007 when the management of municipal waste was included in BEMAB's activites. A “long-term sustainable waste management and energy supply” is expressed as the reason for the municipal ownership. Environmental concerns are now more clearly integrated in the objectives for the company, now stating that the company shall “produce and distribute energy with the least possible environmental impact in accordance to the municipal environmental policy, special decisions and invest in renewable energy sources”, “coordinate and optimise processes involving waste management and energy production” and “describe and evaluate the consequences for human health and the environment when planning, budgeting or procuring”. A more systemic view of the environmental impacts of the company is thus expressed in this directive together with a priority for investments. The directive also states that BEMAB in its annual report shall “include an environmental report which is related to internal and municipal goals” and that the information shall be adjusted “to be used as basis for municipal green key figures”.

In 2009 BEMAB requested that the owner directive should be updated, as BEMAB wanted to participate in international development projects, which was not included previously. The municipal council approved the request to let BEMAB export their knowledge of waste and resource management. In 2011 BEMAB took over municipal water and sewage management, which was added to the owner directive, without changing the objectives or goals in any important way.

5.4.2 Owner Directives in Kungälv

When KEAB was founded in 1991 the municipality issued a directive stating that the company should “distribute according to good technical custom and with optimal use of resources, with special consideration for operational security and customer service”. Somewhat surprising, the directive also states that the company should “follow the municipal energy plan”, although there was in fact no MEP until 1998. This formulation probably related to the plan which was intended in the municipal plan from 1990. The directive was updated in 1999, but no changes regarding the objective or means were made. The goals from the now existing MEP were not further stressed in the owner directive, but the paragraph stating that KEAB should follow the MEP remained.

In 2006 a revision of the owner directive was performed. The new directive stated that “the company shall deliver the highest possible value to the municipality's inhabitants”. What the value that is to be delivered is however not defined. Neither is any directive regarding how the company should prioritise between economic and ecologic value

given. The objective paragraph was changed to "communication and energy related services" as the company by this time was active in district heating and broadband internet access services. No detailed demands from the MEP were added to the directive in this revision. The new climate strategy that was adopted in 2007 concluded that no wind turbines had been built, although this was a goal already in the 1998 MEP and a goal for the municipal council which in 2005 stated that

> *"The municipality of Kungälv views investments in wind power as important to increase the share of renewable electricity and to reduce the emissions from fossil fuels."*

As the construction of wind turbines did not accelerate, the municipal council changed the owner directive for KEAB in 2008 and added that the company should intensify its efforts to construct wind turbines and other plants for renewable electricity generation. Thus, the pressure on KEAB to construct wind power plants has been increased over the years since 1998, but still the company has not fulfilled this goal. After the new MEP was developed, the owner directive for KEAB was changed again in 2010. The directive now states that KEAB should "follow the overarching environmental goals of the municipal energy plan", but no specific targets from the MEP are expressed in the directive, apart from that about wind power.

5.4.3 Owner Directives in Uddevalla

The owner directives for UEAB regarding environmental concern seemingly have not changed during the years. The owner directives state that the target for the company is to achieve the "best possible combination of low prices on energy delivered and services provided, small impact on the environment and high quality and reliability". Guidelines on how to optimise this combination is however not given in the owner directives. The owner directives do however also state that the company should follow common policies for municipal organisations, such as the environmental policy

The municipal environmental policy integrates the EQOs and refers to the three EQOs that have been pointed out as specifically important for Uddevalla municipality (good-quality groundwater, a balances marine environment and no eutrophication). The policy also gives examples of indicators that can be used to measure these objectives, although they are not applicable to the activities of the MEC. However, the policy also states that simply to follow environmental regulation is not enough, the municipal organisation should "by a wide margin comply with laws and regulations in the environmental field". Although this is ambitious, nothing is stated about how this margin should be interpreted in actual activities.

