

Industrial Landscaping of District Heating

- Opportunities for knowledge transfer to the UK market

Anna Rytöft
Lena Strömberg

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

© Ryttoft, Anna; Strömberg, Lena

Department of Environmental and Energy Systems Studies
Faculty of Engineering, Lund University
Box 118
221 00 Lund
Sweden

Department of Business Administration
School of Economics and Management, Lund University
Box 7080
220 07 Lund
Sweden

Masters Thesis in Technology Management – No. 182/2009
ISSN 1651-0100
ISRN LUTVDG/TVTM--09/5182--/SE

KFS i Lund AB
Lund 2009
Printed in Sweden

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

Abstract

Title: Industrial Landscaping of District Heating – Opportunities for knowledge transfer to the UK market

Authors: Anna Ryttoft, Lena Strömberg

Tutors: Christer Kedström
Department of Business and Administration, Lund University

Svend Frederiksen
Department of Energy Sciences,
Lund University

Lennart Larsson
Department Manager
Vattenfall Power Consultant AB

Core issue: The Swedish district heating market is becoming increasingly saturated, whilst the UK heat market is about to run into copious turmoil due to the faltering and decreasing levels of natural gas available. Swedish companies are looking to enter new market segments, and there seems to be something stirring under the surface in terms of district heating in the UK. The development of district heating in the UK is abundantly dependent on the availability and evolvment of knowledge, which is currently oporse to come by.

Purpose: The purpose of this thesis is:

1. To describe the surrounding environment and the dynamics of the UK district heating market
2. To define the growth potential for the district heating in the UK
3. To identify the opportunities to export consultancy services to this market.

Method: An inductive method was utilized for the development of this thesis. A series of case studies were conducted in order to elucidate the market situation of the UK. Both qualitative and quantitative data was collected from interviews, literature studies and a plethora of legislative documentation.

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

Conclusion: When examining the district heating market in the UK it has become apparent that something is stirring under the surface. The Government are under undeniable pressure to deliver reliable incentives that will drive CO₂ emission reductions. If nothing changes, import of gas will continue and in the worst case scenario fuel poverty levels will increase. This would be an unprofitable outcome for all parties involved. Even though no wide scale energy revolution could be identified on the UK market, significant changes are being made and the potential for export of consultancy services is constantly increasing. The trick is to identify the correct stakeholders and schemes to build a foundation for future exploration of the market on. A recommendation made by several of the schemes studied is for a foreign consultant to partner with a local player in order to create a forceful market entry position.

Key words: District heating, CHP, Vattenfall Power Consultant, export, consultancy services, industrial landscaping, multi-organization

Acknowledgements

We are truly grateful for all the assistance and inspiration we have received throughout the writing process of this thesis. First of all we would like to thank Vattenfall Power Consultants who took an interest in us and the topic we chose. A special thanks goes out to Lennart Larsson, our tutor at VPC, for helpful guidance.

We would also like to thank Svend Frederiksen and Christer Kjedström for valuable feedback and ideas throughout the research process.

The result of our research would not have been the same without the enthusiasm that we encountered in the UK and we would therefore like to address a special thanks to all the people that provided us with an abundance of material and information and were kind enough to allot time for numerous interviews filled with positive energy. Thank you: Andrew Crafter, Brian Leask, Clive Barber, David Wickersham, Ewan Huc, James McKenzie, Janice Lyon, John Ferguson, Neville Martin, Paul Smith, Peter North, Robin Wiltshire, Simon Stockwell and Steve Vizor.

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

Table of contents

1	INTRODUCTION.....	9
1.1	BACKGROUND OF DISTRICT HEATING AND THE UK ENERGY MARKET	9
1.2	A BRIEF INTRODUCTION OF VATTENFALL AND VPC.....	10
1.3	CORE ISSUE.....	11
1.4	PURPOSE.....	12
1.5	SCOPE AND DELIMITATIONS	12
1.6	OUTLINE OF THE REPORT	12
2	METHOD.....	14
2.1	OVERALL WORK PROCESS	14
2.2	DATA COLLECTION.....	16
2.2.1	<i>Triangulation</i>	17
2.2.2	<i>Case study</i>	17
2.2.3	<i>Interviews</i>	18
2.3	RELIABILITY AND VALIDITY	19
3	INDUSTRIAL LANDSCAPING.....	21
3.1	HISTORICAL BACKGROUND.....	21
3.2	THE SURROUNDING ENVIRONMENT.....	22
3.3	DYNAMICS OF THE DISTRICT HEATING MARKET	24
3.4	EXPLORING THE OPPORTUNITIES.....	26
4	THEORETICAL FRAMEWORK.....	27
4.1	LAYERS OF THE BUSINESS ENVIRONMENT.....	27
4.2	THE PESTEL FRAMEWORK	28
4.3	MARKET GLOBALIZATION	29
4.4	PORTERS FIVE FORCES.....	31
4.5	STAKEHOLDER THEORY	32
4.6	CONSULTANCY SERVICES	35
5	TECHNOLOGICAL BACKGROUND.....	38
5.1	DISTRICT HEATING.....	38
5.2	THE ECONOMIC PRINCIPLES OF DISTRICT HEATING.....	38
5.3	CHP TECHNOLOGY	40
5.4	DISTRICT COOLING	43
6	THE HISTORY OF DISTRICT HEATING IN THE UK.....	44
6.1	THE START OF DISTRICT HEATING	44
6.2	PRIVATIZATION.....	46
6.3	THE START OF CHP.....	46
7	THE CURRENT AND PREDICTED SITUATION OF DISTRICT HEATING IN THE UK.....	49
7.1	SIZE OF THE UK CHP MARKET.....	49
7.2	SIZE OF THE UK DISTRICT HEATING MARKET.....	52

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

7.3	PREDICTED MARKET GROWTH OF CHP AND DISTRICT HEATING	56
7.4	PREDICTED CONTRIBUTION FROM ALTERNATIVE ENERGY SOURCES.....	60
7.4.1	<i>Biomass status and potential</i>	61
7.4.2	<i>Waste status and potential</i>	61
7.4.3	<i>Geothermal status and potential</i>	62
7.5	IDENTIFIED BARRIERS TO THE PROGRESSIVE DEVELOPMENT OF CHP AND DISTRICT HEATING	63
7.6	IMPORTANT STAKEHOLDERS OF THE DISTRICT HEATING MARKET	66
7.6.1	<i>Regulatory sector</i>	67
7.6.2	<i>Local Authorities</i>	67
7.6.3	<i>Energy Service Company</i>	69
7.7	FURTHER STUDIES.....	69
8	CASE STUDIES: EXISTING DISTRICT HEATING SCHEMES	71
8.1	SCOTLAND	73
8.1.1	<i>District heating and renewables</i>	73
8.1.2	<i>District heating and waste management</i>	74
8.1.3	<i>The power of the consumer</i>	74
8.1.4	<i>The ownership structures</i>	75
8.1.5	<i>Incentives toward waste incineration in Scotland</i>	76
8.1.6	<i>Existing waste to energy schemes in Scotland</i>	78
8.2	ENGLAND.....	78
9	ANALYSIS: HISTORICAL BACKGROUND.....	81
10	ANALYSIS: THE SURROUNDING ENVIRONMENT	83
10.1	POLITICAL STRATEGIES	83
10.2	POLITICAL INCENTIVES.....	85
10.3	ECONOMIC	86
10.4	SOCIAL/CULTURAL	87
10.5	TECHNOLOGICAL	87
10.6	ENVIRONMENT.....	88
10.7	INFRASTRUCTURE	89
10.8	REFLECTION	90
11	ANALYSIS: THE DYNAMICS OF THE DISTRICT HEATING MARKET.....	92
11.1	STAKEHOLDERS OF THE MULTI-ORGANIZATION	92
11.1.1	<i>Competing heating solutions</i>	93
11.1.2	<i>Civil Society</i>	93
11.1.3	<i>NGOs against DH / media</i>	93
11.1.4	<i>NGOs pro DH</i>	93
11.2	THE MULTI-ORGANIZATION OF DISTRICT HEATING SCHEMES	94
11.2.1	<i>National Authority - Government</i>	95
11.2.2	<i>Local Authorities – City Councils</i>	96
11.2.3	<i>Energy Service Companies (ESCO)</i>	97
11.2.4	<i>The customer and the consumer</i>	97
11.2.5	<i>Consultancy services</i>	98
12	ANALYSIS: EXPLORING OPPORTUNITIES.....	100
12.1	MARKET SEGMENTATION.....	100

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

12.2 IDENTIFYING THE STRATEGIC POSITION	102
13 CONCLUSION	103
13.1 FUTURE RESEARCH.....	106
REFERENCES.....	107
APPENDIX I: GOVERNMENT INCENTIVES	114
APPENDIX II: RELEVANT ORGANIZATIONS IN THE UK.....	124
APPENDIX III: CASE STUDIES SCOTLAND	128
DUNBAR	128
ABERDEEN.....	130
SHETLAND ISLANDS	135
BINN ECO PARK.....	142
THE HIGHLAND	144
APPENDIX IV: CASE STUDIES ENGLAND	149
CITIGEN	149
PIMLICO.....	153
LONDON THAMES GATEWAY.....	158
SOUTHAMPTON.....	162
ABREVIATIONS	169

1 Introduction

This chapter provides an introduction to the underlying issues which are dealt with throughout the thesis. The purpose of the thesis is defined alongside a brief outline of the report to give the reader a clearer view of the content.

1.1 Background of district heating and the UK energy market

The roots of district heating can be traced back as early as the middle ages, but was not fully developed in Europe until the 1950's. Today there is a wide variety of northern European countries with advanced district heating systems. In an attempt to replace coal heating, the UK invested in district heating schemes in the period between 1950 and 1970, unfortunately none of the schemes turned out to be very successful. Due to voluminous gas findings in the North Sea, the UK saw a way out of their energy crisis and district heating was forgotten.¹

District heating has been a large part of the Swedish heating industry since the early 50's. Since Sweden is a cold country, a reliable source of heating which is both safe and environmentally friendly is of grave importance; district heating is a great option. During the oil crises of the 70's several district heating plants were built in Sweden in order to replace oil, which was still a major heating source at the time.

District heating is an efficient way of distributing reliable, environmentally and economically sound heating for space and hot water. It is a technique of distributing heat regardless of the source of the energy, unlike a gas scheme which is locked to one specific source of energy. The variety of district heating systems is ample: cogeneration of power and heat, surplus heat from industrial process, geothermal heat, solar heat or heat-only-boilers. The heat which is produced at an energy station is distributed through insulated pipes to the spaces connected to the scheme.

In Sweden today, around 50% of all heating of both private housing and public construction, is distributed through district heating², whereas in England this same number lies around a mere 1 %. Competence and knowledge of district heating in Sweden is deeply rooted, due to the vast expansion of the technology. Developers in the UK are showing an interest in district heating but experience is scarce and knowledge needs to be acquired from other countries.

At the same time, energy politics in the UK are shifting and much more environmentally conscious energy strategies have formed and are being put into action. The European directives of reduction of carbon dioxide (CO₂) emissions place high demands on the UK energy system. The fact that the city of London has set a goal of reducing CO₂ emission levels by 60% by 2025, and England has nationally set

¹ Michael King, Combined Heat and Power Association, speaker at BRE seminar, 2009-04-20

² District Heating and Cooling country by country/2007 survey, Euroheat & Power, May 2007

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

the same goal for 2050, adds to the need for an energy revolution³. Not just the emission reduction requirements are of grave importance to the UK energy situation, but the natural gas collected from the Northern Sea is approaching alarmingly low levels. 77%⁴ of resident housing in the UK is gas heated and since a few years back the country suffers a net-import of gas⁵. The current environmental situation is no longer the only issue threatening the UK; reliability of supply is of considerable importance. The English energy system, being almost entirely dependent on gas, is facing a crossroads. District heating systems have the potential of becoming a complementary heating system to the currently widespread gas heating system. By developing district heating, primary energy can be used more efficiently and renewable energy can be used as a source of energy.

1.2 A brief introduction of Vattenfall and VPC

Founded in 1909 Vattenfall is one of Europe's five largest electricity generator companies as well as Europe's largest heat producer today. Vattenfall are currently active in Sweden, Denmark, Finland, Germany and Poland, but are hoping to explore new markets as the company continues to grow. Within electricity Vattenfall's main strengths lie in generation, transmission, distribution and sales. For heat their strengths lie in production, distribution and sales. With 32 000 employees and over 6 million customers Vattenfall's vision is to become a leading European energy company and their mission is to enhance our customers' competitiveness, environment and quality of life through efficient energy solutions and world-class services.⁶

Vattenfall Power Consultants (VPC) was established in 1976 as an independent consulting company, wholly owned by Vattenfall. They are the leading Swedish consultancy company in both the energy and the power sector. VPC work hard to improve their customers' assets and operations with the help of cost-effective, sustainable solutions. Since the industry sector is ever-changing and expanding, VPC focus on meeting demands for expert knowledge and new technology.⁷

The VPC office in Malmö focuses on energy technology and deal with customers from all over the world such as energy companies, industries, and local authorities. VPC handle questions regarding all aspects of an energy system; electricity, gas and heat supply, efficiency and strategy. They are constantly striving to find new markets

³ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007, Summary

⁴ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007, chapter 3

⁵ Digest of the United Kingdom Energy Statistics, Department of Business Enterprise and Regulatory Reform, UK, 2008, Chapter 4: Gas

⁶ Lennart Larsson, Division Manager Vattenfall Power Consultant, Malmö, 2009-02-12

⁷ Lennart Larsson, Division Manager Vattenfall Power Consultant, Malmö, 2009-02-12

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

and new areas where they can supply their expertise. Within VPC the knowledge of district heating is widespread and well rooted. They have the possibility of providing services within all aspects of a district heating development project and often work with pre-studies (i.e. feasibility), procurement and operation.⁸

1.3 Core Issue

There is currently a strong change in energy politics in the UK, with strict requirements on reduced CO₂ emissions. In order to reach target goals set by both the EU and the local government, the UK need to make severe changes in their energy systems. We have asked ourselves the following three questions:

Will district heating be one of the future techniques in the UK heating market or will the market favor other heating techniques?

What is the growth potential for the UK district heating market?

What are the incentives for development of district heating?

There are some major differences between the development of a district heating scheme in Sweden and in the UK. In Sweden the distribution of district heating is mainly centralized and is thus publicly financed. In the UK, on the other hand, most existing district heating schemes are privately owned and finance.⁹

How does the industrial and political climate of the UK affect the implementation of district heating?

What are the success factors and obstacles for developing a district heating scheme on the UK market?

What does the organizational structure and development process of a district heating scheme look like?

In Sweden district heating has increased over the past 20 years in both the private and the public sector¹⁰, and competence within the field is extremely well rooted and widely spread. However, the Swedish market is becoming more and more saturated, and numerous large players are looking for new markets to enter. In contrast to Sweden, the UK has seemingly limited experience of district heating, but a high percentage of water carrying heating systems within housing, which is compatible to district heating systems.¹¹ This means that the potential for developing wide spread district heating schemes in the UK is a very tangible possibility.

How can a successful district heating project be identified?

Is it possible to sell consultancy services to the UK market?

⁸ Lennart Larsson, Division Manager Vattenfall Power Consultant, Malmö, 2009-02-12

⁹ Collier, U. et al (1997)

¹⁰ www.svenskfjarrvarme.se, 2009-03-14

¹¹ www.svenskfjarrvarme.se, 2009-03-14

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Is there potential for Swedish consultancy companies to enter the UK market and if so, how should this be done?

1.4 Purpose

The purpose of this thesis is:

1. To describe the surrounding environment and the dynamics of the UK district heating market
2. To define the growth potential for the district heating in the UK
3. To identify the opportunities to export consultancy services to this market.

1.5 Scope and delimitations

The market study is limited to exploring the possibility of transfer of knowledge in terms of exporting consultancy services. A mapping of the industrial landscape of a more general character has been conducted and can possibly be utilized by others interesting in the UK district heating market, for example suppliers of equipment or turn-key solutions. The mapping of the industrial landscape of district heating could possibly be applied to other geographical markets where expansion is seen as a viable option.

In much of the literature found, the term district heating entails both industrial and public/private heating. We have chosen to keep the terminology, but have restricted ourselves to look only at the public/private aspect of it. We have come across the term community heating but have chosen to disregard it as it is not as clear cut in regards to what it encompasses as district heating is.

The study does not include Vattenfall Power Consultant's strategies for market entry rather the report should be seen as background research aiding in decisions regarding market entry.

1.6 Outline of the report

The following figure illustrates the layout of the report.

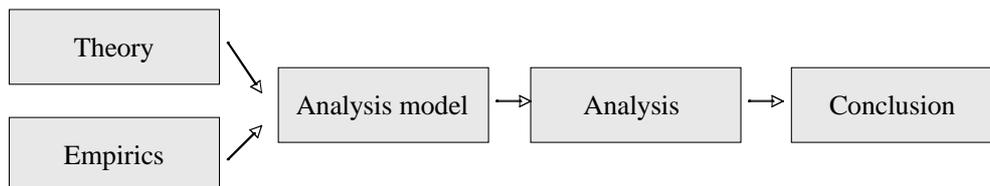


Figure 1. Outline of the report

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

The analysis model is based on the theoretical framework alongside empirical data. The model is presented in the theoretical framework, followed by a presentation of general theories and collected emporia. The analysis chapter is based on the previously recited model and provides a synthesis of the case studies. Finally the most interesting findings are concluded and some recommendations for VPC are presented.

2 Method

This chapter discloses the method used throughout the work process. A brief overview of the work process is given, followed by a more detailed account of the specific method used.

2.1 Overall work process

The first stage of the work process was to decide on an interesting topic of study. We came into contact with a company called Sustainable Business Hub who invited us to join a conference in Malmö early January 2009, discussing the possibilities of expanding district heating in the UK. It seemed that Sweden holds immense competence within district heating and we began wondering why this knowledge was not being transferred to the UK. Digging a little deeper it became apparent that very little or no research was being or had been conducted regarding the possibility of exporting Swedish competence and knowledge of district heating to a potentially profitable market of measurable size such as the UK. We were lucky to capture the attention of Lennart Larsson, Department Manager at VPC, who was interested in finding an answer to the very same question. By collecting information about the current market situation and attempting to grasp the future of district heating in the UK, we initiated the process of creating a theoretical framework for a market analysis.

There are two ways in which to approach the presentation and analysis of theoretical and empirical data; deduction and induction. A deductive method is based on a theoretical framework which is later falsified or verified through the collection of empirical data. On the other end of the spectrum is an inductive method which is based on empirical findings, from which a theoretical framework can be built and more general conclusions can be drawn¹². We decided that an inductive approach would be most beneficial to this study, due mainly to the nature of the empirical data. Since we did not find any studied that describe the industrial landscape of district heating no suitable analysis models was identified. The market findings from the empirical study therefore provided the content needed to develop the model and the theoretical framework functioned as a structural backbone. In order to create a model which could function as a tool for mapping the industrial landscape of district heating various theories were needed. The basic ideas of the theories were synthesized in the analysis model.

We based our research method on Kathleen M. Eisenhardt's article "Building Theories from Case Study Research". The Eisenhardt method describes the process of inductive theory building using case study research. The research approach is deemed appropriate for embarking on research in new topic areas.¹³

¹² Jacobsen, D. I. (2002)

¹³ Eisenhardt, K. M. (1999)

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

We have not found any studies that analyze the market of exporting knowledge to the UK district heating market. We consider the landscaping of the UK district heating market to be an undeveloped topic and thus consider the Eisenhardt method to be appropriate for our study.

An adaptation of Eisenhardt’s existing model “Roadmap for building theories from case studies” was used to create a structured way of building the theoretical model.¹⁴

Step	Activity	Reason
1. Getting started	Defining the research question Neither theory nor hypothesis	Finding focus Retains theoretical flexibility
2. Selecting case	Specify population	Variation sharpens external validity
3. Crafting instruments and protocols	Multiple data collection methods, qualitative and quantitative	Strengthens grounding of theory by triangulation of evidence
4. Entering the field	Flexible and opportunistic data collecting methods	Allows investigators of taking advantage of emergent themes and unique case features
5. Analyzing data	Within case analysis Cross-case pattern using divergent technique	Gains familiarity with data Forces investigators to look beyond initial impression
6. Shaping hypotheses	Iterative tabulation of evidence Replication of cross-cases Search for “why” behind relationships	Constructs definition, validity and measurability Confirm theory Build internal validity
7. Enfolding literature	Compare with similar and conflicting literature	Raises theoretical value
8. Research closure	Theoretical saturation	Ends process when marginal improvement become small

Table 1: An adaptation of an existing model ”Roadmap for building theories from cases studies.

Step 1: We started off by identifying the possible market potential for selling consultancy service on the UK market. In this stage of the process neither the theoretical approach nor the hypothesis were fully defined. We wanted the empirics to determine what kind of theoretical approach would be needed. The scope and delimitations of the study were defined throughout the research process.

Step 2: The selection of cases was not as strategical as it could have been in terms of variation, but were instead selected on the premises of access to reliable and

¹⁴ Eisenhardt, K. M. (1999)

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

substantial information. We believe that the variation of cases is adequate to secure external validation. There are variations in terms of incentives, ownership structure and size of the schemes. Most of the district heating schemes studied are publicly owned, since they allowed for access to information needed.

Step 3: The instrument and protocols of collecting data were constructed to be open to unknown findings. The interview questionnaires were made flexible for the responded and were at the same time of a qualitative nature. By studying nine cases and posing similar questions we hoped to collect quantitative answers that could be applied in order to make generalizations; however the main focus has been to be open to qualitative responses.

Step 4: The primary instrument for collecting data from the case studies was interviews. When first entering the field we were flexible and open to information about new cases. By doing so we allowed for generalizations but also the ability to present a wider spectrum of case studies.

Step 5: Analysis of data was done by way of the constructed method described in Chapter 3. The findings of the case studies were synthesised and analyzed in order to present both general and unique finding, (see Chapter 9, 10, 11 and 12).

Step 6: The conclusions were drawn with the aid of the finding the case studies and validated through interviews with people not directly connected to the scheme in question. People with wider knowledge of the market were used for this step of the process.

Step 7: The enfolding of literature is difficult in this study due to limited access to literature which deals with the same topic. However we have found literature which discusses adjacent topics, which has been used in order to deepen our understanding of the market and provide insights into plausible barriers and incentives present on the market today.

Step 8: Seeing the marginal input decrease along the data collection process is a way of reaching closure to research. Each case presented differs from the next in some way making closure difficult. In terms of general finding the empirical data should be enough to reach reasonable closure.