5.5 Investments and System Development

5.5.1 System Development in Borås

The most apparent and important change for BEMAB during the last ten years is the increasing responsibility for municipal services. From being an energy company mainly providing district heating to a limited number of customers, the company has been transformed into a system integrated actor in the municipality. The perspective of the energy system as standing alone has changed to an integrated view of energy and resources. The company is now a producer of electricity and district heating, responsible for municipal waste management and waste water treatment. The synergies between these different business areas are not yet fully utilised but will continue to develop. Using waste water treatment plants to produce biogas will also let the company expand into a new market – fuel production and selling, mainly to the local buses which will then be able to use a local renewable fuel instead of fossil fuel.

The large production plant, Ryaverket, has been modernised in several steps. Constructed in the mid 1960s as a fossil fuel fired HOB it has been reconstructed and retrofitted to a MSW and biomass fired CHP plant. Waste incineration was introduced in 2004, fulfilling one of the most important goals in the MEP. The DH system has expanded and delivered 820 GWh in 2010, compared to 574 GWh in 2000. District cooling was also expanded in 2004, and in 2008 new capacity was added to the system when two absorption heat pumps were constructed. 2010 the district cooling production was 7.5 GWh which is a substantial increase from the 1.7 GWh ten years earlier. The production is thus based on biomass and MSW but still uses fossil fuels for peak capacity. The demand for peak capacity in the DH system has however been reduced by constructing a large accumulator tank at Ryaverket in 2010.

5.5.2 System Development in Kungälv

When the DH system was planned and constructed it was designed for a heat production of 110 GWh per year. The proposed heat mix was wood chips (57%), oil (27%) and heat pump (20%). A solar heat plant of 20 000 m2 was planned already from the beginning but the heat demand was not large enough to support the investment at the time. The plans for the solar heat plant were later changed and 10 000 m2 of solar heat collectors were installed. Munkegärdeverket was from the beginning a HOB as the cost for a CHP plant was too large at the time. The national energy policy bill presented in 1997 did however emphasise the importance of CHP and thus offered a governmental support for the investment, covering up to 25% of the investment cost. Thus plans were made for a reconstruction of Munkegärdeverket and in 2006 the plant started to produce electricity, although the projected electricity production of 13 GWh per year has not been reached,

the annual production over the four years that the electricity generation has been in full operation has been about 8.6 GWh which is only about two thirds of the projected value. In 2003, the plant received a permit to change the fossil oil to bio oil, which means that the plant now runs only on renewable fuels. In 2007 KEAB agreed with Göteborg Energi to connect the DH system of Kungälv and Göteborg. This would enable Kungälv to use waste heat available in the Göteborg DH system and increase the distribution capacity, which was needed as the local system expanded above the local production limit.

After the successful first years of DH in the city of Kungälv, KEAB started to construct local DH systems in 2005. Kode was the first local DH system to be started and thereafter followed Stålkullen and Kärna. These systems are all fired with wood pellets to cover the base load. The capacity peaks are covered by smaller, oil fired boilers. The system relies almost completely on renewable fuels. Fossil oil is only used in the local DH systems of Kärna, Kode and Stålkullen, but this contribution is very small in the total fuel mix (0.1% in 2010). 2010 started and ended with exceptional cold which makes the heat deliveries peak more than the system has actually grown.

5.5.3 System Development in Uddevalla

The largest change in the local energy system was the construction of the Lillesjö plant which was finished in 2009. The plant is a MSW fired CHP plant and delivers most of the heat needed in the DH system of Uddevalla. Over the last ten years several other important investments have also been made which show the interest of UEAB to improve the environmental performance of the company. The Brattås plant, an old oil-fired plant from 1978, which is used for peak capacity during cold winter days as been converted to use bio-oil instead of fossil oil which reduces GHG emissions substantially from the plant. Hovhult which was built as a coal fired HOB has been converted to wood chips, reducing emissions of GHG and other pollutants. These retrofittings of old plants have made the Uddevalla DH system fossil free today, excluding the fossil part of MSW.

In Ljungskile, a town in the municipality south of the city of Uddevalla, UEAB has constructed a wood chip-fired local DH system which delivers heat to buildings belonging to the municipal organisation and housing. This local DH system replaced several old oil-fired boilers and reduced emissions of GHG. According to the CEO this investment shows that the municipal board and the MEC work together. The system just about covers its cost and the investment could not have been made using a traditional corporate discount rate, but as the owner of the MEC has low expectations on the profit

from the company, the investment was made possible. Direct financial support for certain projects is however not granted, see section 5.7.3 about wind power.

5.6 The Issue of Wind Power

5.6.1 Wind Power in Borås

The municipal administration did a thorough investigation for the construction of wind turbines which was published in 2010 (Borås Kommun 2010). There is one area in the municipality that is considered to be a national interest for wind power. Finally three areas were considered to be very suitable for wind turbine construction, areas where no conflicts were identified between wind power and nature conservation, living environment or other interests. There is thus now a better chance that wind turbines can be constructed in the municipality without the administration having to delay the process due to unclear interest conflicts.

There are not yet any wind turbines in Borås. BEMAB is however planning on constructing a total of nine wind turbines at two separate locations. The site Rångelanda will have four turbines and at Borgstena there will be five turbines if the plans are realised. The original plan was to build six turbines at Rångelanda but this has in the process been reduced to four. The projected electricity generation from these plants would be 63 GWh annually which is about 7% of the total electricity demand of the municipality. BEMAB has also shown an interest to engage the public in the process of constructing wind turbines by making it possible for households and organisations to invest in shares of the wind power plants. The owners of these shares will then be able to buy the generated electricity at a low price and thus it will create a financial opportunity not only for the MEC but also for inhabitants of the municipality. To engage the public in the process in this way may also reduce the risk for a NIMBY attitude, (Not In My Back Yard), that is, although that many at first are positive to the existence of wind power plants, they in the end oppose to place the plants in the suggested locations. Reasons given for the opposition often relate to nature conservation and landscape protection. The question remains: whether greater ambitions for local legitimacy for the energy plan and its proposition to introduce wind power in the municipality could have facilitated the process.

5.6.2 Wind Power in Kungälv

The construction of wind power was, as previously mentioned, stated as a goal already in the 1998 MEP. The plan was also referenced in the owner directive, thus it was indirectly stated as a goal for the company to invest in wind power plants. Today, 14

years after that first plan, there are however still no wind power plants in place in the municipality, which could be described as a failure for the company both to follow directives and to develop the local energy system into a more sustainable one. What actually happened with the question of wind power is however not that easy.

According to the CEO of the company, several investigations regarding wind power in the municipality have been made. There are however several reasons for the failure in completing the projects. It seems that the greatest reason for the problems regarding this issue can be described within the discourse of legitimacy. In the municipality there seems to be a strong focus on the local issues, which seems to have led to the creation of a new political party which also has entered the municipal council, Utvecklingspartiet (eng. *The Development Party*). This party strongly focuses on that all decisions by the municipal council should focus on the local responsibility. Thus, they lead the opposition against local wind power as energy policy is a national policy issue and should not be dealt with municipally. As Kungälv is not described as a national interest area for wind power, there is supposedly no need for the municipality to engage in wind power. Focusing on nature conservation the party refuses to accept any large scale wind power west of the large motorway E6, which is the largest part of the municipality and the part close to the coast where wind power plants would be most efficient. The association Landskapsskydd Kungälv (eng. *Kungälv Landscape Protection*) has also voiced critical concerns regarding the placement of wind power plants in the landscape of the municipality.

Every municipality in Sweden is supposed to have a plan describing the possibilities for wind power. In Kungälv, it has however taken a long time to finish this plan and it was not until 2010 that the plan was finally presented. As the CEO of KEAB describes it, the original 28 locations that were suggested as suitable for wind power plants were during the planning process first reduced to eleven and finally just five locations remained. Largely, it seems that this is a so called NIMBY problem (see section 5.6.1).

5.6.3 Wind Power in Uddevalla

Uddevalla today has two small wind turbines owned by the private housing company Wallenstam. The company also plans to construct six new turbines in the municipality. The municipal administration furthers wind power and sets an ambitious target in the new MEP, but with no real plan for how to reach the target. The MEC UEAB has declared that they are positive to wind power in the municipality but states that the company cannot make such large investments the next few years without economic

support as the company recently has made other very large investments (the Lillesjö plant). The area that has been found most promising for wind power is in the south of the municipality, an area which also is important for wildlife and recreation. Thus there has been a NIMBY conflict also here. UEAB has also therefore chosen not to invest in wind power as it would hurt the local relations, according to the CEO.