2.2 Data Collection

There are two well known methods used for data collection; quantitative and qualitative. The nature of the data usually determines which method is most suitable. Quantitative data is often known as hard data, which is expressed merely with the use of numbers. Numbers can help to create a simpler perspective when providing an overview of considerable quantities of material. The quantitative method is seen as being more structured and formal. In a quantitative analysis variables are often

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

manipulated in order to prove a hypothesis, followed by theory development, i.e. a deductive process. Qualitative data allows for a deeper and more detailed understanding of the problem at hand and the analysis is backed by observations and interviews. Qualitative data, known as soft data can help provide an answer to the question why.¹⁵

2.2.1 Triangulation

Triangulation was defined by Denzin (1978: 291) as “the combination of mythologies in the study of the same phenomenon” and is considered an important aspect of result validation. Triangulation can provide unique variances that could easily be overlooked if one single method is used, specifically a quantitative one.¹⁶

There are typically two types of triangulation; within and between. Within-method triangulation involves cross-checking of internal consistency or reliability, while between-method triangulation tests the degree of external validity.¹⁷ Between triangulation is used to overcome barriers and to create a mix of hard and soft data collection through the use of both surveys and observations.¹⁸

Triangulation is often seen as a way of counterbalancing inherent weaknesses in one method with strengths in another, and thus increasing the validity and the reliability of the collected data.¹⁹ When attempting to exemplify the UK district heating market, qualitative methods were used. A capacious portion of the empirical data was collected through interviews. However, in order to achieve a comprehensive overview of the UK district heating market a triangulation of method was used, i.e. a combination of interviews, reports and articles. The district heating market is complex and ever changing, thus in order to fully grasp the dynamics of the market a qualitative analysis method was used. As research progressed, the core issues were revealed and interviews were carried out with the aid of standardized questions allowing for slight generalizations of the market dynamics and the possibility to compare results from different cases. To identify the potential for district heating it was important to quantify the potential size of the market with the aid of quantitative research methods.

2.2.2 Case study

Case studies are often used in order to clarify or gain a deeper understanding of the dynamics of a certain environment. There are typically three underlying reasons for conduction of a case study; to provide a description, to test, or to generate a theory.

¹⁵ Svenning, C. (1999)

¹⁶ Jick, T. D. (1979)

¹⁷ Jick, T. D. (1979)

¹⁸ Svenning, C. (1999)

¹⁹ Jick, T. D. (1979)

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Relevant information regarding a number of cases is gathered, using a variety of data collection methods. There are four distinguished types of case studies²⁰:

- a) *Independent research method*: comparing two distinctly different groups to get results, i.e. descriptive case studies.
- b) *Preparatory research/generation of hypothesis*: using case studies as preparation for research, and then using it to generate a new hypothesis, which is in turn tested through further studies. These types of case studies are considered to be lacking in magnitude if not tested with a hypothesis.
- c) *Deviating case studies*: supplement to traditional methods of describing cases that fall outside of the general frame of reference.
- d) *Generation and penetration of theories*: researchers search for cases that can develop the theory, asking questions such as “why was it like this” or “how much has actually changed” makes it easier to identify the social fields in the study.

We chose to look at nine cases in order to gain an unambiguous picture of the UK market dynamics. With the aid of the independent research method and the generation and penetration of theories, we collected information by way of interviews, observations and research of published material. To provide valid empirical data and a wider overall perspective, we chose to approach more than one stakeholder per scheme.

2.2.3 Interviews

Personal interviews allow the interviewer to record body language and initial reactions in the interviewee. The danger is that the interviewee is influenced by the mere presence of the interviewer. Interviewees could be influenced to attempt to answer questions in a way that they think the interviewer wishes them to. There is also a risk that the interviewer misinterprets responses given by the interviewee. Lengthy drawn out answers might be summarized and the actually meaning the interviewee is attempting to get across could get misconstrued. The interviewer should make sure to ask for clarification if there is any potentiality of misinterpretation and make sure that they have factually understood what the interviewee wished to portray.²¹ In order to avoid misconstrued information interviewees were given the possibility to cross-check all collected data and confirm that a fair picture of the situation had been captured. The respondents were given the opportunity to correct and alter the material presented in the case studies in Appendix

²⁰ Eisenhardt K. M (1988)

²¹ Svenning, C. (1999)

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

III and IV. The respondents did however, not have the possibility to influence the synthesis of the empirical data presented in Chapter 9, 10, 11 and 12.

People holding key positions should be targeted for interviews regarding any form of organization, because it is where most of the information is stored. However, the closer one gets to sensitive information the greater the risk of receiving information which creates an idealized image. It is therefore recommended to interview key people at the end of the interviewing process, to allow the interviewer to be as well prepared as possible and thus have the ability to sum up information gathered throughout the process.²²

Project leaders and so called project champions were targeted for interviews. They tend to hold a general overview of the specific project, allowing collection of information needed to winnow the dynamics of a scheme. To improve the internal validity of the case studies other dominant stakeholder with a strong connection to the scheme were interviewed.

Most of the interviewees were interviewed by phone prior to meeting in person to ensure the establishment of a reliable contact. The interviewees provided recommended written material that could aid in the preparatory phase prior to a face-to-face interview, which was carried out during a two-week trip to the UK.

2.3 Reliability and Validity

Reliability refers to the legitimacy of research results. Considering a constant population, one should be able to perform the same experiment twice, at two different points in time and achieve identical results. If the results in fact turn out to be equivalent, then the reliability of the research is considered to be high.²³ Reliability may alter over time, and it is important that the researcher/s remain aware of this and constantly question the reliability of their sources. Having two researchers conduct research simultaneously has aided us in maintaining a high degree of reliability. When it comes to information collected through interviews it is difficult to determine the reliability of the various sources. In order to mitigate the risk of misinterpretation during interviews it is important to provide the interviewees with clear definitions and interpretations to minimize the risk of the subject providing their own definitions.²⁴ Since interviews are based predominately on personal opinion these may change over time. By interviewing people holding different positions within the multi-organization of any one district heating scheme, we have attempted to alleviate this risk and simultaneously providing a wider analytical perspective.

Outer validity encompasses the entire project in an all-inclusive reference frame. This type of validation deals with the aggregate and the possibility of drawing out a

²² Svenning, C. (1999)

²³ Svenning, C. (1999)

²⁴ Svenning, C. (1999)

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

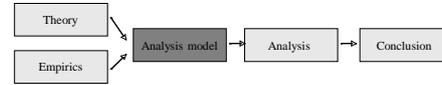
generalization from something specific. In order to make assumptions based on a study, the underlying data must be valid. Quantitative data is often difficult to validate, due to high degrees of contextual dependence, and thus it is often challenging to make generalizations based merely on such data.²⁵ Therefore we can only make conclusions in the basis of the specific cases that we have studied. It is probable that if similar findings are made across the cases it is can be concluded as a general phenomenon.

Internal validity refers to the actual content of a project, and the interactions which occur between theory and emporia. The validity is based on the design and the structure of a project. In order to ensure validity in a project it is imperative that all parts of the projects are validated.²⁶ In order to ensure this type of validity we have validated our findings by presenting them to experts in the field. In order to confirm reliable and trustworthy results from interviews, we positioned our trip to the UK towards the end of our research process. At that point in time we had gained significant knowledge on the subject in order to ask educated questions and to sum up information gathered throughout the process.

²⁵ Svenning, C. (1999)

²⁶ Svenning, C. (1999)

3 Industrial Landscaping



This chapter presents our own market analysis method, industrial landscaping, derived from the theoretical framework and collected empirical data. The method has been adapted to the nature of the UK district heating market and the purpose of the thesis.

Through synthesis of the theoretical framework and the collected emporia a model has been developed to aid us in gaining a deeper understanding of the UK district heating market and identifying a strategic position for a consultancy company on the market. The structure of the model is based on the *Layers of the Business Environment* (see Figure 5). We call our extended model the *Industrial Landscaping Model*. The concept of the original model has been preserved, but adapted and retrofitted to suit the characteristics of the UK district heating market. The model is costumed to map an industrial landscape for the purpose of identifying the potential market segments where business opportunities might arise. The model is build around the opportunities for knowledge transfer to the UK district heating market. The hope is that the *Industrial Landscaping Model* will be inclusive enough to suffice for application on further geographical markets or potentially be utilized by other business interested in the UK district heating market.

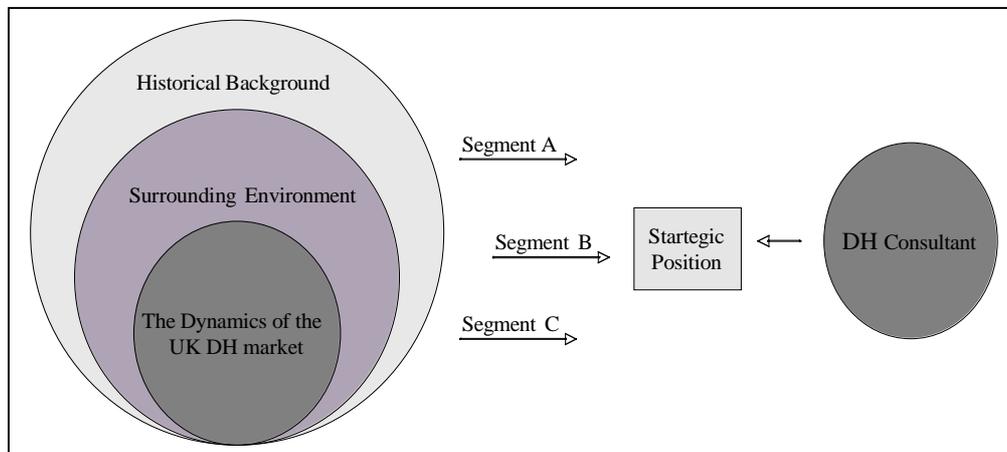


Figure 2. The Industrial Landscape: a synthesised model used to analyse the district heating market situation in the UK

3.1 Historical background

In the *Layers of the Business Environment Model* the most outer layer describes the surrounding environment. While examining the UK district heating market, it became apparent that the historical background, both of the country and the technology in

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

itself, was a salient parameter to consider. The historical perspective was therefore an important addition to the *Industrial Landscaping Model*. We have found that the historical perspective influences both the surrounding parameters and the nature of the dynamics of the market.

3.2 The surrounding environment

The second layer of the *Industrial Landscaping Model* represents the surrounding environment of the UK district heating market and entails the most important external parameters that determine the surrounding market conditions. The parameters considered are based on the *PESTEL framework* (see Chapter 4.2), which has consequently been altered to suit the UK district heating market.

A list of seven factors is presented below (see Figure 3). These seven factors will aid us in presenting a more structured and detailed view of the market. Each factor contains specific parameters which influence and shape the market situation seen in the UK today. These parameters can be seen as potential drivers of change and need to be continuously investigated in order to keep track of possible shifts in the market. By describing the importance of the parameters, we hope to give the user of the *Industrial Landscaping Model* a checklist to govern the potential of any global, inflating market.

Industrial Landscaping of District Heating
 Opportunities for knowledge transfer to the UK market

Political strategies	<ul style="list-style-type: none"> •EU directives •National policies and goals •Regional Authorities •Local Authorities
Political incentives	<ul style="list-style-type: none"> •Legislative •Subsidies •Fees/taxation •Information/education
Economic	<ul style="list-style-type: none"> •Financial •Energy prices: spark gap, electricity, fuel (gas, oil, waste, woodchips, bio oils)
Social/cultural	<ul style="list-style-type: none"> •Public awareness •Peoples presumptions •Capability to change
Technical	<ul style="list-style-type: none"> •Lack of competence in terms of knowledge and available products •Acceptance of new technologies
Infrastructure	<ul style="list-style-type: none"> •Construction of buildings (construction material, insulation, heating system) •City planning •Gas distribution systems •Electrical distribution systems (national grid, local grids)
Environment	<ul style="list-style-type: none"> •<i>Climate</i> •Heating and cooling demand •Natural resources: gas, geothermal, biomass, and generation of waste •Environmental awareness and threat of climate change

Figure 3. Parameters for analysis of the surrounding environment of the UK district heating market

We have chosen to separate political strategies from political incentives. We believe that the political strategies are formatted to explain the direction of energy politics and that the actual means of control are set by the incentives by way of legislations, subsidies, taxes/fees and general information.

The infrastructure is considered to be separate factor and has thus been added to the original *PESTEL* framework. The state of existing infrastructure has proven to be a determining factor for establishment of district heating alongside infrastructural investments.

3.3 Dynamics of the district heating market

In order to distinguish possible business opportunities for a consultancy company, identification and definition of the dynamics of the UK district heating market is crucial. This layer of the *Industrial Landscaping Model* requires an understanding of the multi-organization of a district heating scheme and the *Stakeholder Model* has been utilized to analyse the relationships between key partners and surrounding stakeholders. Inspiration was taken from Julia Roloff's article on multi-organizations and stakeholder relations (see Chapter 4.5). She points out the importance of focusing on a multi-organization's needs and demands rather than placing the main focus on a single organization. Important input was simultaneously collected from *Porters five forces* (see Chapter 4.4) to deepen the analysis and allow for identification of the stakeholders responsible for development of a scheme.

Through a synthesis of findings collected from the array of case studies and a variety of stakeholder models the figure presented below was compiled (see Figure 4). The coloured circles are part of the multi-organization whereas the white circles represent the surrounding stakeholders believed to be the most influential.

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

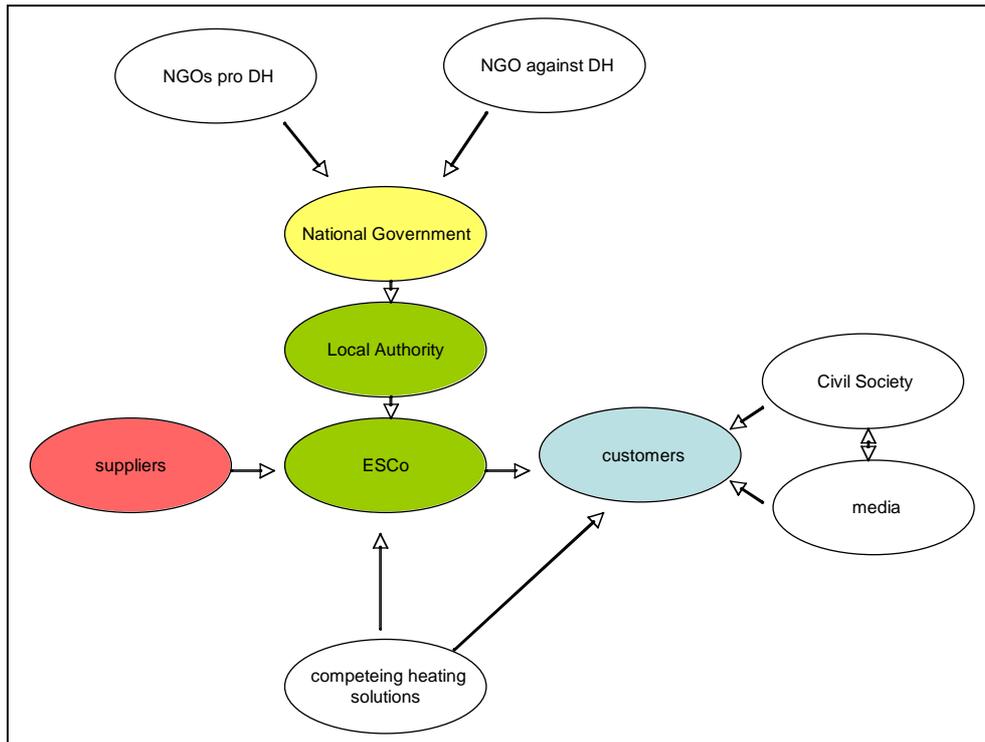


Figure 4. The adapted multi-organizational stakeholder model

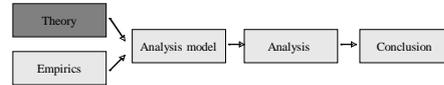
The case studies presented in this thesis make it apparent that a district heating scheme requires participation from more than one stakeholder. The owner of a district heating grid is placed in the centre of the adapted stakeholder model, connected to suppliers and customers through a heat value chain. It is palpable that community councils alongside various levels of Government are salient members of the multi-organization. In comparison to Fassin's stake model²⁷, in which he places the Government outside of the organization, we believe that when dealing with district heating authorities directly benefit from and participate in district heating schemes. Local authorities are not only an essential stakeholder in the multi-organization but are in some cases concurrently the owner and developer of a given scheme. The functions and relations within a multi-organization are discussed further in Chapter 11.2.

²⁷ Fassin, Y. (2009) p. 113–135

3.4 Exploring the opportunities

The mapping of the industrial landscape is carried out by general means but also in the context of an organization interested in exploring the market. In this case the opportunities for knowledge transfer are under investigation and with it, the potential of exporting consultancy services. With the aid of segmentation analysis of the considered market a company should be able to identify possible entry channels. If there is a match between the organizations core competences and the identified knowledge gap on the desired market, market entry should be considered. In the end it comes down to matching organizational decisions with company strategies and executing a cost benefit analysis of possible market entry. It is vital for the consultancy company to identify a valuable strategic position which matches the specific competences and strengths found within the company.

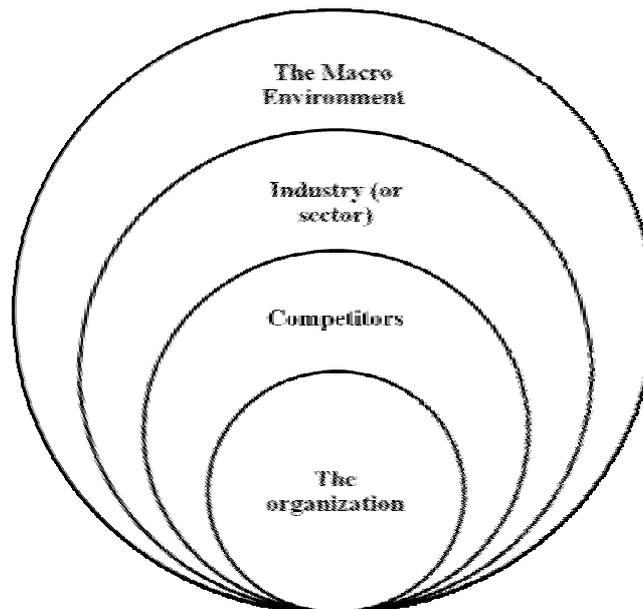
4 Theoretical Framework



This chapter presents theories that have aided us in the process of developing our theoretical framework; Layers of the Business Environment, PESTEL, Globalization, Porter's five forces, stakeholder theory and consultancy services. The synthesizing of these theories lays the ground for the Industrial Landscaping analysis model.

4.1 Layers of the Business Environment

It is often difficult to make sense of a market and its environment due to the immense diversity which surrounds it. There is a certain degree of complexity present on any given market due to the fact that many of issues in a business environment are interconnected. An example of this symbiosis is technological development which changes the way things work. When the way things work is altered lifestyles are



forced to adapt and in turn a shift in consumer behavior is inevitable. Another issue affecting the environment is the rapidity of change, which is constantly increasing.²⁸

Figure 5: The Layers of the Business Environment

The outmost layer of the environment is referred to as the “macro-environment”. This level of environment has a substantial impact on organizations, and it is important to

²⁸ Johnson, G. et al (2008), p.64

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

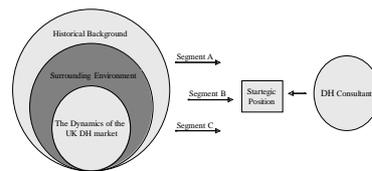
understand how this environment can burden a single organization. The key drivers of change can be identified with aid of the *PESTEL framework*. The drivers alter from sector to sector, and from country to country, and it is therefore often a good idea to construct scenarios of possible future environments.²⁹

Within the macro-environment the next layer is often called the sector or the industry and it is seen as a group of organizations that produce or provide identical products or services. In order to understand the competitive dynamics of the market it may be helpful to look at *Porters five forces* and cycles of competition.³⁰

The final layer is one that inevitably has the largest direct impact on the organization and is made up of competitors and markets. The concept of strategic groups can be helpful to identify competitors. Consumer behavior change over time and can be analyzed through the concepts of *market segmentation* and *critical success factors*.³¹

4.2 The PESTEL framework

It is important that managers understand the key drivers of change and the impact that these external influences can have on particular industries, markets and individual organizations. It is important that the *PESTEL* framework is used when looking at the future impact that influences might have. It is important to remember that the seven factors are not independent of each other but rather more often than not, intertwined.³²



²⁹ Johnson, G. et al (2008), p.65

³⁰ Johnson, G. et al (2008), p.65

³¹ Johnson, G. et al (2008), p.68

³² Johnson, G. et al (2008), p.69

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

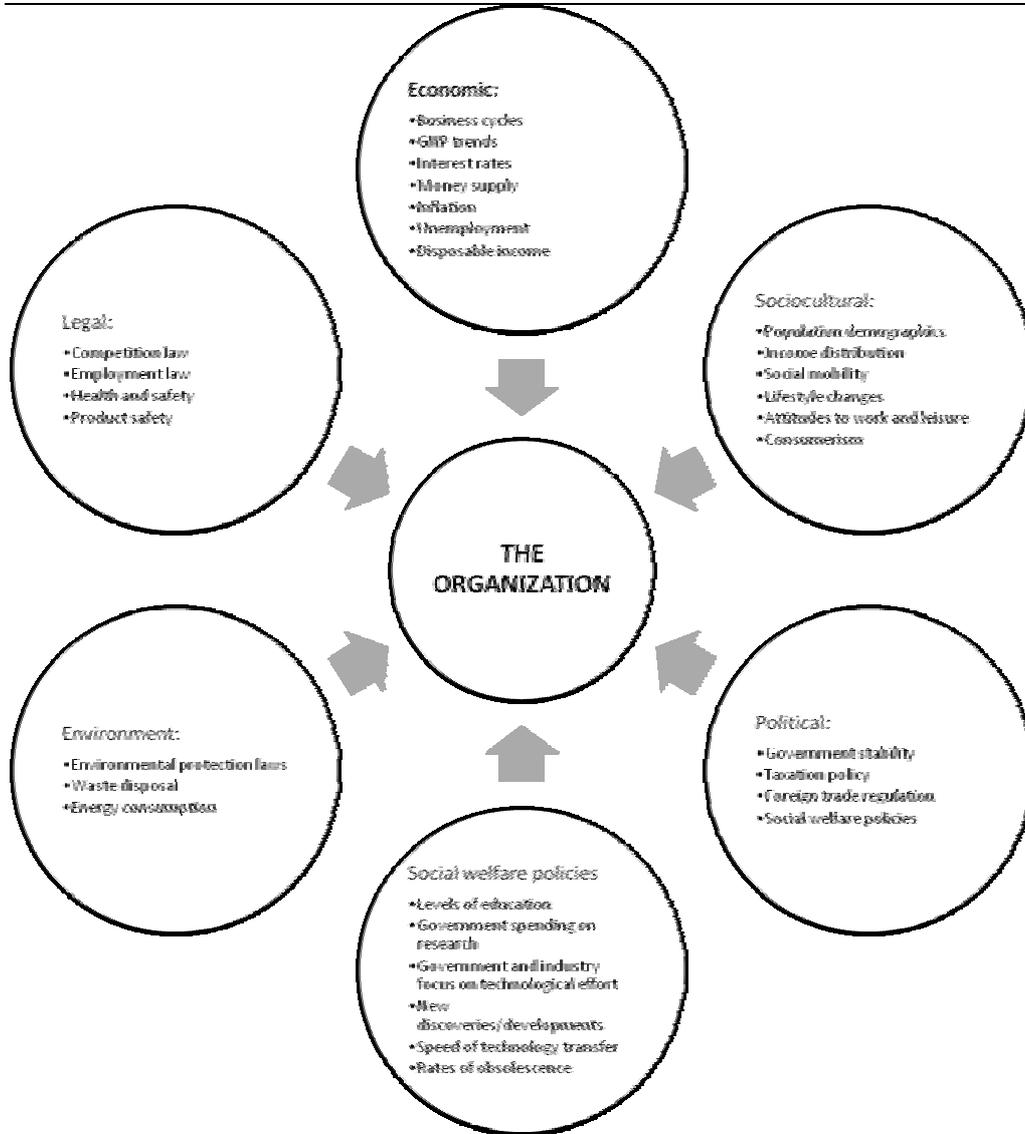
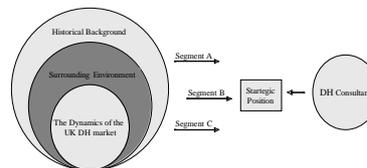