6. Concluding remarks

6.1 MEPs and the EQOs

The energy plans refer to the national EQOs, but do not use them consequently as a basis for environmental impact assessment. Using the EQOs as a consistent basis could make the impact assessment easier to limit and focus. The roles of different actors, which are mentioned in the MEPs, are not as clear in the impact assessment. By promoting the use of indicators, i.e. adapted from the indicators for the EQOs, evaluation of the MEP could become easier.

The EQOs that are pointed out as the most important for the energy sector, reduced climate impact, clean air, natural acidification only and a good built environment, are not related to the role of the energy company in the MEPs studied.

6.2 Environmental Indicators for MECs

It has been shown that indicators can be adapted to MECs from the national indicators for the EQOs. The list of indicators here proposed includes many aspects of environmental concerns that are since long well-known, such as emissions of NOx and SOx, but also other concerns which are not as well regulated. To use such indicators can give a picture of the development of a company. Even if systems may not be directly comparable, it may be interesting to see how a system has developed over time with regards to these indicators. The MEC can show that the development of the system is in fact going in the right direction, i.e. toward a more sustainable one with less environmental impact. The owner, the municipality, can easily get an image of how the MECs are contributing to municipality's work with the EQOs, for which they have a large responsibility in the present policy.

6.3 MEPs and the MECs

It has been shown that the MEPs, although the MECs are involved in the planning process, make out a plan for the development of the companies. The municipal administration and the board of the MECs have good relationships extending beyond local political conflicts. The management of the MECs feel a great confidence from the owners, the municipal administrations. The driving force for development of the companies is the internal prioritisations of the MEC. The main support from the political administration lies in a will to work for a local sustainable society such as the goal in Borås for a fossil-free society, and that the MECs do not have to deliver high

profits. This enables the companies to make investments that increase the sustainability of the system although they are not economic successes.

6.4 MECs and Wind Power

None of the three MECS that have been studied has been successful in constructing wind turbines, although there is a political ambition in all the municipal administrations to have wind turbines in the municipalities. The problem seems to be common, a NIMBY attitude among inhabitants in the municipalities which may be formulated as “Of course wind turbines should be constructed, but it must be better to construct them in Norrland”. It does not seem easier for MECs, with a strong local connection, to rise above the conflict, in fact it seems as if MECs are hesitant about wind turbines as the companies may lose the trust that they have earned locally. If municipalities are serious about a fast increase of wind power production and want their energy companies to invest in wind power, it thus seems that more support is needed.

7. Further Research

There are still questions unanswered regarding the relation between municipal administrations, municipal energy companies and national environmental policy. Some of these questions may best be answered by engineers and some by social scientists, such as:

- How is the implementation of municipal environmental policy perceived by the different actors?
- How can a winning strategy for a municipal energy company to deal with the problems concerning expansion of wind power be formulated?
- In what ways can increased participation of different actors in municipal energy planning broaden the scope and the chances of successful implementation?

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APPENDIX – Interviews

The interviews conducted for this thesis were semi-structured, i.e. although a set of questions were formulated before the interview, new questions were added as specific information was presented by the interviewee and the questions were rearranged to fit into the conversation. The aim was to interview the CEO of the MECs in all the three municipalities in the case study, the CEO of Borås Energi och Miljö AB has however not been able to participate in the study.

Interviewees

Hans Larsson-Ljungblad
CEO, Kungälv Energi AB
0303-23 93 15

Roger Johansson
CEO, Uddevalla Energi AB
0522-69 62 10

Interview Questions

Is the MEC a driving force in the sustainability work in the municipality?

Is the municipal board experienced as listening or governing?

How do the MEC and the municipal board communicate?

Which factor is the most important when deciding upon new investments, e.g. MEP, return on investment, municipal environmental concerns?

What are your views on MECs on the energy market, do they have a role?

Will the MEC grow and increase its market share?

What happened with the wind power?

Do MECs have a better possibility of constructing wind turbines as they are locally anchored or is that a disadvantage?