Figure 6. The PESTEL framework

4.3 Market Globalization

The first driver of change is considered to be market globalization. On certain markets consumer preferences and needs are becoming increasingly similar. As the markets become global, the players on these markets become global customers. The extensive development of global communication and distribution channels can be factors which drive globalization, in large part due to the increased use of the internet. The Internet creates an opportunity for transference of



Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

marketing across countries. This allows for expansion of a brand globally which can raise global demand and expectations from customers.³³

The second driver is cost globalization and can be a source of competitive advantage, since some organizations will be more aware or have more access to information regarding these advantages than others. There might be cost advantages to be found from experience which builds up from wide-scale operations. Country-specific cost, such as labor or exchange rates, can encourage companies to search globally for low cost options that match competitors who already hold an advantage due to location.³⁴

Globalization of government policies is considered the third driver of change and has been encouraged through technical standards between countries. In many countries the government encourages global players to act on their markets in order to increase globalization.³⁵

The fourth and final driver of change is Globalization of competition. With high levels of import and export between countries competition is increasing and driving globalization. If a company competes globally it tends to increase the pressure for competitors to become more globally active.³⁶

³³ Johnson, G. et al (2008), p.70

³⁴ Johnson, G. et al (2008), p.70

³⁵ Johnson, G. et al (2008), p. 71

³⁶ Johnson, G. et al (2008), p.71

Industrial Landscaping of District Heating
 Opportunities for knowledge transfer to the UK market

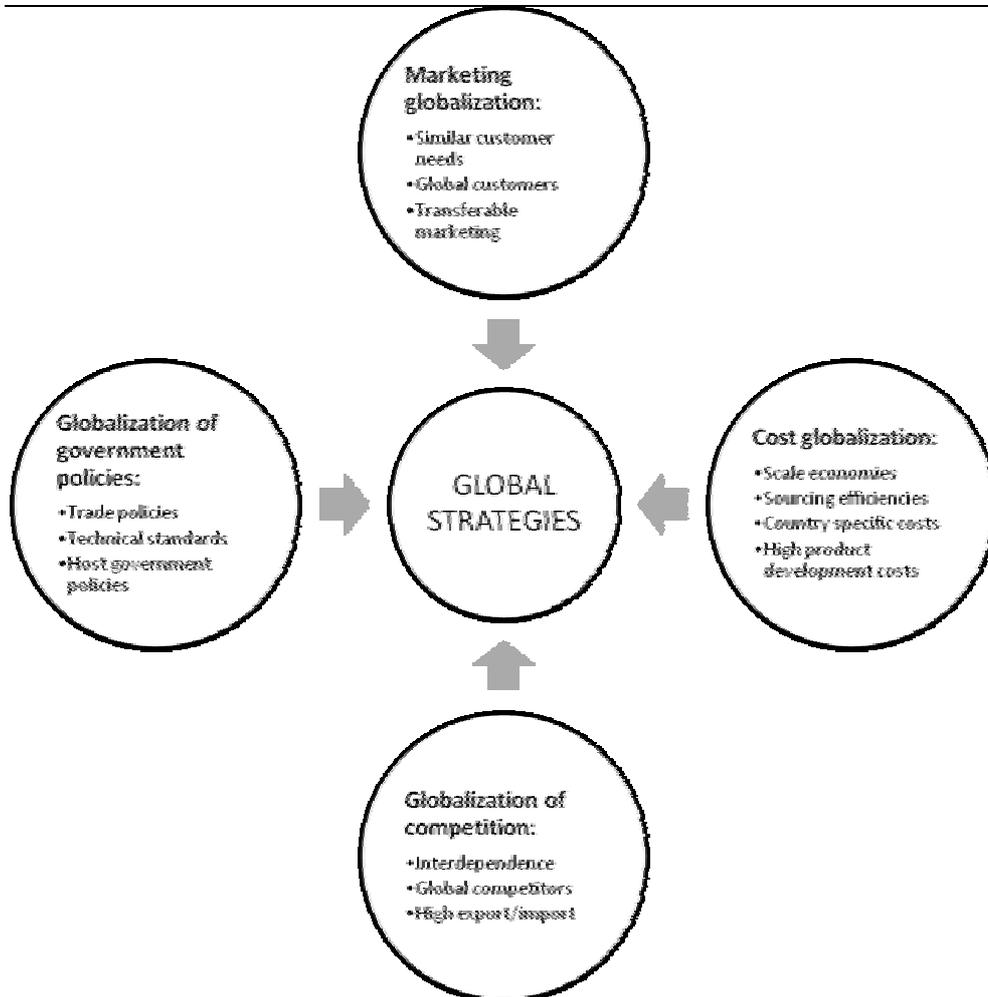
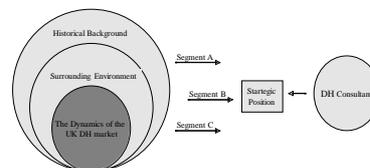


Figure 7. The key drivers of change

4.4 Porters Five Forces

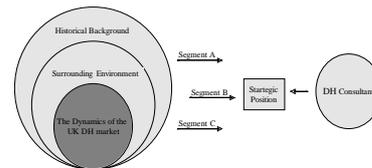


Business is all about gaining an advantage over ones competitors. Managers often underestimate the impact competitors can have on an organization. Michael Porter developed the *five forces framework* as a way of assessing the profit potential of an industry, and can be used as a tool to identify sources of competition in that industry or sector. The five forces considered in Porters framework are: threat of entry, threat of substitutes, the power of buyers and suppliers respectively, and competitive rivalry. Threat of entry refers to the extent to which there are barriers to entry identified on a given market. These barriers need to be overcome by new entrants in order for them

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

to compete successfully on the market, and are often seen more as delays rather than firm barriers preventing entry. The threat of substitutes deals with the availability of products similar to that of the company attempting to make an entry on the market. Consumer demand decreases as the amount of alternatives (i.e substitutes) increase. If substitution becomes too high there is a risk of products or services becoming obsolete. The power of buyers and suppliers are often dealt with as one uniform force as they can have similar effects on diminishing strategic freedom of the entrant. Buyer power is influenced by concentration, switching costs and threat of supplier acquisition. Supplier power is likewise influenced by concentration and switching costs, but at the same time forward integration (suppliers competing directly with customers). The fifth and final force to be considered is the cluster of competitive rivals facing a company hoping to enter a new market. Competitive rivals entail companies who supply similar products or services to the same target group. The degree of competitive rivalry is affected by balance, growth rates, fixed costs, exit barriers and differentiation between competitors.³⁷

4.5 Stakeholder theory



Since we are dealing with a network of variant stakeholders we have chosen to take a look at Freeman's stakeholder theory in order to get a clearer picture of the relationships between the various stakeholders.

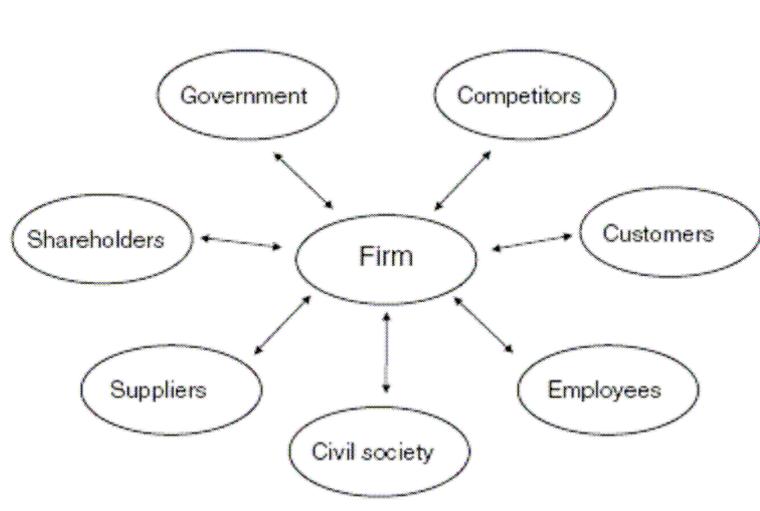


Figure 8. The Freeman stakeholder model (1984)

³⁷ Johnson, G. et al (2008), p. 82-84

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

According to Freeman a stakeholder is defined as any group or individual who “can affect or is affected by the achievement of an organization’s objectives”³⁸. Once the stakeholders are identified they are divided into three categories: stakeholders, pressure groups and regulators. Each of these groups has a distinct impact on and responsibility towards the firm.³⁹

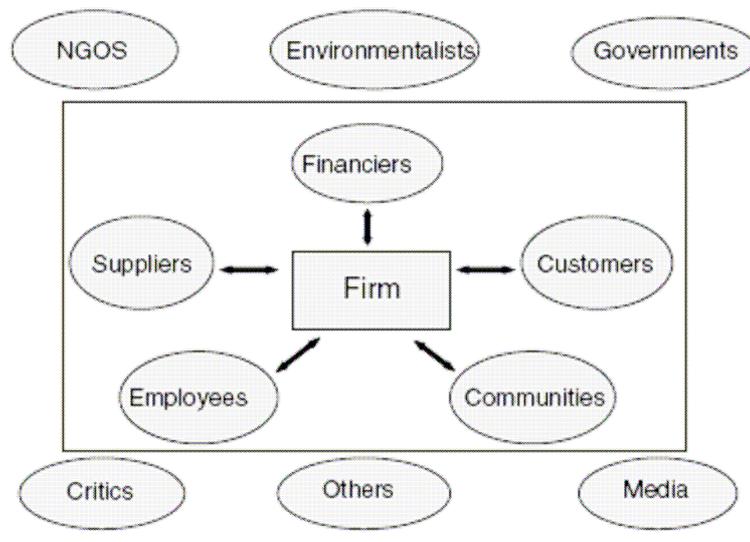


Figure 9. The adapted stakeholder model (Fassin 2009)⁴⁰

In 2003 Freeman adapted his own stakeholder model to include a wider variety of influences. He realized that it was not only the stakeholders within the firm that tended to execute control over the firm, but that stakeholders with a less direct connection could have immeasurable impact.⁴¹

Throughout the years there has been a vast variety of criticism of the original theory, declaring that it can be seen as “suffering from vagueness in scope and ambiguity due to the possible interpretation of the basic stakeholder concept in either narrow or broad senses”⁴².

³⁸ Freeman, E. (1984)

³⁹ Fassin, Y. (2009)

⁴⁰ Fassin, Y. (2009)

⁴¹ Fassin, Y. (2009)

⁴² Fassin, Y. (2009)

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Yves Fassin found that the grouping of stakeholders could be achieved in a clearer and more insightful way. He proposed that stakeholders should be divided into three new categories; stakeholder, stakewatchers and stakekeepers.⁴³

The first group is seen as the *real* stakeholders who have an actual stake and a genuine interest in the firm. The second group, the stakewatchers, are those who do not have an actual stake in the firm, rather they protect the interests of the stakeholders. Stakewatchers can be unions who protect the employees of a firm or associations that defend the stake of consumers. The last group consists of the stakekeepers who generally have no stake in the firm but are often in a position to execute control and influence. The stakekeepers are often governmental institutions who can, with the aid of legislations and laws, execute significant control over firms.⁴⁴

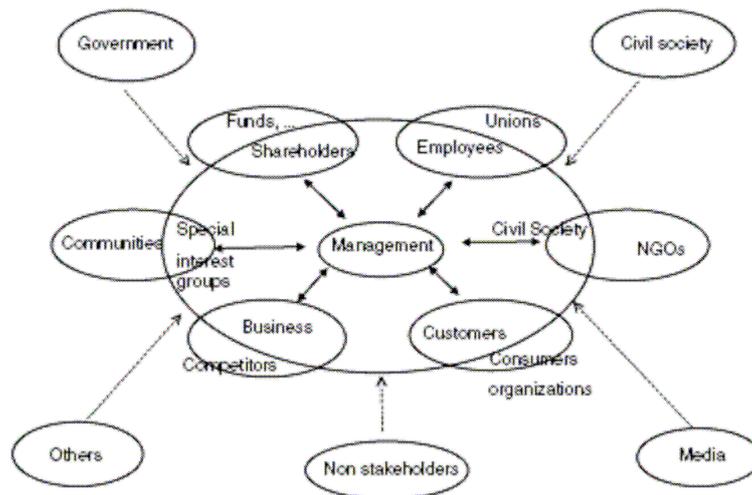


Figure 10. Fassin's stake model of the firm

Fassin adapted the Freeman model to fit his view of the stakeholders involved in a firm. In the model presented above stakeholders are placed in their appropriate oval circles in accordance to what their influence is over the firm. In the stake model the stakeholders within the large oval represent the firm. The next step out is considered the business environment which contains the stakewatchers. The wide spread oval, the stakekeepers, represent the social-political arena. According to Yassin the inner circle, the power of the firm dominates the stakeholders; whereas the stakewatchers located outside the firm have largest influence in their relationship with the firm.⁴⁵

⁴³ Fassin, Y. (2009)

⁴⁴ Fassin, Y. (2009)

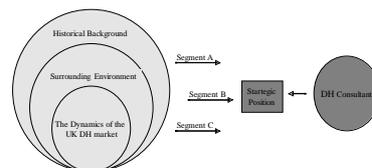
⁴⁵ Fassin, Y. (2009) p. 126

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Another strong critique of the original stakeholder theory is that it focuses too much on the organization itself. Why not, as Julia Roloff argues, look at a multi-stakeholder network, where stakeholders “interact in a non-hierarchical fashion with each other”⁴⁶.

Instead of focusing on one single organization and its needs and demands, in a multi-stakeholder network discussions circle around a common issue or concern. Roloff states that “in these networks actors from business, civil-society and governmental or supranational institutions come together in order to find a common approach to an issue that affects them all and that is too complex to be addressed effectively without collaboration”.⁴⁷ The argument for multi-organizational networks is that if no one realizes that there is a common problem needing to be solved, any individual solutions brought forth are bound to fail.⁴⁸ Another point brought to light by Roloff in regards to the multi-organization is the difference between organizational- and issue-focused stakeholder management. The main divergence is that organization-focused management places the firm and its objectives in the centre of attention whereas issue-focused management prioritizes approaching an issue which is relevant for several actors in the organization. Issue-focused stakeholder management is dominant in multi-organizations since it “enables corporations to address complex problems and challenges in cooperation with stakeholders”⁴⁹. In order for the multi-organization to be able to identify and enable a shared course of action, communication becomes a vital part of the interaction between stakeholders.⁵⁰ Roloff explains that in terms of dealing with conflicts, issue-focused management might be beneficial since it allows for a more flexible approach to the problem at hand.⁵¹ In conclusion Roloff states that “successful issue-focused stakeholder management has the potential to initial more sustainable solutions, because it builds social capital like trust, mutual understanding, knowledge about the issue and the experience of collaboration”⁵².

4.6 Consultancy services



The analysis model is constructed in the context of the potential of transferring knowledge to the UK district heating market by exporting consultancy services.

⁴⁶ Roloff, J. (2008) p. 238

⁴⁷ Roloff, J. (2008) p. 234

⁴⁸ Roloff, J. (2008) p. 240

⁴⁹ Roloff, J. (2008) p. 233

⁵⁰ Roloff, J. (2008) p. 245

⁵¹ Roloff, J. (2008) p. 246

⁵² Roloff, J. (2008) p. 246

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

According to Edvardsson et al, there are three main ways in which services differ from other consumer products. First and foremost services are often much more abstract. Services can be difficult for the supplier to explain to their customer, and at the same time as it may be difficult for customers to judge and test services being provided. Often the expectations on services are higher than what can be lived up to by the company providing them.⁵³ It is up to the supplier to control the customers' expectations and to create a realistic image of what a given service actually entails. Since services are abstract the customer usually judges them in accordance to what is reliable and concrete, which is why the service companies personnel can play a decisive role in closing deals. Often the service itself is strongly related to the supplier as a sales representative, meaning they need to be able to sell themselves as people and develop a trusting relationship with customers.⁵⁴

Secondly, services are often seen as a process in which the interaction between individuals plays a central role. This means that the ability to understand and to interact with customers is vital. The demands placed on service companies are usually miles from those placed on a standardize production company.

The last factor which sets services apart from other products is that the customer is directly involved in the production process, which is another reason why interaction with customers is so important. By keeping a close relation to the customer companies can make use of customer knowledge and improve their services to better fit the needs of their customers.

Entering a new market, regardless of the product being sold, will always be a difficult task. A combination of the above mentioned three factors are a large contribution to why globalization/internationalization of services can be more challenging than that of other products. Services are, as Edvardsson points out, very difficult to standardize partly due to the fact that they are often closely connected to individuals who are in turn culturally and socially rooted in their own environment. This then creates a problem of mobility, since there is a demand for local presence.⁵⁵ In order to expand globally, personnel must be acquired which can be a lengthy and time consuming process. Since the interaction with customers is such an important part of selling services, complications might occur due to cultural and linguistic barriers. According to Edvardsson at al. the quality of services is difficult to perfect and needs to be adapted to the diffuse receptibility and maturity of the new market.

According to Edvardsson et al research within services has made large advancements in Scandinavia. The so called "Nordic School of services" has become a well knows term. What is typical of the Nordic school is that much emphasis has been placed on a market and customer oriented view of developing services. Some of the

⁵³ Edvardsson, B. (1992), p. 10

⁵⁴ Edvardsson, B. (1992) p. 10

⁵⁵ Edvardsson, B. (1992) p. 12

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

revolutionaries in the subject include Christian Grönroos, Evert Gummesson and Richard Normann.⁵⁶

According to Edvardsson et al the internationalization process can be split into four stages. The first stage being the prospecting stage; where a company works with an open flow of knowledge in order to find new opportunities and to establish contact with new customers. Knowledge collection is made mainly through taking action and learning by doing, following the entrepreneurial strategy of basing what happens on what the company chooses to do. It comes down to the company itself creating an environment and thereby choosing an initial strategic direction.

The second stage is called the introductory stage, where the company attempts to organize and establish their business within one or more new geographical areas. The strategy becomes more limited in this stage. When developing on new markets the need for organizational creativity increase alongside the need to identify and establish relations with interesting customers.

The third stage is known as the consolidation stage where companies focus on consolidating and making their position on the new market more efficient. Established international business on each submarket will be conducted independently from other markets. This once again increases the need for organizational creativity, especially between submarkets and head offices. The most important aspect of this stage is the development of new clientele on the new markets. Though development of a new customer base, the company can start to focus on income as opposed to expenses.⁵⁷

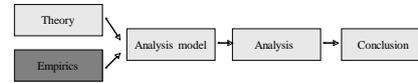
The fourth and final stage of the internationalization process is the development process, where the company adapts to local conditions on each specific market in order to develop a new strategy. Once the company has reached this stage they are again face with the demand of increased organizational and market driven creativity. If the company fails to create necessary growth during this stage, they will need to look into financial creativity in order to restructure and avoid economic difficulties.⁵⁸

⁵⁶ Edvardsson, B. (1992) p. 20

⁵⁷ Edvardsson, B. (1992) p. 21

⁵⁸ Edvardsson, B. (1992) p. 22

5 Technological background



This chapter presents a brief technological background to district heating and combined heat and power.

5.1 District heating

District heating is a technology for the distribution of centrally produced heat to residential houses, public buildings and commercial sites. The heat is then utilised for space heating by dint of radiators, air distribution systems and deliverance of hot water. District heating can also be applied to industrial purposes, but the conducted study has not focused on investigating the potential for this.⁵⁹

Heat can be generated from numerous sources of energy; including industrial processes, electricity generation, waste incineration or renewable/sustainable energy sources. A district heating system is flexible in its ability to derive heat from different sources and is therefore not locked into a specific fuel source. The large investments made in district heating are not tied to the fuel source but rather to the distribution system itself.⁶⁰

A district heating system is constructed based on an energy source where heat is generated, for example an energy station. Once this source has been located it will be connected to assorted properties through the medium of a heat distribution pipe network. When the heat reaches the desired property, heat is transferred via a substation (with heat exchangers, valves and other equipment) to the local property heating and hot water distribution systems. The outflow from the heat exchanger is then distributed back to the energy station and reheated. A metering system is employed to the heat exchangers within the substation and a connected customer will be charged based on the amount of heat delivered to the property. Heat storage has been adapted at uncounted locations to even out the heat demand throughout the day.

5.2 The economic principles of district heating

There is an economic principle based on calculating the difference between delivering heat centrally and individual heating systems. The cost for the centrally generated heat plus the distribution cost of heat cannot outweigh the fuel cost for locally generated heat.⁶¹

There are two basic needs required to fulfil this first economic principle:⁶²

⁵⁹ Svensk Fjärrvärme, 2009-05-07

⁶⁰ Frederiksen, S. and Werner, S. (1993) p. 71

⁶¹ Frederiksen, S. and Werner, S. (1993) p. 368

⁶² Frederiksen, S. and Werner, S. (1993) p. 368

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

- Primarily a high density heat demand is required in order to keep the heat demand per distribution cost low. The heat demand is typically measured in MWh/year per m² of land area or MWh/km/year per km of piping.
- The principles of district heating demand lower heat generation costs at a central location. It is therefore interesting to look at the disparate energy sources used. An uncostly or free of cost heat source could potentially drive the development of a district-heating scheme. It is important to look at the displacement cost of other heating alternatives to be able to define the economic potential for district heating.

A district heating system has a markedly surpassing lifespan than other energy investments. Financial calculations should always be contrived with the aid of whole life costing in order to recognize the true potential of a scheme. The technology is initially indubitably capital intensive and demands hefty up front funding from the owner. Figure 11 illustrates a comparison to conventional heating techniques.⁶³

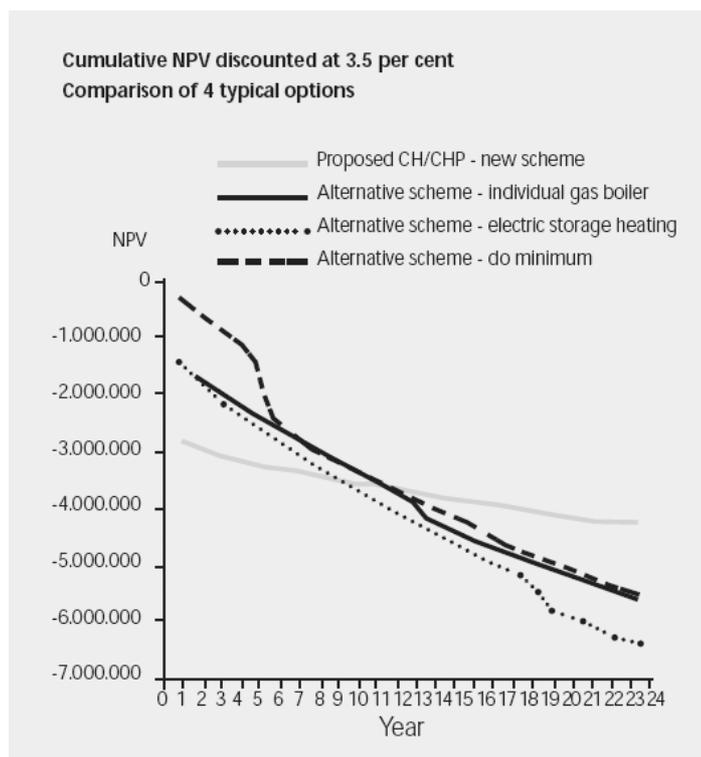


Figure 11. NPV comparison between district heating and conventional techniques⁶⁴

⁶³ Community heating – a guide, Energy Saving Trust, UK, 2004

⁶⁴ Community heating – a guide, Energy Saving Trust, UK, 2004

5.3 CHP technology

As previously mentioned, one of the principles of district heating is being able to access heat at an equitable price. Electricity produced in a steam turbine power station for electric power production, only uses about 40% of the energy input. Using surplus heat from the power generation processes is a way of conserving untapped heat in a sensible way. By replacing a local gas or electric storage heating system with a district heating system of this kind, the possibility for CO₂ emission reduction would also come into play. This technique of cogeneration of heat and power is sometimes called combined heat and power (CHP).⁶⁵

Figure 12 illustrates the difference in heat losses between separate heat and power and CHP generators. The comparison shows that the total utilization of combustion heat energy can increase from 50% to 80% using the same power outtake. The efficiency, of course, differs between particular CHP technologies.⁶⁶

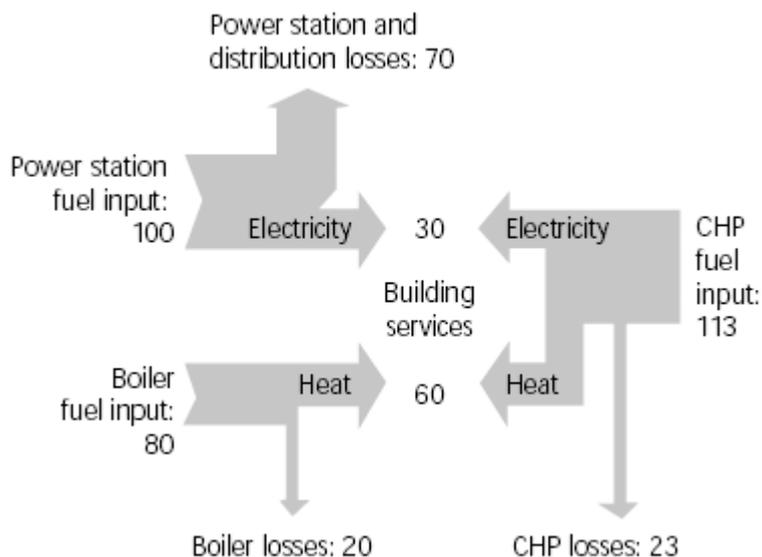


Figure 12. Energy balance for CHP and separate heat and power generation⁶⁷

By recovering heat from the generation process, close to 85% of fuel energy can be utilized. When combining a steam turbine plant the electric efficiency is only around 40%, which would decrease to about 30% if conservation of heat for district heating was put into use. A combined cycle with gas turbine in combination with steam cycle for electric power production only has an electric efficiency of about 55%, which will drop to about 50% efficient when recovering heat. These measures are assumptions

⁶⁵ International District Energy Association, 2009-05-08

⁶⁶ Community heating – a guide, Energy Saving Trust, UK, 2004

⁶⁷ Community heating – a guide, Energy Saving Trust, UK, 2004

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

that alter depending on where in the process heat is taken out and at what temperatures.⁶⁸

	Steam turbine	Combined cycle
Power generation solely	40%	55%
Power generation with CHP	30%	50%
Heat generation with CHP	55%	30%

Table 2. Energy efficiency by different technologies

The difference in CHP technologies is described by the following figures, and the technology difference between combined cycle and steam turbine cycle is presented.

The steam turbine cycle relies on a closed cycle where a wide variety of fuels can be employed. Fuel is combusted, which in turn heats up water to steam which then generates electricity in a turbine.⁶⁹ A combined cycle in its common form means that power is taken first from a gas turbine and then from a steam turbine.⁷⁰

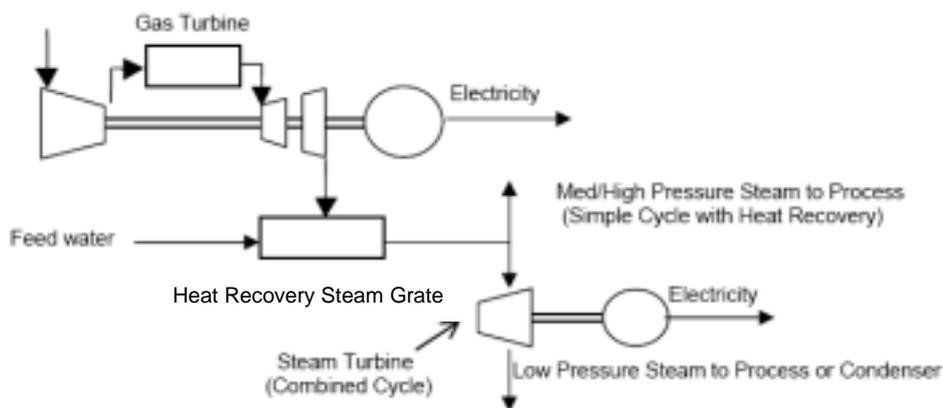


Figure 13. Heat recovery from a gas turbine system (combined cycle supplying steam for a process)⁷¹

Figure 13 shows a plant in which heat is being extracted to provide heat energy to a process. Additional heat can be recovered from the cycle when low pressure steam gives off heat to a condenser connected to a district heating network. Otherwise, heat

⁶⁸ Svend Frederiksen, Professor Lund University, Department of Energy Sciences, 2009-04-17

⁶⁹ Technology Characterization: Steam Turbines, Energy and Environmental Analysis, USA, 2008

⁷⁰ Technology Characterization: Gas Turbines, Energy and Environmental Analysis, USA, 2008

⁷¹ Technology Characterization: Gas Turbines, Energy and Environmental Analysis, USA, 2008

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

generated at steam condensation will be wasted.⁷²

Steam plants are used within a wide variety of variously sized schemes, while the use of combined cycles, normally run on natural gas, is reserved for bigger plants only. Gas (reciprocating) engines are sometimes used for smaller CHP plants (below 20 MW electric power).⁷³

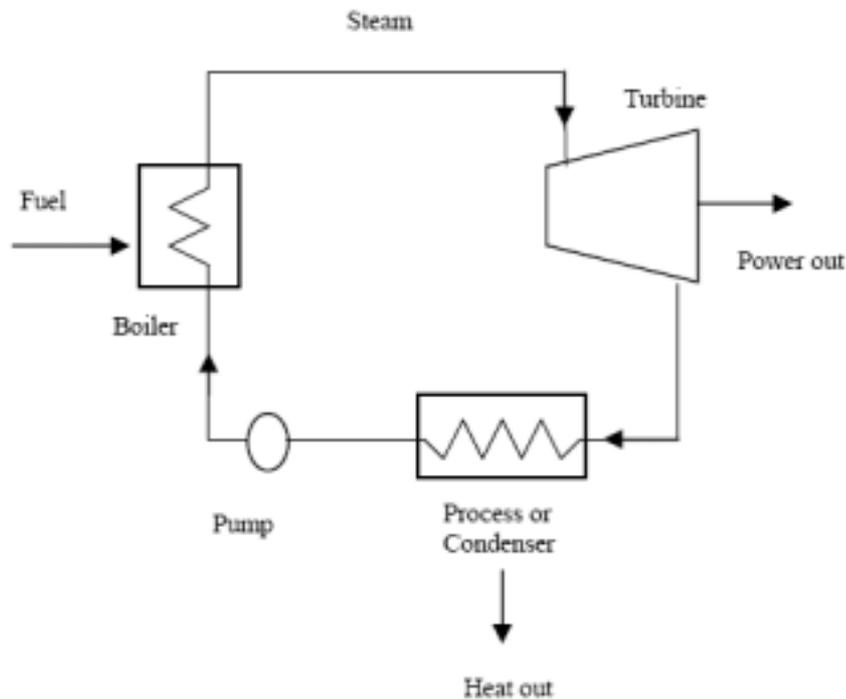


Figure 14. Simplified steam power plant layout⁷⁴

The design of the energy station needs to be according to heat demand and a district heating scheme will need peak-/back-up boilers that can deliver heat when heat demand is profoundly high (at low outside air temperature, otherwise mornings and afternoons). The boilers will also serve to assure reliable output whenever technical difficulties at the original energy station arise. The scheme can also be designed to generate an as even demand as possible by connecting contrasting heat loads, for example by connecting both residential and office buildings. Heat storage can as mentioned avail to even out demand throughout the day.

⁷² Svend Frederiksen, Professor Lund University, Department of Energy Sciences, 2009-04-26

⁷³ Svend Frederiksen, Professor Lund University, Department of Energy Sciences, 2009-04-26

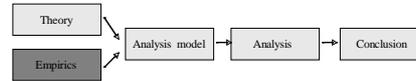
⁷⁴ Technology Characterization: Steam Turbines, Energy and Environmental Analysis, USA, 2008

5.4 District cooling

The principle of district cooling is to produce cooling during the warmer months of the year. With the aid of district cooling the energy station's capacity can be utilized even when heat demand is low. The principle is similar to that of district heating, but cold water is distributed through a cooling network to a cooling central at the connected property. The cold water can be used to propel air conditioning systems.⁷⁵

⁷⁵ Svensk Fjärrvärme, 2009-05-07

6 The history of district heating in the UK



This chapter presents a background to the UK district heating market in order for the reader to gain an understanding of what underlying factors have shaped and influenced the market to reach its current state.

6.1 The start of district heating

District heating began in the UK in the late 1920's with the Dundee and Sterling schemes being built in Scotland.⁷⁶ During the 1960's and 70's close to 500 schemes were developed throughout the region. Local authorities were responsible for this development and the vast amount of newly built housing estates was the main driver.⁷⁷

Due to the fact that the majority of schemes were oil fired, the oil crisis in 1973 put a swift end to the rapid development of district heating in the UK. The schemes that were established struck major difficulties due to high energy costs and lack of funding to allow for a switch to alternate fuels. Tenants became unsatisfied and elected to switch to individual heating systems. The schemes ran in to trouble because of faulty boiler installation and pipe work, inefficient boilers, dysfunctional metering systems and paltry management. During this same time district heating continued to bloom and flourish in many parts of Europe, but for some reason it did not take off in the UK.⁷⁸

Not only was the lack of successful schemes hindering the development of district heating, but a large inhibitor proved to be the political system. The UK local authorities access limited funding possibilities in large part due to the fact that the taxation system is connected directly to the UK government.⁷⁹

According to Collier U. et al, the autonomy of Swedish local authorities is considered much greater than that of UK local authorities. Swedish local authorities developed municipal energy plans in 1977 as a response to the oil crisis, which has continued to develop ever since. The municipal ownership of energy distribution companies who in turn own and operate district heating schemes is one of the reasons why district heating technology development has been a possibility in Sweden. The lack of financial independence of UK municipalities is one of the significant differences between the situation as seen in the UK and Sweden. UK municipalities have no influence over energy companies and their main focus is profit oriented.

⁷⁶ Babus'Haq, R. F. et al (1996)

⁷⁷ International Energy Agency, 2009-05-08

⁷⁸ International Energy Agency, 2009-05-08

⁷⁹ Collier, U. et al (1997)

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Municipalities in Sweden, on the other hand, have the possibility to weigh in both social and environmental benefits into their financial calculations.⁸⁰

Collier U. et al claim that municipalities have little or no say in energy and environmental issues. If a local authority presents genuine interest in getting involved in energy distribution either through ownership or cooperation with the private sector, the Government will not allow them the use of accumulated capital in order to invest. Collier U. et al also state that there is a clear lack of competence regarding such investments within local authorities.⁸¹

The history of gas findings in the Northern Sea was very important for the energy system in the UK. At that time it seemed an affordable, clean and reliable source of energy. Therefore gas is the main source of energy for space heating in the UK today and is important in terms of competing energy system to district heating. Hence, since 2004 (see Figure 15) the UK has become a net importer of gas.⁸² Due to both economical and reliability reasons this can be a potential driver of change of the UK energy system.

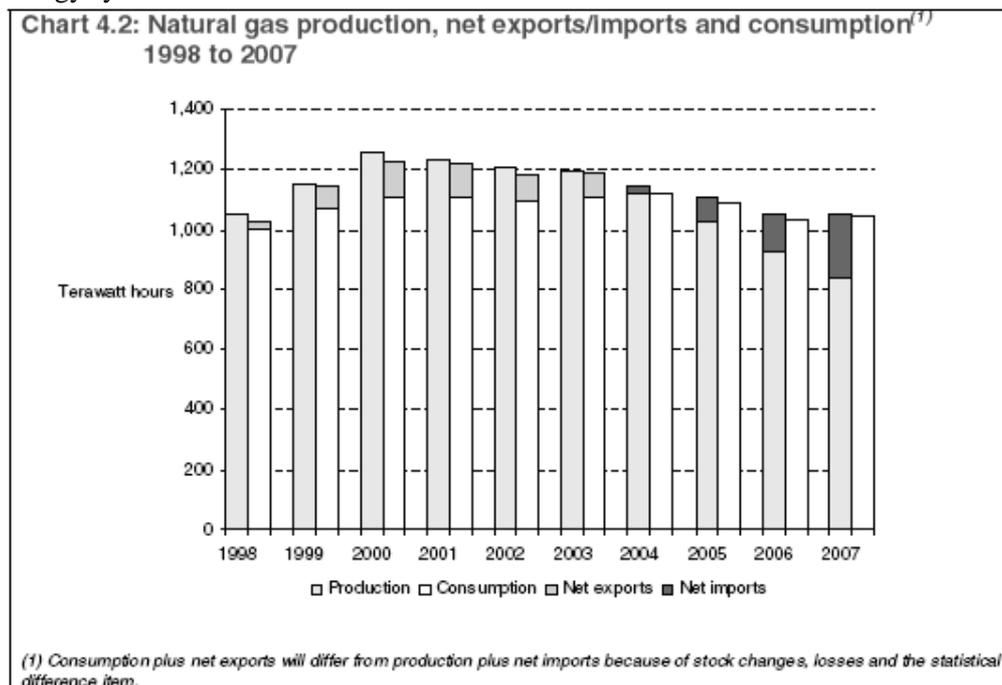


Figure 15. National gas production UK⁸³

⁸⁰ Collier, U. et al (1997)

⁸¹ Collier, U. et al (1997)

⁸² Digest of the United Kingdom Energy Statistics, Department of Business Enterprise and Regulatory Reform, UK, 2008, Chapter 4: Gas, page 6

⁸³ Digest of the United Kingdom Energy Statistics, Department of Business Enterprise and Regulatory Reform, UK, 2008, Chapter 4: Gas, page 6

6.2 Privatization

In 1990 electricity privatization was implemented in the UK, leading to the break-up of the monopoly held by the Central Electricity Generating Board (CEGB). By 1998 there was retail supply of electricity available to all competitors on the market. In 2000 the pool-pricing system was replaced by bi-lateral trading and privately organized markets, known as the British Electricity Transmission and Trading Arrangement (BETTA). The large bulk of electricity today is traded through internal deals between large electricity companies who, outside of supplying energy, possess their own generation units. Some of the energy is traded between the main electricity suppliers and sizable generators with the aid of long-term contracts. All generators over 50 MWe have to be registered to meet conditions of the balancing and settling code (BSC).⁸⁴

CEGB's monopoly was ended, and the Government was hoping to introduce competition wherever possible. Twelve new regional electricity companies (REC's) replaced the twelve area boards and were pushed to promote competition. With the aid of competition the Government believed the REC's would have stronger initiatives to pursue energy systems for local generation and to handle peak demand in order to get away from bulk generation. The REC's started promoting independent power station projects.⁸⁵ The CHP market was affected by the arrival of large players willing to make large investments who had the financial capability to provide end users with alternatives to direct investment.⁸⁶

6.3 The start of CHP

Combined heat and power generation is an important technology for heat generation in district heating schemes in the UK. Contrary to Sweden, where the use of boilers has been the most common⁸⁷, nearly all schemes in the UK are powered by CHP.⁸⁸

CHP has been identified as offering significant economic benefits, especially in processes with substantial steam demand (paper, chemical and food). The majority of the currently installed CHP systems are, as previously stated, found in the industrial sector, and just about all of the investments have taken place on sites where existing boilers needed replacing. This allowed for reduced incremental costs and improvement in economic paybacks. Few of the sites involved power export and were sized purely to meet requirements of the location.⁸⁹ The CEGB were pushing for

⁸⁴ Toke, D. et al (2008)

⁸⁵ Harvey, K. (1994) p.179

⁸⁶ Harvey, K. (1994) p.180

⁸⁷ District Heating and Cooling country by country/2007 survey, Euroheat and Power

⁸⁸ Appendix III: Case studies Scotland and Appendix IV: Case studies England

⁸⁹ Harvey, K. (1994) p.180

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

economies of scale and wanted large plants in remote locations to provide for extensive areas, hoping to improve the efficiency of coal fired conventional plants. The differences between fuel and power prices were widening. The 1983 Energy Act offered a greater degree of flexibility and control to end users. By the time the electricity industry was privatized, the concept of CHP was primed for further development and many of the new players created by privatization had recognized this.⁹⁰

Essentially, it is not deemed practical (under the British Electricity Transmission and Trading Arrangement) for small CHP units to trade directly on the open power markets, and as a result they suffer significant reductions in income for exported electricity. There is considerable administration involved in registering projected production alongside significant credit conditions implemented on participation in trades which further complicate the situation.⁹¹ CHP operators are reluctant to attempt connection to the main grid due to the possibility that they may suffer severe penalties for failing to generate in accordance with projected production. Many CHP district heating units have fluctuations in on-site electricity demand making it difficult to deliver sufficiently accurate projections.⁹²

CHP's are exempt from paying Climate Change Levy (CCL) on both fossil fuels and electricity.⁹³ In addition, a minimum limit has been established which allows export of power up to 500 kWe without a supply license.⁹⁴ CHP operators receive full retail value for the electricity they are able to sell on-site and the CHP plants benefit from so called 'enhanced capital allowance'. Enhanced capital allowance means that companies who chose to install CHP can write off taxes on possible profits the year the investment was made. However, this incentive is unconvincingly strong enough to balance out the problems faced by CHP operators attempting to obtain a fair price for the electricity sold to the grid.⁹⁵ David Toke states that "*the CCL exemption on CHP electricity exports, worth around £4 per MWh to a CHP operator, is less than the say, £10 per MWh that might be lost compared to a power market price of £40 per MWh that a power station would earn for the same amount of produced electricity.*"⁹⁶

The way the system is built today CHP operators are given negative rewards for their environmental contribution. The lack of incentives for CHP operators to sell electricity to the grid encourages scheme designers to keep CHP's to a small scale. It appears that under the current system it is the most profitable to operate CHP's that are have an output of less than 50 MWe.⁹⁷

⁹⁰ Harvey K. (1994) p.181

⁹¹ Toke D. et al (2008) p. 1449

⁹² Toke D. et al (2008) p. 1449

⁹³ Toke D. et al (2008) p. 1450

⁹⁴ McNaught C. (1998)

⁹⁵ Toke D. et al (2008) p. 1450

⁹⁶ Toke D. et al (2008) p. 1450

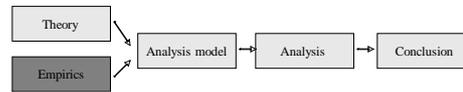
⁹⁷ Toke D. et al (2008) p. 1450

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

In 2006 the Government introduced an obligation for new development of power generators to investigate the potential for CHP.⁹⁸ This type of legislations has historical had low impact on the development of district heating. Developers have commissioned consultants to make feasibility studies that say that there is now offset for heat and therefore no possibility for CHP.

⁹⁸ CHP/DHC Country Scorecard: United Kingdom, International Energy Agency and AEA Technology, 2007

7 The current and predicted situation of district heating in the UK



This chapter presents data describing the size of the UK CHP and district heating markets. It also provides insight into the predicted development of the district heating market as well as that of competitive energy sources.

7.1 Size of the UK CHP market

The district heating debate in the UK is strongly intertwined with the development of CHP. Most of the heat utilized for district heating is generated through CHP, as opposed to in Sweden where only 20% of heat load is derived through the use of CHP.⁹⁹ The efficiency in cogeneration of heat and power makes CHP technology interesting to the district heating market and thus follows a presentation of CHP plant market size in the UK. Far from all CHP stations are connected to district heating, many of them function as an electricity generator and heat supplier for industrial sites in need of both energy sources.

The UK Government believes that development of CHP will spur reduction of CO₂ emissions and the Climate Change Program, produced in 2004, presents a target of achieving at least 10,000 MW of electricity produced through CHP by 2010. The current capacity is measured at 5700 MWe.¹⁰⁰

A program called Good Quality CHP (GQ CHP) works with assuring CHP facility quality, with the goal of achieving good energy efficiency within CHP. While the target is to increase CHP usage, the growth of GQ CHP has slowed over the past couple of years and showed a noteworthy decrease between 2006 and 2007.¹⁰¹ The current trend of CHP development will make it very difficult for the UK to reach the 2010 target of 10,000MWe installed capacity.

The following figures present the allocation of variously sized CHP facilities in the UK. Facilities smaller than 1 MWe are represented as micro-CHP system, 1MWe-10MWe facilities are named large community heating systems, and smaller industrial systems and facilities larger than 10MWe are denoted as large industrial CHP

⁹⁹ District Heating and Cooling country by country/2007 survey, Euroheat and Power

¹⁰⁰ The Government's Strategy for Combined heat and Power to 2010, Department of Environment Food and Rural Affairs, UK, 2004

¹⁰¹ Digest of the United Kingdom Energy Statistics, Department of Business Enterprise and Regulatory Reform, UK, 2007

¹⁰¹ CHP/DHC Country Scorecard: United Kingdom, International Energy Agency, AEA Technology, 2007

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

schemes.¹⁰²

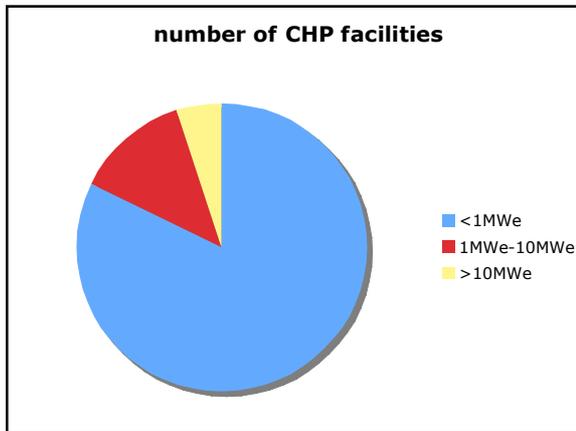


Figure 16. Number of CHP facilities by size

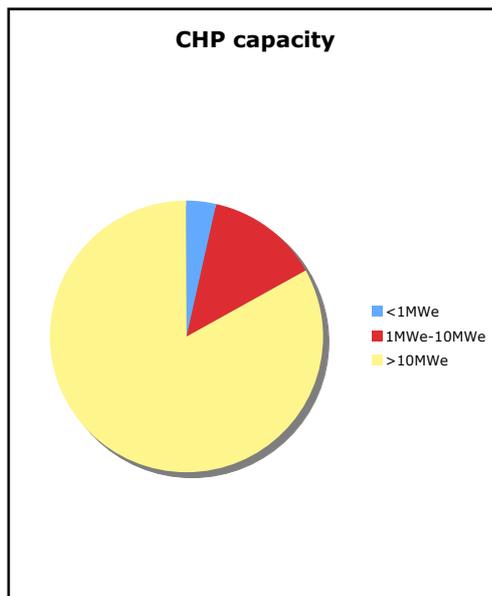


Figure 17. CHP capacity by size

Out of a total CHP installation of 5700MWe only 13% are represented by facilities placed in the community heating and small industrial applications category.¹⁰³

¹⁰² Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007, chapter 3

¹⁰³ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007, chapter 3

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

If the target for 2010 of 10,000MWe of GQ CHP is going to be reached the development of CHP will be 4300 MWe. If we assume same size distribution the 2010 target would require 560MWe of new mid-size CHP installations (1MWe-10MWe). Presuming all of these projects are for district heating we can calculate the maximum increase in CHP to land somewhere around 150 new CHP schemes by the end of 2010. This must be seen as a maximum estimation since the target will most likely not be achieved and not all mid-size CHP is connected to district heating.

In BERR's (The Department of Business, Enterprise & Regulatory Reform) "Digest of the Energy Statistics 2007", the industrial sector represents 90% of total CHP electricity capacity, whereas only 4% is represented by "other sectors", including district heating, see Figure 18.¹⁰⁴ Using the same assumptions as in the previous calculation, the maximum increase of CHP purposed for district heating by 2010 would be 170MWe and 45 new installations.

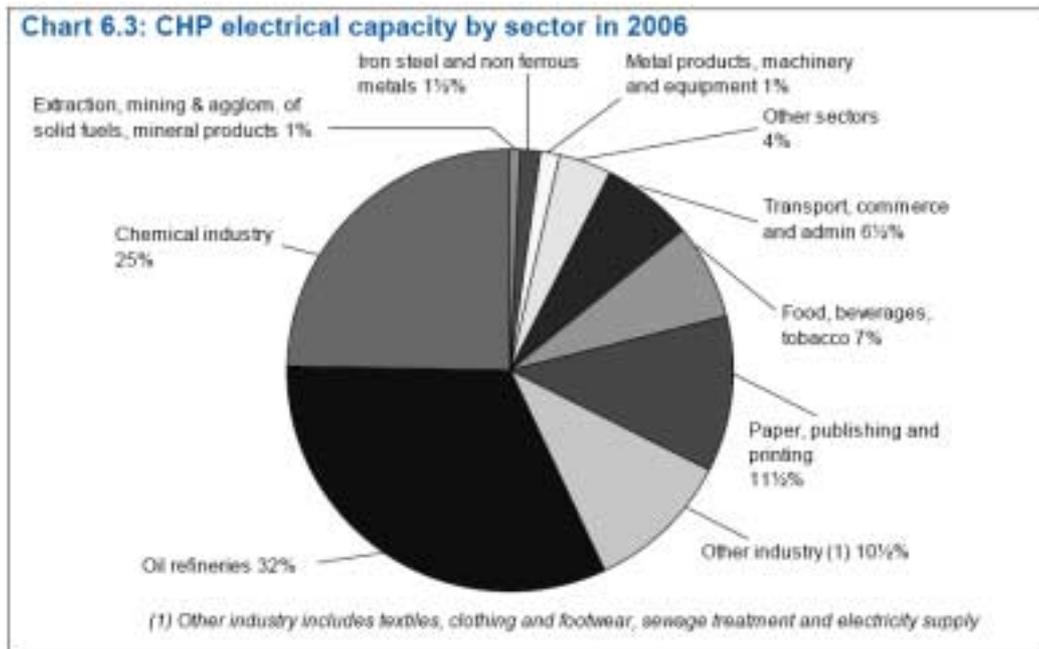


Figure 18. CHP electrical capacity by sector in 2006¹⁰⁵

¹⁰⁴ Digest of the United Kingdom Energy Statistics, Department of Business Enterprise and Regulatory Reform, UK, 2007

¹⁰⁵ Digest of the United Kingdom Energy Statistics, Department of Business Enterprise and Regulatory Reform, UK, 2007

7.2 Size of the UK district heating market

Heat is responsible for 47% of annual CO₂ emissions (equivalent to 71 MtC/year) in the UK. 12% of the UK CO₂ emissions come solely from heat losses within electricity generation.¹⁰⁶ CHP-plants in combination with district heating could therefore be a solution to emission reduction.

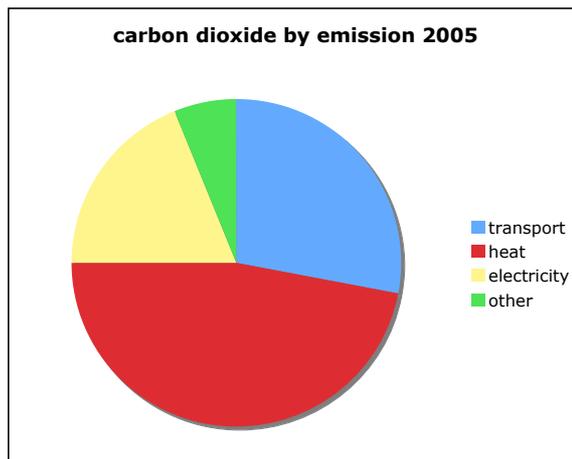


Figure 19. Carbon dioxide by emission in 2005¹⁰⁷

UK heat use is divided into six categories, with space heating being the largest; a total of 54%. 4% of space heating is in its turn distributed through district heating networks i.e. a mere 2% of the total heat demand according to BERR.¹⁰⁸

¹⁰⁶ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007, chapter 3

¹⁰⁷ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007, chapter 3

¹⁰⁸ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007, chapter 3

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

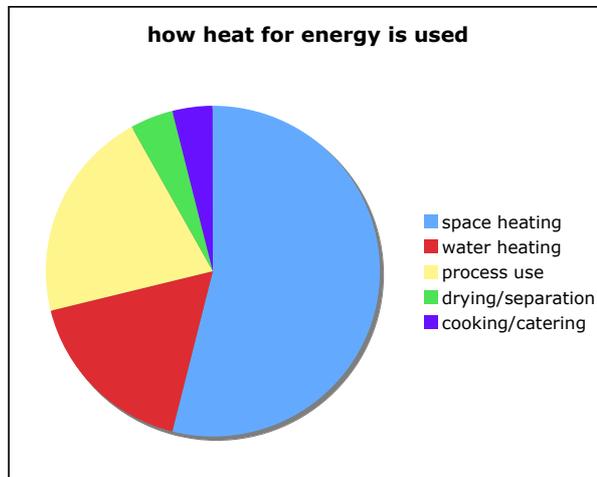


Figure 20. Distribution of heat demand¹⁰⁹

According to BERR most UK homes are gas heated. In 2004 close to 77% of homes were registered to be users of gas heat whereas a mere half a million homes (about 2 % of all housing) were heated through district heating.¹¹⁰ Defra's (The Department for Environment, Food and Rural Affairs) 2008 "Heat Call for Evidence" report divides district heating into sectors of space heated, see Figure 21. The industrial sector encompasses roughly 45% of the district heating load and the remaining 55% is district heating for community purposes. District heating for housing purposes only stands for about 0,6% (social housing 0,2% and private housing 0,4%).¹¹¹

¹⁰⁹ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007, chapter 3

¹¹⁰ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007, chapter 3

¹¹¹ Heat call for evidence, Department of Business Enterprise and Regulatory Reform, UK, 2008, chapter 6, p. 66

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

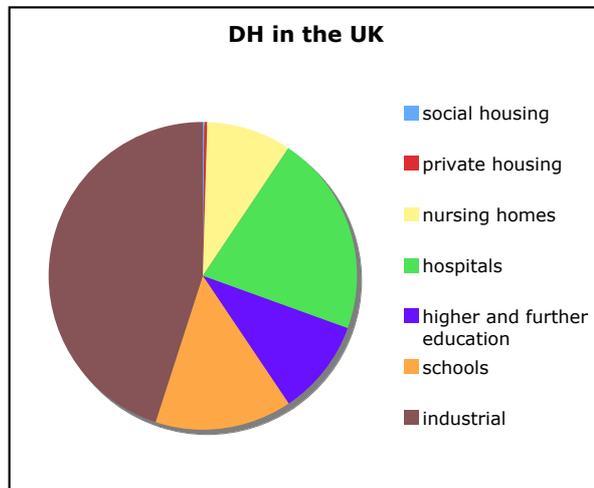


Figure 21. Distribution of district heating in the UK¹¹²

According to “Heat call for evidence” the total district heating market share equates to about 1% of total heat demand in the UK.¹¹³ According to “AEA-report” the total current market of district heating for housing is 4TWh per year and equivalent to 1% of the residential heat demand.¹¹⁴

The limited use of district heating manifests that it is indeed a niche technology in the UK; however due to the size of the country and current number of district heated homes it cannot be considered a negligible market.

The UK total heat demand is about 740 TWh/y distributed over 452TWh/y (61%) for residential demand, commercial 205TWh/y (28%) and industrial demand 81TWh/y (11%).¹¹⁵ The market for residential and commercial purposes 657TWh/y is the total heat market that is considered in this report. The following figures further categorize the residential and public markets into sectors.

¹¹² Heat call for evidence, Department of Business Enterprise and Regulatory Reform, UK, 2008, chapter 6, Primary source: Desk study on heat metering: EC Directive on Energy End Use Efficiency, Department of Environment Food and Rural Affairs, 2007

¹¹³ Heat call for evidence chapter 6

¹¹⁴ AEA report– Renewable Heat and Heat from CHP Plants – Study and Analysis, p. 30

¹¹⁵ Renewable heat initial business case, Department of Business Enterprise and Regulatory Reform and Department of Environment Food and Rural Affairs, UK, 2007

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

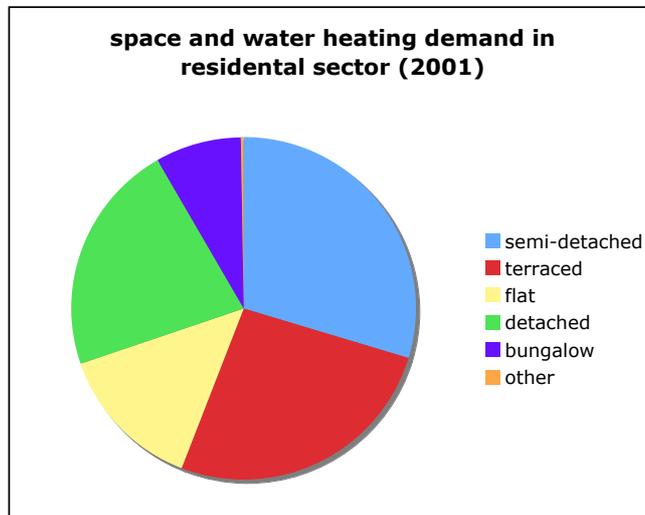


Figure 22. Space and water heating demand in residential sector in 2001¹¹⁶

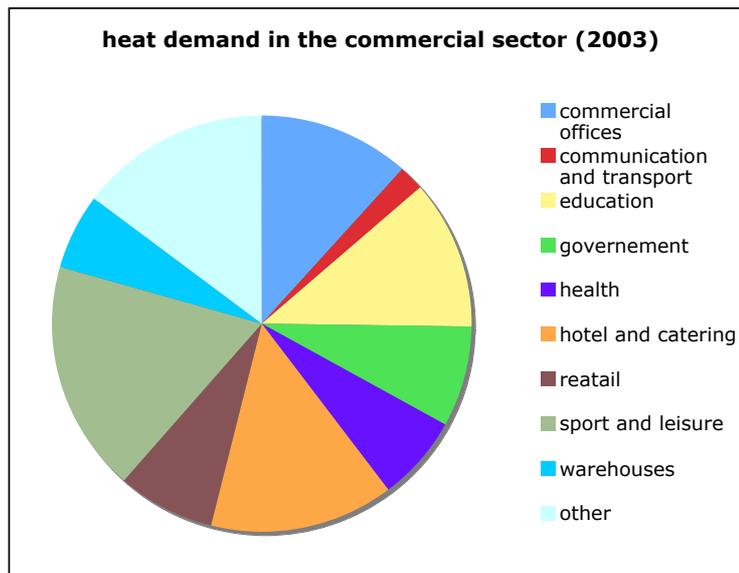


Figure 23: Heat demand in the commercial sector in 2003¹¹⁷

¹¹⁶ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 17

¹¹⁷ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 19

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

7.3 Predicted market growth of CHP and district heating

In this section the predicted market for CHP in general and CHP for community purposes in specific is summarized. Existing reports showing predicted market size have been utilized to sum up the potential. The first section of the predicted market refers to CHP applications. The Heat Call for Evidence Report refers to all breeds of district heating.

According to the Defra report “Analysis of the Potential for Combined Heat and Power¹¹⁸ district heating in the industrial sector has a markedly greater growth potential than in the public/private sector. The prediction of the capacity in the public/private sector in 2015 is a mere 0,6TWh/year heat compared to the total prediction in the industrial sector which lies at 94,3TWh/year¹¹⁹ (see Table 3). It is also evident that Defra believe in superior profitability for industrial investments. The calculations (presented in Table 3) for the public/private sector are based on a 9% discount rate, compared to 15% when predicting district heating in the industrial sector.¹²⁰

Scenario	Delivered Energy (TWh)		Capacities (MW)		Energy Savings (TWh)
	Heat	Electricity	Heat	Electricity	
Low temperature industry	70	55	8646	6808	37
High temperature industry	0.48	0.53	120	130	0.5
Other industries (Refineries & LNG)	11.0	19.2	1150	2300	10.4
Buildings (GB only)	11.8	6	2456	1228	8
CH (9% DR)	0.6	0.5	67	56	0.4
Buildings NI	0.4	0.2	90	45	0.3
Total*	94.28	81.43	12,529	10,567	56.6

Table 3. Prediction of district heating in difference sectors using interest rates 15% except from the public/private sector which uses a 9% interest rate.¹²¹

In the same Defra report the potential within three different scenarios of discount rates was calculated. With decreasing discount rates the potential capacity of CHP for the public/private sector increases rapidly. Predicted heat capacity is 0,6TWh (9%),

¹¹⁸ AEA report for the Department for Environment, Food and Rural Affairs (Defra), Analysis of the UK potential for Combined Heat and Power (October 2007), p. 22

¹¹⁹ AEA report for the Department for Environment, Food and Rural Affairs (Defra), Analysis of the UK potential for Combined Heat and Power (October 2007), p. 22

¹²⁰ AEA report for the Department for Environment, Food and Rural Affairs (Defra), Analysis of the UK potential for Combined Heat and Power (October 2007), p. 21

¹²¹ AEA report for the Department for Environment, Food and Rural Affairs (Defra), Analysis of the UK potential for Combined Heat and Power (October 2007)

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

150TWh (6%) and 230TWh (3%) (see Table 4). A lower discount rate reduces the importance of capital costs and increases the capacity of the CHP for a given heat demand.¹²²

CH/CHP potential	Units	3.5%	6%	9%
Total net CH/CHP Potential for UK	MW _e	33,125	21,517	75
Number of postcode sectors	-	6,897	4,204	46
Total electricity produced	GWh p.a.	189,472	123,119	518
Total heat sold	GWh p.a.	230,358	149,686	630
Primary Energy Saving	GWh p.a.	159,881	103,890	437

Table 4. Potential of district heating from CHP in the public/private sector, using different interest rates (3,5%, 6% and 9%).¹²³

It is clear that the use of CHP in the public/private sector requires a discount rate of 6% or lower. A private company therefore faces difficulties when investing in these types of projects since they normally require higher returns on investments. A public owner is more likely to be able to realise the predicted projects when it comes to the required discount rates.

The BRE (Business and Research Enterprise) have also made calculations regarding the potential for district heating with CHP in the UK. They present calculations showing a potential of district heating in the public/private sector lying somewhere between 787MWe and 18,263MWe of installed CHP capacity.¹²⁴ Compared to the current CHP capacity of 5700MWe the predicted market is awfully ambivalent and requires discount rates of less than 6% to make a significant difference in the size of the market.

BRE predict that the majority of future schemes will be located in major cities that are already equipped with district heating schemes. Table 5 presents a list of the cities that BRE consider to have the greatest potential for large-scale implementation of district heating.¹²⁵

¹²² AEA report for the Department for Environment, Food and Rural Affairs (Defra), Analysis of the UK potential for Combined Heat and Power (October 2007), p. 16

¹²³ Analysis of the UK potential for Combined Heat and Power, Department of Environment Food and Rural Affairs, UK, 2007

¹²⁴ The UK Potential for Community Heating with Combined Heat and Power, Business and Research Enterprise (BRE), UK, 2003, p. 8

¹²⁵ The UK Potential for Community Heating with Combined Heat and Power, Business and Research Enterprise (BRE), UK, 2003 p. 9

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

Location	CH/CHP potential MW _e		
	6%	9%	12%
London postcodes	2,448	460	206
Birmingham postcodes	815	123	33
Manchester postcodes	466	72	37
Sheffield postcodes	356	73	32
Southampton postcodes	204	49	20
Leicester postcodes	393	48	17
Liverpool postcodes	171	46	25
Leeds postcodes	251	40	16
Bristol postcodes	272	38	12
Newcastle postcodes	441	29	18
Cardiff postcodes	194	42	6
Glasgow postcodes	222	29	11
Edinburgh postcodes	134	18	7
Belfast postcodes	234	31	12
Other UK cities	11,851	1,343	477
Sub-total	18,453	2,441	929
Less existing CHP capacity ^d	190	152	142
TOTAL	18,263	2,289	787

Table 5. Areas with sizable potential for district heating, estimated by BRE.¹²⁶

At a 6% discount rate the potential is significant (18,300 MWe) and shows that the UK, with its predominance of high-density urban development, is suitable for district heating.¹²⁷

According to the prediction models used, an economic barrier to development of CHP for the public/private sector has been identified. This barrier could potentially be reduced by means of lowered capital cost, lowered lending cost, lowered gas prices and increased electricity prices. The effect of the latter two has proven, with the aid of a sensitivity analysis, to be exceedingly congruous for the predicted market situation.¹²⁸

BERR have after various calculations come to the conclusion that the potential for district heating in the UK accumulates to heat distribution to somewhere between 5.5 and 6.5 million households in the residential sector and a large share of public buildings. These calculations are of course in no way precise and will fluctuate with engineering costs, fuel prices, policy frameworks and the way in which urban lifestyles evolve. The data is however consistent with residential and heat density, giving the predictions a high degree of reliability.¹²⁹

¹²⁶ The UK Potential for Community Heating with Combined Heat and Power, Business and Research Enterprise (BRE), UK, 2003, p. 9

¹²⁷ The UK Potential for Community Heating with Combined Heat and Power, Business and Research Enterprise (BRE), UK, 2003

¹²⁸ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 55-56

¹²⁹ Heat call for evidence, Department of Business Enterprise and Regulatory Reform, UK, 2008, p. 73-74

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

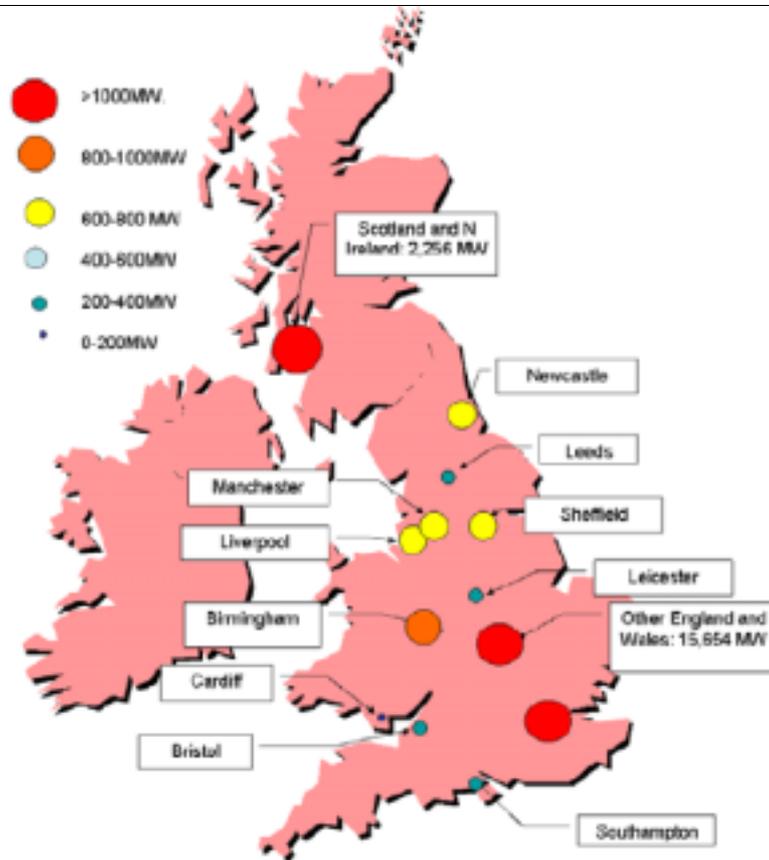


Figure 24: Possible location of district heating at maximum potential¹³⁰

The map above gives an idea of where the greatest potential for development of district heating lies. Most of the areas that are currently served by gas networks, with considerable investments already made in heat boilers and will thus require copious investments in order to erect a district heating network. BERR estimate a capital investment requirement of £50 billion for development of a district heating scheme in any of the areas marked on the map above.¹³¹

¹³⁰ Heat call for evidence, Department of Business Enterprise and Regulatory Reform, UK, 2008, chapter 6, p. 74

¹³¹ Heat call for evidence, Department of Business Enterprise and Regulatory Reform, UK, 2008, chapter 6, p. 74

7.4 Predicted contribution from alternative energy sources

As notarized in the introduction an abundance of strives for CO₂ reductions have emerged in recent years. The efficient use of energy through CHP is an important driver for district heating. Concurrently, renewable energy sources are also considered an important part of a strategy towards CO₂ emission reduction.

AEA Technology made a projected contribution of discrepant renewable energy technologies. The calculations are based on both technological premises and market opportunities. The predictions are based on industrial, commercial and residential district heating potential. The total of the projected contribution does not solely refer to district heating possibilities. Figure 25 presents the projected contribution of different renewable energy technologies used for heating purposes. The total predicted contribution from renewable technologies is estimated at 35TWh of heat per year. If the total potential was to be taken up by 2020, carbon savings equivalent to 1,2% of the total UK emissions could be made.¹³²

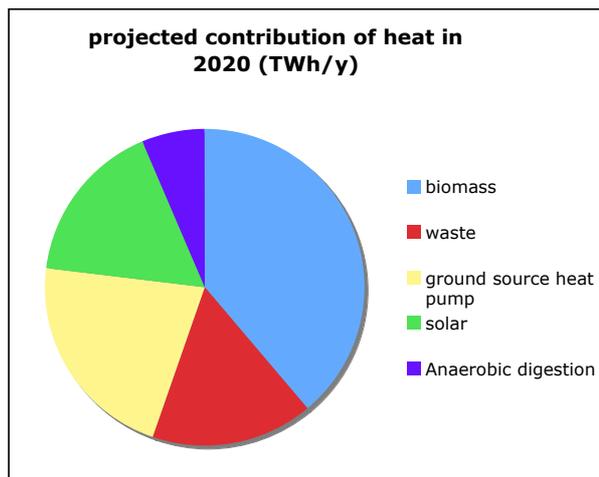


Figure 25. Projected contribution of renewable energy technologies for heat generation¹³³

The contribution from ground source heat pumps and solar energy are primarily used locally and are not considered to be strong drivers of district heating. The contribution from biomass, waste and anaerobic digestion is further discussed in the following sections.

¹³² Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 65

¹³³ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 65

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

7.4.1 Biomass status and potential

Governmental energy strategies favour renewable electricity production with implementation of Renewable Obligation Certificates (ROCs). CHP from biomass is thus a potential driver for district heating and the predicted market is 15TWh/year. Current biomass contribution to the heat market is a meager 6.3TWh/year and only 2.4TWh/year for residential purposes.¹³⁴

The predicted contribution of heat from biomass in 2020 is derived by sector and presented in Table 6.

	2010 (TWh/y)	2015 (TWh/y)	2020 (TWh/y)
Residential	0.3	1	2.4
Commercial	0.7	1.5	2.2
Industrial	2.8	5.7	8.5

Table 6. Predicted contribution of biomass for heat¹³⁵

Albeit many district heat developers are considering the use of biomass for cogeneration of electricity and heat, biomass is a limited energy resource. Available biomass to be used as fuel is estimated at around 42.2 TWh/year within the UK.¹³⁶ The total heat market is currently estimated at 740 TWh/year¹³⁷ and therefore the potential of domestic biomass for heating is 5.7% of the total market. Any extra needs to be imported and the UK will have to be dependent on external forces.

7.4.2 Waste status and potential

Energy from waste could potentially be one of the drivers for development of district heating in the UK. The Government Waste Strategy is one of the drivers for reduced landfill and incentivized by increased landfill taxation.

When the AEA report was published, there were three CHP waste to energy schemes in the UK with two more in a planning stage. The current contribution of heat from these schemes lies at 391GWh/y. The majorities of waste to energy plants are created for electricity production only.¹³⁸

¹³⁴ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 25

¹³⁵ AEA Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 29-30

¹³⁶ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 26

¹³⁷ Renewable heat initial business case, Department of Business Enterprise and Regulatory Reform and Department of Environment Food and Rural Affairs, UK, 2007

¹³⁸ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 54

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Waste to energy plants have a longstanding bad reputation and environmental groups are actively opposing their development. The need for large-scale waste to energy plants in the UK is undeniable however due to the vast disapprobation among the public they tend to be located far from city centres with limited use for district heating for communal purposes.¹³⁹ These practical implications are further discussed in the Dunbar case in Appendix III. There are a few successful waste to energy district heating schemes in the UK today and in the Shetland case such a development process is described, see Appendix III.

AEA have estimated the market potential for heat from waste incineration and the projected contribution of heat is presented in Table 7. AEA has not separated the contribution from industrial and public/private purposes but the difficulties in finding substantial residential heat loads are mentioned in this report.

	2010 (TWh/y)	2015 (TWh/y)	2020 (TWh/y)
Waste incineration with heat recovery	0	2.9	5.7

Table 7. Predicted contribution of waste incineration to heat¹⁴⁰

Anaerobic digestion is another technique of recovering energy from waste. The technology provides a way of converting organic waste into methane through an anaerobic microbial process. The methane can then be utilized as fuel in CHP generation. In the AEA rapport the potential for anaerobic digestion for heat contribution is treated separately from that of waste incineration. The current contribution according to the AEA is 0.61TWh of heat per year from anaerobic digestion mainly from sewage sludge, see Table 8. The predicted potential is 2.2 TWh/y.¹⁴¹

	2010 (TWh/y)	2015 (TWh/y)	2020 (TWh/y)
Anaerobic digestion	0.91	1.5	2.2

Table 8. Predicted contribution of anaerobic digestion to heat¹⁴²

7.4.3 Geothermal status and potential

The Southampton district heating scheme is the only one of its kind using geothermal heat as an energy source in the UK (Appendix IV) contributing with 2MW of heat to

¹³⁹ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 53

¹⁴⁰ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 55

¹⁴¹ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 57

¹⁴² Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 60

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

the district heating scheme. As can be seen from the map below there is similar potential in other regions of the UK but the sources are incredibly finite. According to the British Geological Survey, the geological heat potential is only 0,75MWh/year. According to AEA the practical implication is limited and geothermal energy is not considered a driver for district heating.¹⁴³

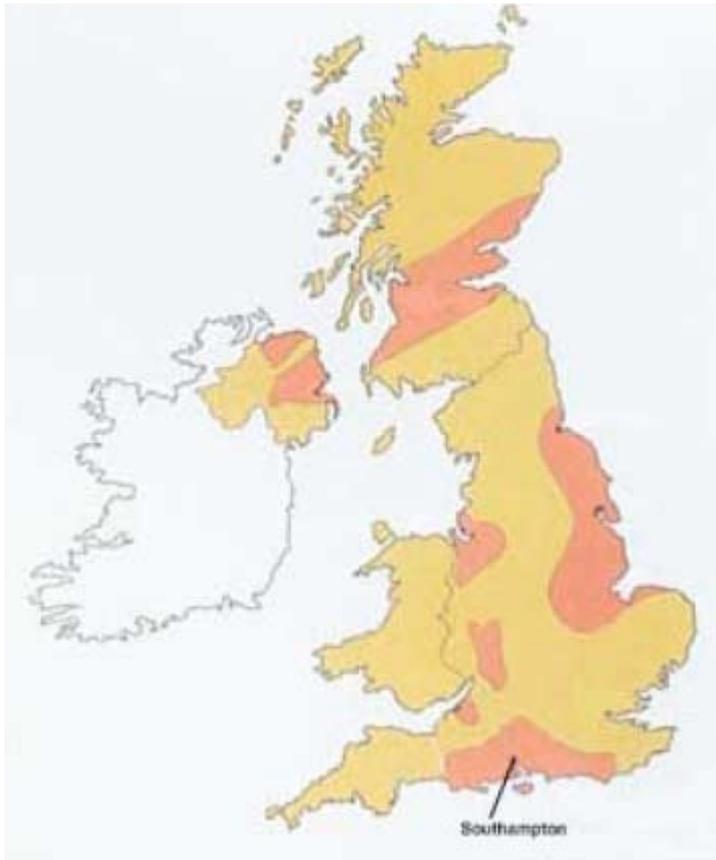


Figure 26. Areas for potential geothermal aquifers in the UK¹⁴⁴

7.5 Identified barriers to the progressive development of CHP and district heating

The market share of district heating is limited and the potential for district heating in the future is uncertain. When commercial discount rates are utilised for predictions, the market potential is confined and increases with lowered discount rates. A

¹⁴³ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 51-52

¹⁴⁴ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 51

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

summary of various articles and publications discussing barriers to district heating is presented below.

Judging by today's situation the underlying reason for the lack of widespread district heating in the UK is connected to the scarcity of large scale CHP. However the rate at which CHP is adapted will be determined in reference to several key factors; corporate profitability and confidence, financing costs, fuel costs and electricity price relativity.¹⁴⁵

The rates of return on heating systems do not seem profitable enough to the naked eye. CHP is making a sweeping entry into both the industrial and the commercial market sectors and the next step is to break ground on the domestic housing market. The regional electricity companies (REC's) should be willing to provide services to such a market, using local authorities as a point of entry. There is a strong need to move into this market and local authorities need to be given more freedom to make decisions regarding such matters.¹⁴⁶

There are currently a wide range of barriers hindering the development and expansion of CHP and district heating in the UK. The most commonly identified barriers are¹⁴⁷:

- Unfavorable gas and electricity prices (cause reduction on returns on investment, affect in the financial value of the electricity generated)
- Volatile fuel prices and uncertainty regarding the fuel market (causes investments to be put on hold or can encourage installation of conventional heating)
- Uncertainty regarding how a site's heat demand will evolve over time
- The need for high initial capital investments
- High initial costs, difficulty to allocate funds even with attractive ROI
- Non-strategic and uncoordinated energy management, long term investments
- Regulatory constraints and requirements on embedded generators
- Lack of awareness and distrust of the CHP-DH technology amongst general public as well as industries
- Lack of exemplars
- Perceived additional risk of innovation/technologies

Even though there are renewable sources that can drive the development, the use of gas fired CHP is the most conventional way of expanding district heating schemes. The obstacles for larger scale district heating schemes are further discussed in Defra's Analysis of the UK potential for CHP.¹⁴⁸

¹⁴⁵ Analysis of the UK potential for Combined Heat and Power, Department of Environment Food and Rural Affairs, UK, 2007, p. I-II

¹⁴⁶ Harvey, K. (1994) p. 3

¹⁴⁷ McNaught, C. (1998)

¹⁴⁸ Analysis of the UK potential for Combined Heat and Power, Department of Environment Food and Rural Affairs, UK, 2007

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

The main reason why CHP appears substandard in financial terms is the relative price of fuel, alongside the value of the electricity generated in a CHP scheme. The commonly used term spark-gap, a measurement of the difference between electricity and gas prices, is used to quantify these relative prices. The larger the spark-gap (i.e. the higher the electricity price and the lower the gas price), the more desirable the conditions for operating a CHP scheme are.¹⁴⁹ Since most CHP plants are fueled with gas and electricity is sold at a fluctuating price, scheme profitability is reliant on the price relationship between the gas and electricity.

*“In the ten years between 1994 and 2004, both electricity and gas prices fell, with gas prices falling by 6% in real terms over this period. However, between 1999 and 2004 there was a 35% increase in gas price but no corresponding increase in electricity prices. During this period then, the economic conditions became more unfavorable to CHP”.*¹⁵⁰

An example of the dissatisfactory financial situation emanating from the spark gap, is the gas fired district heating scheme Citigen in London, who attribute part of their unprofitable situation to the unfortunate energy prices of late.¹⁵¹

Existing heat and power networks must be rebuilt in order to fully support CHP and thus connect to a system where distributed generation can make a significant contribution. In response to this barrier, Ofgem (Office of the Gas and Electricity Markets) encourage distribution network operators to connect and utilize distributed generation.¹⁵² Often the installation of CHP requires agreeable connection to both gas and electricity networks, however some parts of the UK have little or no access to mains gas networks.¹⁵³

When small CHP units sell electricity to the grid, they often do so through intermediaries called “consolidators”, who treat the power as negative demand as to avoid registration with BSC. Unfortunately the CHP scheme only extorts¹⁵⁴ a fraction of the price when forced to go through a consolidator. The consolidators earn more than a CHP district heating scheme operated by a local Council would, selling the exported electricity to the same supplier.¹⁵⁵

¹⁴⁹ Analysis of the UK potential for Combined Heat and Power, Department of Environment Food and Rural Affairs, UK, 2007, p. 6

¹⁵⁰ Analysis of the UK potential for Combined Heat and Power, Department of Environment Food and Rural Affairs, UK, 2007, p. 6-7

¹⁵¹ Citigen case study, Appendix IV

¹⁵² Analysis of the UK potential for Combined Heat and Power, Department of Environment Food and Rural Affairs, UK, 2007, p. 8

¹⁵³ Toke, D. et al (2008) p. 1449

¹⁵⁴ Toke, D. et al (2008) p. 1449

¹⁵⁵ Toke, D. et al (2008) p. 1449

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

A calculation was made of the difference between what a small CHP operator would earn annually from a contract with a ‘consolidator’ and what they would earn if they were able to sell the electricity on the power exchange to the same income per MWh as a power station. The results showed that the CHP operator would have earned around one third more selling by themselves rather than using the consolidator.¹⁵⁶

One way of improving the financial situation of a scheme is to increase the capacity of the CHP station by using thermal storage. Currently only a small number of CHP plants are being built with thermal stores, with the aid of funding granted by the Community Energy Programme.

In order for CHP to spread across the UK it is vital that local Governments create incentives to reach national goals. More and more of the local authorities are adopting planning rules for new and refurbished buildings to use on-site renewable sources in order to reduce CO₂ emission, and at the same time encouraging developers to look for energy efficient construction options.¹⁵⁷

The notion of proof for the limited use of district heating is also explained by the comparatively milder climate in the UK.¹⁵⁸ The number of heat degree days in London is 1700 in comparison to Copenhagen with 2009.¹⁵⁹ Heating degree days are measured as the difference between 15.5°C and the average daily temperature when it drops below 15.5°C. This type of comparison makes a difference in terms of economic viability of constructing a district heating scheme.¹⁶⁰ Albeit outdoor temperature is a validating factor in determining heat demand, building structure and consumer behavior are of grave precedence. UK heat demand will vary due to the elongated characteristic of the region. AEA estimate the annual average heat demand of dwellings for the predicted market to be 18,000kWh/year¹⁶¹. The Shetland case states that the average heat household demands up to 18,000 kWh/year.¹⁶²

7.6 Important stakeholders of the district heating market

Multi-organization theory has been presented to describe the district heating market. In “District heating comes to town” by Jane Summerton, multi-organizational theory was used with the aim of describing the organization of a district heating scheme in Sweden. The members of the multi-organization that Summerton present in her thesis are *energy companies*, the *regulatory sector* (national and local authorities), the

¹⁵⁶ Toke, D. et al (2008) p. 1450

¹⁵⁷ Toke, D. et al (2008)

¹⁵⁸ Roberts, S. (2008)

¹⁵⁹ Making ESCOs Work: Guidance and Advice on Setting Up and Delivering an ESCO, London Energy Partnership, The Greater London Authority, UK, 2007

¹⁶⁰ Roberts, S. (2008)

¹⁶¹ Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK, p. 17

¹⁶² Shetland case study, Appendix III: Case studies Scotland

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

delivery sector (of equipment, energy, consultancy services, and interest groups), the *consumer sector* and the *competing sector*. Summerton states that the support and shared purpose of the members of the multi-organization is vital for the success of a scheme.¹⁶³

7.6.1 Regulatory sector

There are a number of changes that have taken place over the past 30 years in the UK, which have paved the way for the development of CHP/DH (see Appendix II). As time moves on the Government seems to be playing a more dominant part in promoting energy efficiency and climate change action. Just recently the DECC (Department of Energy and Climate Change) was stipulated to deal with actions regarding climate issues facing the UK.¹⁶⁴ The UK Government has now reconditioned that heat plays a major role in energy system and for the first time a strategy which deals purely with heat is under construction.^{165 166}

7.6.2 Local Authorities

Looking to the predicted market it becomes evident that one of the possibilities for development of district heating is publicly initiated schemes. The barriers associated with this are therefore a preeminent parameter to consider. In the history of district heating in the UK (see Chapter 6) the differences between the role of local authorities in Sweden and the UK are discussed. UK local authorities are faced with far fewer possibilities of investing in a district heating scheme than those in Sweden.¹⁶⁷

In Gordon Walkers article “What are the barriers and incentives for community-owned means of energy production and use?” public ownership is brought into light. According to Gordon there are currently four different types of ownership present on the UK market. They all involve communities/municipalities in some way; however they steer away from 100% community ownership¹⁶⁸.

- *Cooperative*: Baywind was the first cooperative wind farm to be step up in the UK 1990's and was based on the Scandinavian model. People in the local community became members and shareholders. This type of ownership is only profitable if finances are available within the community to make the necessary investments.

¹⁶³ Summerton, J. (1992) p. 84

¹⁶⁴ Department of Energy and Climate Change and Communities (DECC)

¹⁶⁵ Robin Wiltshire, Chairman International Energy Agency and employee BRE, 2009-04-21

¹⁶⁶ Heat and Energy Strategy Consultation, Department of Energy and Climate Change and Communities and Local Government, UK, February 2009

¹⁶⁷ Chapter 6, The history of district heating in the UK

¹⁶⁸ Walker, G. (2008)

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

- *Community charities* – Association with charitable status which provides or runs facilities for the local community. The charities act in the interest of all those part of the local community.
- *Developments trusts* – These are frequently used in Scotland and act in the interest of all those in the local community.
- *Shares owned by a local community organization* – Shares from a commercial project go to a local organization such as a trust and are once again only profitable if finances are available within the community to make the necessary investments.

Walker also lists the opportunities and reasons for community ownership¹⁶⁹:

- *Local income and regeneration* - Community-owned means of production can generate income locally, through returns on investment, sale of generated energy (electricity or heat), or the creation of employment opportunities.
- *Local approval and planning permission* - Projects owned or part owned by the community will be more locally acceptable and have fewer problems obtaining planning permission.
- *Local control* – Can determine such matters as the scale of development, and details such as the siting and orientation of turbines on wind farms. It can spur local interest for future projects.
- *Lower energy costs and reliable supply* - the cost-effectiveness of renewables can be problematic, particularly if significant infrastructure costs are involved.
- *Ethical and environmental commitment* – These drivers are of importance for public and private sector bodies which have environmental and social responsibility policies.
- *Load management* - If the existing load in an area is closely matched to the new scheme expensive upgrades and extensions of the network can be minimized. Load management creates islands of security during grid outages and contributes to voltage stability.

Fuel poverty is an underlying reason for public ownership and could be subcategorized to fit under ethical and environmental commitment. People forced to

¹⁶⁹ Walker, G. (2008)

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

use more than 10 % of their income to pay energy bills, are considered to be suffering from fuel poverty.¹⁷⁰

According to DECC's Heat Consultation¹⁷¹, local authorities are not only owners and scheme developers but by way of public buildings the most common customer of district heating present on the UK market today. The DECC state that agreements on Governmental scheme connections often trigger the development of a district heating network. These connections are referred to as anchor-loads.¹⁷²

7.6.3 Energy Service Company

An ESCo is defined as a company that provides a wide range of energy solutions, such as power generation and energy supply, design and implementation of energy saving projects, risk management, and energy conservation. An ESCo is typically set up to develop and operate a specific scheme. ESCo encompass all relevant information and knowledge of a scheme and tend to handle signing of contracts for both services and a large variety of equipment. The savings made in terms of energy cost are usually used to repay capital investments made early on in the development process. At times the saving will be recycled back into the company to allow for upgrades that would otherwise seem unattainable. If a project fails to provide sufficient returns on investment the ESCo will be held responsible for financing this gap. There are of course variations to the structure of an ESCo, but the description above refers to those most commonly found on the UK market.¹⁷³

7.7 Further studies

Above several studies have been mentioned that touch upon the main topic of this report. By solely studying published articles opportunities of fully examining the three purposes of the study become limited. By studying cases of existing and planned development of district heating in the UK further insight into the dynamics of the district heating market will be established. With the aid of both published materials and gathered emporia the hope is to gain an understanding of what strategic position would be most valuable to embody when selling consultancy services to the identified market. The written articles have been sources of inspiration in terms of study focus and have spurred specific interest in the following questions: *What and/or who initiates the development of a scheme? What does the constellation of the multi-organization of a scheme look like? What drives the scheme toward further*

¹⁷⁰ Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

¹⁷¹ Heat and Energy Strategy Consultation, Department of Energy and Climate Change and Communities and Local Government, UK, February 2009

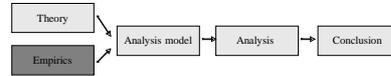
¹⁷² Heat and Energy Strategy Consultation, Department of Energy and Climate Change and Communities and Local Government, UK, February 2009, p. 98

¹⁷³ Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

development? What are characteristics of a successful scheme? How is knowledge acquired on a market with a severe knowledge deficit?

8 Case studies: Existing district heating schemes



This chapter presents a summary of the most important findings from the nine cases studied in the UK.

Even though district heating still only exists at a very small scale in the UK at the moment, there are a few district heating schemes which have attracted a great deal of attention. In order to gain clarity on the way in which a successful district heating scheme is created in the UK, we have chosen nine specific sites to investigate. We hope to find trends and/or similarities in initiation processes, financial and ownership structure, location etc between the cases. Initially we chose to study one of the schemes that perhaps has attracted the most attention, and has been an inspiration for many other schemes, namely the Southampton district heating scheme. Further on we decided to concentrate on schemes in London and in Scotland

The following tables present consolidated information about the schemes that we investigated in the study. The cases studied are in different stages of the development process. Due to the fact that some of the projects still very much in a planning phase, information is limited and some cells are not filled in.

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

Scheme	Public owner	Private owner	External consultant	Incentive	Subsidies	Heat customers	Future connections
Aberdeen	X		Yes	Fuel poverty/ energy performance	CEP, EEC	Residents/ public buildings	increase in capacity, biomass gasification
Binn Eco Park		X				Residents/ food producers	
Citigen		X	Yes	Profit	None	Public and commercial buildings	On hold
Dunbar		X		Profit/landfill taxation		Industrial/ public	Looking for customers
Highland	X		Yes	CO ₂ reduction/ landfill taxation			Looking for customers
Pimlico	X		No	Fuel poverty/ CO ₂ reduction	CEP, CERT, EU Thermie grants	Residents/p ublic and commercial buildings	Current demand for heat, need for contractors
Shetland	X		Yes	Benefit to tenants economy	CEP/ ERDF/ EU Thermie grants	Residents/ public and commercial buildings	Demand for heat, need to increase capacity
Southampton		X	No		EU Thermie grants	Residents/ public and commercial buildings	
London Thames Gateway	X		Yes	CO ₂ reductions	EDIP/ JESSICA	Residents/ public and commercial buildings	

Scheme	CHP	Energy source	Electric capacity (MW)	Heat Capacity (MW)	Cooling capacity (MW)	Mains (km)
Aberdeen	Yes	Gas	1.5	2,6	No	
Binn Eco Park	Yes	Waste			No	
Citigen	Yes	Gas/Oil	25	28	12	3,6+2,6
Dunbar	Yes	Waste	17			
Highland	No Yes	Waste, biomass		6,5		
Pimlico	Yes	Gas	1.5	24		
Shetland	No	Waste	-	6,5	No	30

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

Southampton	Yes	Geothermal Gas	48	70 GWh/y	Yes	11
London Thames Gateway	Yes	Gas		170		23

8.1 Scotland

When speaking to people in Scotland we rather quickly found out that they were eager to tell us more about how district heating is developing in the region. Our access to various schemes around the country paved the way for our exploration of the region.

When speaking to Neville Martin, founder of the Shetland district heating scheme, we found out that the Scottish Government is presently developing guidelines for thermal treatment of waste and that they are willing to support the development of waste to energy solutions. The Scottish Government are also supporting district heating from renewables and thus we decided to set up a meeting with the renewables department of the Scottish government.

8.1.1 District heating and renewables

Sue Kearns, Head of Renewables Strategy & Onshore Renewables, Scottish Government, provided us with insights into scottish incentives towards district heating from renewables. Scotland is currently evaluating applications under the Scottish Biomass Heat Scheme, which is designed to support business use of biomass for heat, and also to demonstrate the wide applicability of a district heating scheme. The government have funded small community owned district heating schemes under the Scottish Community and Householder Renewable Initiative and are hoping to run heat-mapping pilots with a couple of local authorities.¹⁷⁴

The Glasgow City Council and their fellow partners are developing the so-called Sustainable Glasgow initiative, which includes district heating plans for the area. Kearns says that all of the above mentioned initiatives are useful and will be captured as part of the work going into developing an Action Plan for Renewable Heat in Scotland. However, Kearns believes that any wider change to district heating in Scotland (renewable and non-renewable) will require large scale and widespread infrastructural investment and the issues relating to such changes are being considered on a UK level.¹⁷⁵

¹⁷⁴ Sue Kearns, Head of Renewables Strategy & Onshore Renewables, Scottish Government, 2009-03-30

¹⁷⁵ Sue Kearns, Head of Renewables Strategy & Onshore Renewables, Scottish Government, 2009-03-30

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

8.1.2 District heating and waste management

The Scottish government have presented a new vision for waste and an outline for government policies for zero waste in Scotland.¹⁷⁶ The Scottish Rural Affairs and Environmental Minister Richard Lochhead announced that their strategy towards sustainable waste management entails managing waste as a resource.¹⁷⁷ The main message they are hoping to get across is that waste should be treated according to the waste hierarchy; the first step is to prevent the generation of waste, the second step is recycling and the third and final step is to reuse energy created by waste. The technique of waste incineration will take on a fairly limited role in Scotland but is none the less mentioned in the waste strategy. The Scottish Environmental Protection Agency (SEPA) is developing guidelines for thermal treatment of waste.¹⁷⁸ One of the requirements on waste incineration will be that the incineration plant needs to be at least 60% energy efficient, resulting in a need for conservation and utilization of heat generated from incineration. Such a requirement favours the development of district heating in future development of waste incineration.¹⁷⁹

Minister Richard Lochhead mentioned the following:

*“The Sustainable Development Commission said in its report last month that “energy from waste may be, in the right circumstances, compatible with sustainable development and a move towards a Zero Waste society”... Of the options considered by SEPA, 70 per cent recycling with 25 per cent energy from waste performed the best in relation to climate change and non-renewable resource depletion.”*¹⁸⁰

*“The Scottish Government has a Zero Waste Fund of over £150 million over the next three years. We intend to allocate over £100 million of this Fund to support recycling and composting infrastructure; anaerobic digestion plants treating source segregated organic waste; high efficiency energy from waste plants and other facilities which divert waste from landfill and have high environmental performance.”*¹⁸¹

8.1.3 The power of the consumer

Simon Stockwell¹⁸², Head of National Waste Plan at the Scottish Government, stated in a phone interview that the Scottish waste strategy is not as straightforward as he had hoped but he believes that the strategy will support development of small waste to energy plants. He is unsure of the potential of district heating derived from waste incineration. According to his experiences the power of the people within a

¹⁷⁶ The Scottish Government new vision for waste, January 2008

¹⁷⁷ The Scottish Government new vision for waste, January 2008

¹⁷⁸ Thermal treatment waste guidelines, Scottish Environmental Protection Agency, 2009

¹⁷⁹ The Scottish Government new vision for waste, January 2008

¹⁸⁰ The Scottish Government new vision for waste, January 2008

¹⁸¹ The Scottish Government new vision for waste, January 2008

¹⁸² Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-03-25

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

community is one of the most important forces for developers to consider. “*Many inhabitants are not interested in having waste incineration nearby their homes but at the same time the CHP plant cannot be located too far away from the heat consumer.*”¹⁸³

The UK has a free energy market with a customer choice of energy supply. Stockwell mentions that the true obstacle for district heating is to find offset for heat. He believes that in the future for district heating systems are going to be connected to public sector buildings such as hospitals, schools, local prisons and industries instead of residential buildings. Many public buildings in Scotland are owned by the Government and not by the local authority. Waste management is in most cases seen today privatised and therefore Stockwell states that the role of the community council, in future waste incineration and district heating, will be limited.¹⁸⁴

8.1.4 The ownership structures

Scotland has a longstanding tradition of landfill as it is a cheap and efficient way of dealing with waste. Since 1996 there have been steps taken towards a move away from landfill, with a variety of incentives on both a UK and a Scottish level. In England landfill sites are traditionally owned by the private sector whereas in Scotland ownership fluctuates between private and local authority. In the UK today most of the waste collection is run by local authorities, but the actual disposal process is private.¹⁸⁵

Until just a few years back the standard financial ownership structure in Scotland, just as in England, was private-public partnerships. It has been proven that these partnerships are no longer profitable and should not be considered the way forward. There are trusts being set up to compensate for the loss of private financial influx, but according to Stockwell this has been put on hold due to the “credit crunch”.¹⁸⁶

Stockwell mentions that there are three different ways in which initiatives are taken, the latter two being typical organizational models for future development of schemes.¹⁸⁷

1. Public initiative by local authority that commissions an energy company to build the scheme. It is rare that a local authority bears the financial risk and Shetland should be seen as an exemption to this rule. Stockwell stated that the Shetland council is wealthy (more like Norway) and can afford to finance their own development.

¹⁸³ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-03-25

¹⁸⁴ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-03-25

¹⁸⁵ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-04-23

¹⁸⁶ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-04-23

¹⁸⁷ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-04-23

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

2. Public initiative by local authority with ownership and operation through an energy company. This model requires a competitive procurement process. This process is in line with EU directives of local authority procurement. The tender spends large amounts on preparing a bid for a contract.
3. Private initiatives that are taken to develop sites with a purely financial incentive. The advantage is that a private company might have use for the heat and can therefore give the community a better price for the waste.

Even though local authorities' involvement is limited according to Stockwell the community council's role is infrastructural planning and granting of building permits. In general in Scotland and the UK, the market is dominated by large waste management companies such as WRG, SITA, Grundons, Viola, Virdor, Shanks, etc. These companies have their origins in landfill, and many of them were very successful. There has over the past few years been a gradual shift away from landfill and towards incineration. The most prominent reason for this is the new EU landfill target calling for a reduction of the amount of waste sent to landfill. If a community fails to reach this target, fines will be enforced. The problem here is that the directives do not lay down any ground rules for vicarious action. "It doesn't really matter how you achieve these targets, just as long as you do."¹⁸⁸ Some of the smaller companies emerging on the market have started looking into CHP as a substitute to landfill. The thermal treatment guidelines should also be seen as a strong driver for investigating the potential of heat recovery.¹⁸⁹

8.1.5 Incentives toward waste incineration in Scotland

Simon Stockwell believes that an incentive for waste incineration should be the landfill taxation, which is due to increase by 8£ per year until it reaches 72£ per ton in 2013. Municipal waste management is currently dealing with issues on how to treat the waste when moving away from landfill. According to targets set by the Scottish Government most of the waste should be dealt with through recycling. The goal for municipalities is 70% recycling by 2025; they are currently at half of that. There is a new target which states that 25% of all waste needs to be treated through waste to energy by the year 2025. The 25 % only applies to municipal waste, i.e. a total of 850,000 tons.¹⁹⁰ In an interview with Neville Martin¹⁹¹, he explains that Shetland's district heating scheme has been criticized for unprofitable development. Martin claims that the upcoming landfill fees in 2010 will severely affect other communities while Shetland has been proactive and can thus avoid future fees. Neville believes that incineration as in Shetland will have a future. *"I argue in the UK that energy from waste plants will be the main driver to start DH schemes in the UK. Once*

¹⁸⁸ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-04-23

¹⁸⁹ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-04-23

¹⁹⁰ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-04-23

¹⁹¹ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-03-25

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

*numerous schemes have been built then other energy sources can be exploited including power stations which currently dump all the heat.*¹⁹²

The general impression is that local authorities believe that a 70% recycling target is too ambitious and that they would rather strive for larger amounts of waste to energy. Similar statements were made in the Scottish Government's new vision for waste:

*"The Lothians themselves suggested that around 50 per cent of their waste could be incinerated."*¹⁹³

There needs to be financial incentives to drive CO₂ emission reduction. Many of the targets are being set before proper calculations of how these targets should be reached have been made. Targets for Scotland have been set at 20% for energy consumption from renewables and 50% of the electricity being generated needs to come from renewables by 2020, 11% from heat, and 10% from transport. There are ongoing discussions as to which materials should be included under the term "renewable", and the list is constantly changing.¹⁹⁴ According to Stockwell there are enough targets set for waste; *"if there was ever a time for action, this is it."*¹⁹⁵

In Scotland there is a big drive towards cutting nuclear power. Scotland is against nuclear power generation, due to radioactive waste issues and is instead strongly committed to the development of wind power, wave power and new renewable energy. Stockwell predicts that there will undeniably be an issue of supply of energy sources in Scotland in the future; however he is hopeful in that Scottish supply of woodchips can help to alleviate this pending obstacle. Simon Stockwell stated that incentives can be seen around the country striving for development of efficient energy generation, but the incentives are almost entirely privately initiated and funded. He believes that the strong incentives need to come from the UK government in order for a nationwide initiative to take flight.¹⁹⁶

There is strong local planning present throughout Scotland. All of the planning guidelines are currently undergoing Reform, because the planning minister thought that the existing guidelines were too diffuse and wanted them synthesized in one single document. Stockwell would be satisfied with retaining the original notes, but agrees that a movement towards a single document could improve the communication and connection between the vastly different governmental divisions involved in the planning process (waste treatment, renewables, housing, city planning etc.). Scotland holds a vision for what they hope planning will look like for the nearest future. This vision is supposed to give developers a strategic overview of what development needs

¹⁹² Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-03-25

¹⁹³ The Scottish Government new vision for waste, January 2008

¹⁹⁴ James McKenzie, Policy Officer of Renewable Department at Scottish Government, 2009-04-23

¹⁹⁵ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-04-23

¹⁹⁶ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-04-23

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

to take place over the next few years. Stockwell mentioned that many of his planning colleagues are keen to see the planning system encourage more development in order to in turn drive economic development.¹⁹⁷

NGO's are generally opposed to mixed waste incineration and the concept of collection of the so called "black bags" and they believe that it can cut across recycling. The Scottish Government does not hear much from environmental NGO's, but if they started lobbying for large incinerator plants, Stockwell believes they will have trouble keeping the NGO's off their back.¹⁹⁸

8.1.6 Existing waste to energy schemes in Scotland

The following are the main cases of district heating identified in Scotland¹⁹⁹:

- Dundee – very forward thinking with waste incineration already in 1990.
- Shetland – has developed a community owned scheme
- Highland – in pipeline of developing four district heating using a similar model as in Shetland Islands
- The waste management company Viridor Waste management is planning a waste incineration plant with district heating in Dunbar outside of Edinburgh. The waste management company takes the incentive and the ownership will be private (model 3).

A detailed presentation of three of the cases is presented in Appendix III: Case studies Scotland. Numerous other prospects have been presented to SEPA and according to Simon Stockwell some of these schemes will come to be realized whereas some will not. The reasons why some will fail is solely due to financial difficulties and SEPA unwillingness to provide permits needed for development of a new scheme.²⁰⁰

8.2 England

All of the large scale district heating schemes in the UK are located in England. Southampton, Nottingham, Sheffield and London are cities with a tradition of district heating and the four larger district heating schemes are located in these cities.

Governmental legislations are set on a UK level, but in London an additional strong governmental force comes from the Greater London Authority (GLA). The involvement of local authorities in London combined with a fair amount of interesting schemes lead us to conducting further studies around the London area. There are an abundance of case studies that have been carried out on the Southampton district heating scheme and the access to information and the ownership structure being lead

¹⁹⁷ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-04-23

¹⁹⁸ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-04-23

¹⁹⁹ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-03-25

²⁰⁰ Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-03-25

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

to a closer study of the scheme. Further information on these schemes is presented in Appendix IV: Case studies England

One of the main reasons as to why we chose to focus on London was that we were invited to a seminar on development of district heating in the UK, held by Business and Research Enterprise (BRE). There are a number of district heating schemes situated in London at present and the London Development Agency (LDA) are planning a large-scale scheme for the eastern part of London. Parts of the London Plan which issued by the GLA contain incentives that notably encourage district heating.²⁰¹

The premises are favourable in terms of water carried heating systems in buildings within areas of high heat density and clusters of aged public buildings. Public buildings often function as anchor loads for the development of a scheme.²⁰²

David Wickersham, developer and owner of Pimlico District Heating Undertaking, stated that if district heating cannot be developed in London he does not know where it could. Various governmental organizations, local authorities and private companies in London have plans for development of district heating schemes providing three engaging case studies in central London; Tames Gateway, Pimlico and Citigen.

The development of schemes is often governed by the national strategies described in Appendix I, but also by local strategies put forth by the GLA. Alina Lazar²⁰³, GLA, explains that they hope to coordinate energy distribution with fewer energy stations and at the same time invest in district heating as described in the London Thames Gateway scheme. The GLA's role is to stipulate strategies that will help cut CO₂ emissions in London.

The GLA have formulated several strategies for the city of London and the London Plan was developed in large part thanks to former Mayor Ken Livingstone. He was determined to take action on CO₂ emission reduction and enforced the Plan. According to the London Plan²⁰⁴ and Alina Lazar²⁰⁵ the three steps towards reaching the targets is to go lean, clean and green. Lean means to support CO₂ savings from preservation of energy through for example energy efficient buildings. Clean refers to the efficient use of energy in terms of using combined cooling, heating and power generation. As a final step the GLA will support the use of renewable energy. As can be seen in the figure below most of the calculated CO₂ savings are to be obtained with the implementation of CHP and district heating/cooling measures.²⁰⁶

²⁰¹ The London Plan - Sustainable Energy, Greater London Authority, UK

²⁰² Alina Lazar, Environmental Team Greater London Authority, 2009-04-20

²⁰³ Alina Lazar, Environmental Team Greater London Authority, 2009-04-20

²⁰⁴ The London Plan - Sustainable Energy, Greater London Authority, UK

²⁰⁵ Alina Lazar, Environmental Team Greater London Authority, 2009-04-20

²⁰⁶ The London Plan - Sustainable Energy, Greater London Authority, UK

Industrial Landscaping of District Heating
 Opportunities for knowledge transfer to the UK market

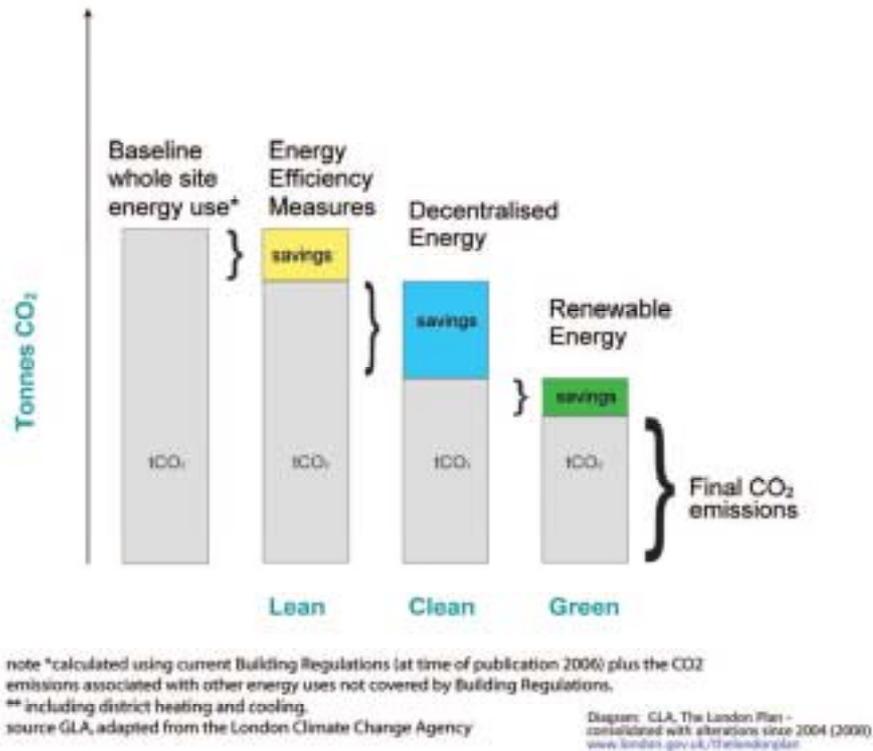


Figure 27. Predicted CO₂ savings in London, derived by measures presented²⁰⁷

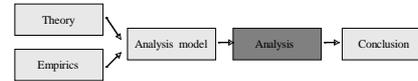
Another section of the London Plan includes pressure placed on city planners to examine the opportunities of CHP and district heating/cooling for new property developments. They are, in an early design stage, required to consider CHP as their main source of energy supply and if a district heating scheme is available they are mandated to connect to it.²⁰⁸

A presentation of the cases studied in London are presented in Appendix IV: Case studies England

²⁰⁷ The London Plan - Sustainable Energy, Greater London Authority, UK

²⁰⁸ The London Plan - Sustainable Energy, Greater London Authority, UK

9 Analysis: Historical background



This chapter presents the first stage of the analysis and discusses the impact of the historical background on the development of district heating in the UK.

The companies who have shown an interest in exploring the district heating market cannot possibly affect the history of the country; however it is vital that they are aware of the historical situation which has contributed to shaping the market into its current condition.

It is often difficult to shake a deeply rooted reputation, not least when it is of a negative nature. Current district heating developers often tend to refer back to the start up of district heating and labelling it as a consequence for the slow evolution of district heating seen in the UK today. There still seems to be a very strong negative association with district heating present in the customer mindset in the UK. McNaught²⁰⁹ determined that one of the obstacles for district heating is the lack of successful exemplars and it seems the only way to change the current reputation is with the aid of good practice. Rewriting or creating a brand new history for district heating seems to be an important factor in increasing the expansion potential.

Successful schemes atone much of their success to their own ability to overcome and outlast the complications that arose in the early days of district heating development. A prime example of this is the Southampton scheme where they were able to convince customers that a scheme would not only provide reliable heat distribution, but to an affordable price. Scheme owners guaranteed provision without any major energy losses.

The repercussions from English energy privatization can still be seen today in terms of the ownership structures that surround heat distribution. Many schemes developed in Sweden in the 1970's were owned and developed by local authorities. This allowed for a wide development of non-profitable schemes and is one of the underlying reasons as to why up to 50% of Swedish households are heated with district heating.²¹⁰ Due to the strict rules and regulations brought into society after privatization, this same type of development was never an option in the UK. District heating is seen as a niche product and energy distribution is more often than not privatized. Even if there is a willingness among local authorities to put up a scheme, funding will remain an obstacle due to the limited financial resources within community councils. This in turn means that there is immense pressure on the scheme to be build with profitable pay back times, something which seems fairly difficult to come by at first glance.²¹¹

²⁰⁹ McNaught, C. (1998)

²¹⁰ District Heating and Cooling country by country/2007 survey, Euroheat and Power

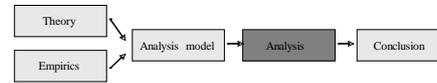
²¹¹ Collier U. et al (1997)

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

While the Swedish were developing district heating in the 1970's, the British found and begun collecting gas from the Northern Sea. This then paved the way for a national gas distribution system, which is still present throughout the UK today. The problem facing the British is a diminishing gas source and they are experiencing a shift from net export to net import of gas. The pressing need for something to be done in the heating sector is no longer fictional but a very real challenge for the UK government.²¹²

²¹² Digest of the United Kingdom Energy Statistics, Department of Business Enterprise and Regulatory Reform, UK, 2008, Chapter 4: Gas, page 6

10 Analysis: The surrounding environment



This chapter presents the second stage of the analysis in which the surrounding environment, which plays a large role in determining the fate of district heating in the UK, is discussed.

10.1 Political Strategies

To clarify, by political strategies we are referring to the many nationally, regionally and locally entrenched political goals identified in the UK. Many of these goals are directly related to EU directives set in terms of CO₂ emission reduction. These directives have been transferred to a national level with an UK target of 60% reductions by 2050 using a 1990 baseline²¹³, alongside a local London wide target for another 60% reduction by 2025²¹⁴. When looking at the plans that have been laid out in terms of how to achieve these targets, they appear fictitious. The extent to which district heating is included in these targets is ambiguous to say the least at this point. The Energy White Paper²¹⁵ (BERR) focuses mainly on energy efficiency and green energy production but there are very few mentions of district heating. In more recent reports such as the consultation on Heat and Energy Strategy 2009 (DECC)²¹⁶, the Government's solution to the ongoing energy crisis is not purely targeted toward green electricity; the principles of district heating are brought into light. According to Robin Wiltshire, BRE, there is a political focus on heat for the first time in UK history.²¹⁷ District heating has the potential to increase energy efficiency with cogeneration of heat and power. Surplus heat from power stations contributes to 12%²¹⁸ of total CO₂ emissions in the UK and could potentially replace some of the fossil heat thus further contributing to CO₂ emission reductions.

In certain regional policies more specific goals regarding district heating have been identified. In Scotland there is a large drive towards waste incineration and for technology to be energy efficient, suggestively with the aid of CHP.²¹⁹ In The London

²¹³ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007, Executive Summary

²¹⁴ Alina Lazar, Environmental Team Greater London Authority, 09-04-20

²¹⁵ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007

²¹⁶ Heat and Energy Strategy Consultation, February 2009, carried out by Department of Energy and Climate Change and Communities and Local Government

²¹⁷ Robin Wiltshire, Chairman International Energy Agency and employee BRE, 2009-04-21

²¹⁸ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007, chapter 3

²¹⁹ Thermal treatment waste guidelines, Scottish Environmental Protection Agency, 2009

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Plan, former Mayor of London Ken Livingston specifically addressed the issue and development of district heating.²²⁰

These various goals and policies laid out by the Government appear to be strong forces driving a change in energy systems, but the reality of this change is severely questioned by those active within the district heating community.²²¹ Changes in the UK energy and heating systems will not come about spontaneously, but will be driven by political incentives laid forward by the regulatory sector.

Another parameter that needs to be considered regarding political strategies is that the Government has recently focused on developing strategies specifically dealing with heat supply. Since the Government has previously focused much more on electricity generation the fact that heat strategies such as Heat Call for Evidence, the Consultation on Heat and Energy Strategy and incentives such as the Renewable Heat Incentive are being constructed the chance that district heating will make a notable entrance on the market seems plausible and far more realistic than ever before.²²²

The way in which political strategies have affected the development of district heating schemes are onerous to determine. Many of the scheme developers we spoke to in the UK regarding the power of political strategies found there to be much talk but little action. Below is a summary of the strategies developers believed to have had the largest impact on their scheme.

Scheme	Political Strategy
Aberdeen	Home Energy Conservation Act to reduce fuel poverty
Binn Eco Park	25% energy efficient waste to energy, increasing landfill taxation
Citigen	Reducing CO ₂ emissions
Dunbar	25% energy efficient waste to energy, increasing landfill taxation
Highland	25% energy efficient waste to energy, increasing landfill taxation
Pimlico	Prevention of fuel poverty
Shetland	Shetland Charitable Trust to benefit to the Shetland economy
Southampton	The national strategy of developing four geothermal sources in the UK
London Thames Gateway	Greater London Authority target on reducing CO ₂ emissions (60% CO ₂ reduction in 2025)

Table 9. Political strategies driving development of district heating

Traditionally reduction of fuel-poverty was a main driver of the development of district heating. More recent project seems to be politically driven by waste strategies and to some extent CO₂ emission reduction.

²²⁰ The London Plan - Sustainable Energy, Greater London Authority

²²¹ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

²²² Robin Wiltshire, Chairman International Energy Agency and employee BRE, 2009-04-21

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

10.2 Political Incentives

Political incentives or means of control is a way for the Government or local authorities to control the market towards lowered levels of CO₂ emissions. There is an abundance of incentive present on the sundry political levels in the UK, the most important of which are a diversity of funds and subsidies. Below is a compilation of the incentives utilized by the schemes studied. The Community Energy Programme has been a strong political subsidy for many of them. The Programme is no longer active but will be “replaced” by a similar programme called the Community Energy Saving Programme (CESP). This type of program only incentivizes small scale development of district heating since the total CESP fund lies at £30 million nowhere near enough to drive a UK wide change.²²³

Scheme	Political Incentive
Aberdeen	Community Energy Programme, Energy Efficiency Commitment
Citigen	Planning Power
Pimlico	Community Energy Programme, Community Emission Reduction Target, Energy Efficiency Commitment, Planning Power
Shetland	Community Energy Programme, European Regional Development Fund, European Thermie grants
Southampton	European Thermie grants, Planning Power
London Thames Gateway	Planning Power

Table 10. Funds and subsidies used by the district heating schemes

Almost everyone we have spoken to has referred to the Renewable Obligation for Electricity as a strong incentive which will impact the UK energy system. The DECC are currently developing a Renewable Heat Initiative (RHI) which will more specifically influence the district heating market. Renewable sources of energy such as woodchip, geothermal, solar, wind and waste are favoured by the RHI’s and many believe that future district heating projects will be fuelled by renewable sources.²²⁴

Fees and taxations are possible influences on the district heating market. The shift seen in Scotland away from landfill and toward waste incineration is largely based on new waste taxation and fees. Waste incineration in turn opens up options for the development of district heating networks.²²⁵

Information and education may also be important parameters influencing the development of district heating. The Energy Saving Trust is a non-governmental organization (NGO) that provides information regarding best practice and various

²²³ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

²²⁴ Robert Tudway, Department of Energy and Climate Change, 2009-04-20

²²⁵ Simon Stockwell, Head of National Waste Plan at Scottish Government, 24-04-23

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

case studies of successful schemes as a source of inspiration, such as the community-heating guide. The educational incentive seems to influence the direction a scheme takes during the course of development, rather than decide whether or not the scheme will actually come to be realized.²²⁶

10.3 Economic

The financial system of a country is most definitely a determining factor in the development of district heating. Since it is a capital intensive technology, the need for strong financial backing is a precondition. The difficulties in retaining sufficient funding seem to be one of the major obstacles for developers. The UK system of privatized energy supply does not favour district heating. Energy companies are not satisfied with the returns on their investment in district heating while local authorities do not have the autonomy or capital to invest in such infrastructure.

From what we can see happening on the market today the financial crisis has taken its toll on the development of district heating and will continue to do so, due largely to the need for private investments. Andrew Crafter, Corporation of London²²⁷ claims that the Citigen scheme will continue to struggle with their development plans mainly due to the lack of new property developers. Private ESCo's calculate the NPV (net present value) of an investment with an interest rate of somewhere between 12-15%. However to get a fair picture of calculations on district heating systems Whole Life Costing is required.²²⁸ The possibility for local authorities to make large investments in infrastructure is limited and plans for widespread district heating schemes remains undeveloped. However as seen in Aberdeen, if the local authority looks to long term economical benefits there will almost always be ways of bringing forth the necessary funding. Aberdeen City Council was able to take out a loan on the premises that the energy bills for future connected public buildings would be lower than the previous year.

In a country like Germany that adheres to a much stronger district heating tradition (14 % heating market share), new legislation opens up for subsidization of district heating which reflects a strong political commitment to the technology.²²⁹ No parallels to this can be found in the UK. This is all the more striking in view of the fact that Britain and Germany share issues with energy policies of aiming to reduce dependence on natural gas, and a need to cut back on CO₂ emissions.

Energy prices affect the profitability of a scheme, in particular in relation to the price of gas. The so-called spark gap is especially salient for gas fuelled CHP plants. The

²²⁶ Community heating – a guide, Energy Saving Trust, UK, 2004

²²⁷ Andrew Crafter, London Corporation, 2009-03-24

²²⁸ Guidance on procuring energy services to deliver community heating and power schemes, Action Energy from The Carbon Trust, 2004

²²⁹ Svend Frederiksen, Professor Lund University, Department of Energy Sciences, 2009-05-26

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Citigen scheme has been unprofitable since E.ON's takeover in 2002 partly due to high gas prices alongside low electricity prices.²³⁰ The prices and accessibility of fuels will affect the choice of energy system but the advantage with the district heating scheme in itself is that it is independent from the heat source. The fluctuation of fuel prices is however an important factor due to the unreliable calculations for profitability which it creates. EON, owner of the Citigen district heating scheme, claims that one success factor is to create long term fuel contracts with suppliers in order to avoid these kinds of uncertainties.²³¹

10.4 Social/Cultural

As we have mentioned the history of unsuccessful schemes has affected public opinions of district heating. In general, tenants have the freedom to choose whatever heat distribution they wish. The power of the customer is therefore very important in developing a district heating scheme in the UK. The customer has to be convinced that the new technology is reliable and price worthy compared to other older, well tested alternatives. The end consumer's interest in and awareness of new technologies has proven to be of determining value. Simon Stockwell explained that many people do not care where the heat they are consuming comes from and thus have a very limited interest in considering changing to a different system.²³² The tradition of each apartment buying its own gas for heating makes it difficult to switch to a more centralized system where the apartments can utilize a communal system.

The public's awareness of environmental issues can be an advantage which compels extensive use of district heating. The environmental advantage of district heating has been used as leverage for convincing consumers that an investment in the system is worthwhile.

10.5 Technological

There is an unmistakable issue of not being able to find skilled engineers and contractors in the UK. The risk of unsuccessful projects increases when utilizing uncertain and under-qualified work forces and in turn makes it even more difficult to locate finances.²³³ The lack of technical competence and technical awareness amongst engineers in the UK makes the possibilities of progress within district heating rather restrained. The confined number of contractors and suppliers of district heating devices has hampered the development of the Pimlico district heating scheme according to David Wickersham, owner and developer of PDHU²³⁴. They have encountered difficulties with locating contractors willing to aid them in widening

²³⁰ Andrew Crafter, London Corporation, 2009-03-24

²³¹ Steve Vizer, EON UK, 2009-04-22

²³² Simon Stockwell, Head of National Waste Plan at Scottish Government, 24-04-23

²³³ Heat and Energy Strategy Consultation, Department of Energy and Climate Change and Communities and Local Government, UK, February 2009, p.99

²³⁴ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

their scheme. When putting out tenders for contractors to lay pipes connecting new buildings to the scheme, they only received one proposal. The proposal turned out to be far out of their budget range and PDHU found themselves back on page one. The problem seems to lie largely in the fact that there are not enough contractors on the market willing to get involved in district heating.

Interestingly enough the dearth of competence in the UK can provide an advantage for companies anxious to explore the district heating market. Even though the competition on the market is meager the projects are concurrently finite. The limited knowledge and the possible size of the market, was one of the reasons why it essentially was an interesting market to explore.

Acceptance of new technology is not only an issue of customer cultural and social behaviour, but compliance with the potential developers of a district heating scheme is determining.

10.6 Environment

The natural resources present in the UK plays a decisive role in the selection of an energy system. As described in the historical background, the gas findings in the North Sea have shaped the development of the heat distribution system. Secure delivery of energy sources and the looming threat of gas import is an influential parameter which will enforce a change in the heating system.

Alternate natural resources that can function as surrogates to the gas heated system are parameters that could possibly have a capacious affect on the district heating market. Geothermal findings, solar possibilities and the accessibility of woodchips can determine the availability of usable, reliable, alternate fossil fuels. Looking to market prediction it is evident that biomass is the natural resource which has the largest potential of driving the development of district heating.

Waste is progressively being seen as a source of energy. Albeit it can be questioned to which extent it is a natural/renewable resource waste is potentially a note-worthy source of energy for future district heating schemes.²³⁵ Taking for granted that less incineration is more or less a necessity, it is justified to consider recovering waste heat from the process and thus represent energy savings potential. The incentives towards lower levels of landfill are encouraging waste incineration and consequently the expansion of district heating.²³⁶

The heating and cooling demand of the UK plays a role in determining the potential for development of district heating systems. Heat demand is related to both the climate of the country and the level of energy efficiency of buildings. The

²³⁵ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

²³⁶ Ewan Huc, Waste management officer, Highland City Council, 2009-04-27

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

construction and structural layout of buildings are considered in Chapter 10.7. The somewhat milder climate of the UK compared to Scandinavia could be one of the underlying reasons for such a limited development.²³⁷ The case studies have, however, proven that the heat demand is generous enough to economical justify national expansion of district heating.

10.7 Infrastructure

Building construction is the second aspect which influences heat demand. The many aged, poorly insulated buildings is one of the parameters which contributes to making the UK compatible to district heating. In Shetland the average heat demand reaches 17,000 MWh/year but newly built energy efficient housing only demand 8,000 MWh/year.²³⁸ New developments, containing well insulated buildings and zero carbon homes, are a potential threat to district heating. To counteract this trend newly developed buildings can instead function as a trigger for district cooling. Andrew Crafter, Corporation of London, explains that they experience no issues with getting offset for the cooling produced by the Citigen scheme and that it has even contributed to improving the status of the district heating and cooling system.²³⁹

City structure and planning is exigent when determining the potential of a district heating system since district heating is predominately profitably in dense city areas. Although high heat density areas can be found in UK cities, the general tendency is toward one or two storey buildings, compared to multi-storey city housing in many other European countries.²⁴⁰

In order for district heating to spread across the UK on a national level it is imperative that city planners are forced to consider energy efficient options when implementing new heating systems. Most industrial sites and production plants are located in the outskirts of cities, limiting the feasibility of retaining residual or surplus heat to be transferred it to a district heating system. There are modest incentives seen across the market within this area, but in order for there to be a sizable scale revolution something needs to be done on a national level. One such incentive, which has been put into action in England, is the previously mentioned London Plan. With the aid of the London Plan, the Government and the LDA are hoping to drive district heating into the future. Since developers are being forced to consider energy efficient options when refurbishing or creating new areas or estates, the possibility of wide spread district heating networks becomes a believable reality.

The current energy distribution system is considered to be a critical parameter. There is a long standing tradition in the UK of independent, individual gas supply systems

²³⁷ Roberts S. (2008)

²³⁸ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

²³⁹ Andrew Crafter, London Corporation, 2009-03-24

²⁴⁰ Svend Frederiksen, Professor Lund University, Department of Energy Sciences, 2009-05-

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

to each household. To pave the way for a district heating system this tradition needs to be broken and customers need to welcome a small connection fee. Heat distribution could most likely be metered in a similar fashion to that of the gas distribution system today.

Calculations made in a variety of published reports point to that the potential for district heating is notably higher in areas without an installed gas system, such as Shetland, or areas where refurbishment is unavoidable. Most of the cases studied explain that their focus lies on selling to new developments and areas undergoing refurbishment.²⁴¹ The gas system is also one of the major differences between the Swedish and the UK market.

Most cases of district heating utilize heat in cogeneration with electricity for generation. Therefore the structure of the electricity grid and electricity distribution system impacts the potential of district heating on the UK market. From Toke's and Fragaki's report it becomes clear that the current generation system does not favour power generation from CHP facilities used for district heating.²⁴²

10.8 Reflection

To summaries the influence of the surrounding environment we believe the parameters listed are important for the development of district heating. We have experienced that some of these parameters are not constant but rather changing over time. A variety of new strategic documents and budgets have been presented by the UK Government during our research process and we see a need for keeping track of the most important parameters.

New strategies are constantly presented but many seem to be empty worlds and we therefore believe that it is actions from the political arena that can possibly change the premises of district heating. It will be important to keep a close eye on the Renewable Heat Incentive. Since it will function as an obligation for fossil produced heat to help finance the renewable heat the potential of a strong incentive for district heating without major affect on UK Government finances arises.

Apart from political strategies and incentives we believe that other more stable parameters have a viable influence on the potential for development of district heating. The financing of district heating investments is a large obstacles and the need for private ownership of energy system might hinder the development. An institutional change giving more power to local authorities would enable lower discount rates and bring environmental and social benefits into the calculations.

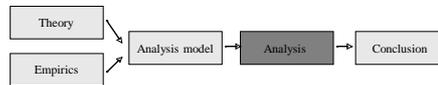
²⁴¹ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

²⁴² Toke D. (2008) p. 1449

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

In the context of knowledge transfer to the UK market, we see that the lack of technical competence as an important factor. The lack of awareness of district heating might hinder the development and increase the possibility to continue the unsuccessful story of district heating in the UK. However the relatively low knowledge level might be an important opportunity for export of consultancy services.

11 Analysis: The dynamics of the district heating market



This chapter presents the third stage in the analysis describing the dynamics of the district heating market in as wide of a context as we have been able to identify it.

In order to describe the dynamics of the district heating market we have decided to look not only at the multi-organizational constellation, but at external stakeholders who in turn influence the multi-organization.

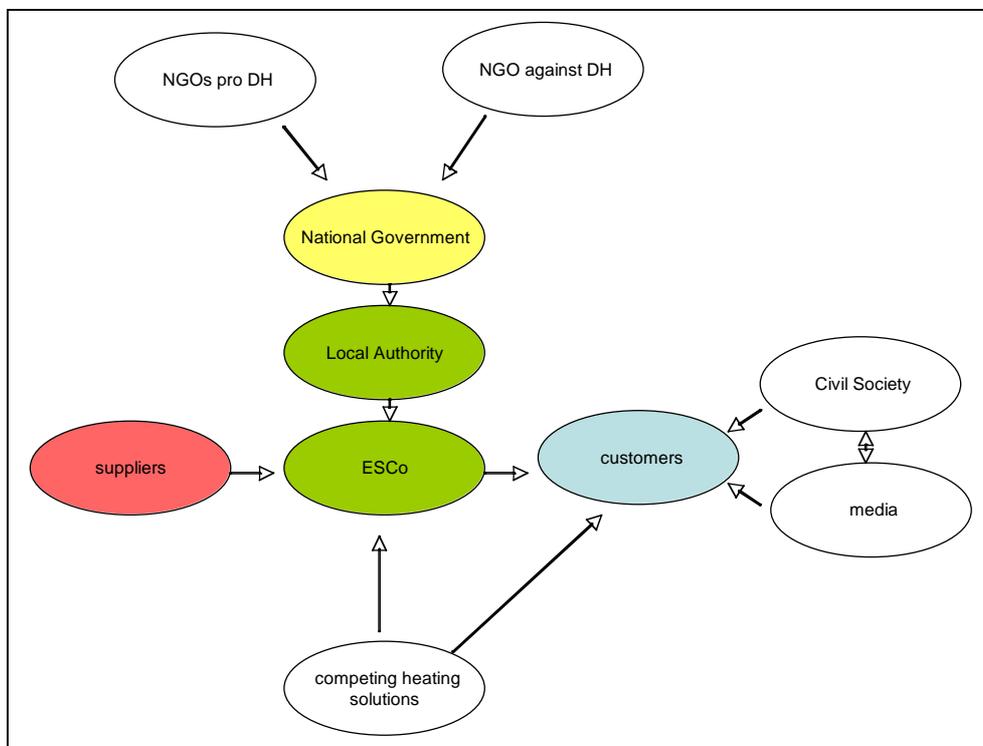


Figure 28 The multi-organization and the surrounding stakeholders of a district heating scheme

11.1 Stakeholders of the multi-organization

In order to get a clearer picture of the market situation and what factors influence and shape district heating in the UK, several stakeholders were identified with the aid of the Stakeholder Model. As described earlier the theory was interpreted and altered to better fit the district heating market. Below is a summary of what affects and elements of control that each of the stakeholders has on the multi-organization.

11.1.1 Competing heating solutions

One vital surrounding stakeholder is alternative heating systems for planned and /or existing energy systems installed in customer properties. Without the possibility to connect to the gas grid, district heating becomes more viable due to increased displacement costs when putting in a gas system. Illustrative examples of this are the Shetland, Highland and Aberdeen cases.

Competition from other energy solutions is vast. The large UK energy companies are showing constrained interest in district heating and without their pursuit large-scale transformation of the UK heating system will be onerous. Two energy companies, Scottish and Southern Energy and EON UK, have been found to hold strategies which include development of district heating, however to a fairly limited extent.

11.1.2 Civil Society

Public awareness and poor reputation of district heating in society has been explained earlier as a factor hindering the development of district heating. Public acceptance influences the customer's willingness to connect to any given scheme. The reputation of district heating in the public eye is fatally important since the customer has proven to be a key driver of many schemes. Neville Martin, creator of the Shetland scheme, accredits much of his success to the wide spread acceptance he has met from both clients and the general public.²⁴³

11.1.3 NGOs against DH / media

District heating from waste incineration is even more challenging to handle since environmental organizations such as Greenpeace, with the aid of various forms of media attention, paint a picture of hazardous emissions from these types of plants.²⁴⁴ The main obstruction of incineration is the public's fear of having plants located in close proximity to residential areas. Ewan Huc, waste management officer at the Highland council, argues that this fear is much more political than it is public. He believes that politicians have convinced themselves that the public will be disapproving of waste incineration without actually having the data to back it up.²⁴⁵ Thus plant locations remain remote and the possibility of finding customers to buy and utilize surplus heat becomes almost absurd.²⁴⁶

11.1.4 NGOs pro DH

The national lobbying organization for district heating is the Combined Heat and Power Association. They are however not purely concerned with issues of district heating but tend to lobby for efficient use of energy in general. Looking at the market situations and where it is at today, the UK seems to be in need of an organization

²⁴³ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

²⁴⁴ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

²⁴⁵ Ewan Huc, Waste management officer, Highland City Council, 2009-04-27

²⁴⁶ Simon Stockwell, Head of National Waste Plan at Scottish Government, 24-04-23

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

which can focus 100 percent on lobbying for district heating.²⁴⁷ The Swedish District Heating Association has a strong influence on a national political level, which has proved to be an important part of the governmental support for district heating in Sweden.²⁴⁸

11.2 The multi-organization of district heating schemes

There are a variety of different models that define the organizational structure of a scheme and the scheme developer can vary from case to case. Below is a short presentation of a few generalized models of ownership structures present on the UK market today. The scheme developer is an important stakeholder to categorize since he/she/it is in charge of any given project and thus holds the funding needed to acquire competence in terms of equipment, fuel supply and consultancy services.

The detailed multi-organization of a district heating schemes can be described as shown in Figure 29. The local authorities are in most of the cases studied both the initiator and the developer of the district heating scheme. The local authority is usually driven and influenced by targets passed down from national Government. The targets can touch on anything from cutting CO₂ emissions, reducing fuel poverty or finding efficient thermal treatment options of waste in order to reduce landfill. The Government can leverage the scheme developer with the aid of both subsidies and legislative measures. The initiation of a scheme often come from the local authority it self. Initiation does not equal ownership and the ownership constellations are almost as many as there are schemes. The local authority generally decides to set up an Energy Service Company (ESCO) that is set in charge of developing and operating the scheme. The actual supply of heat is in some cases separated from the ESCo. In many energy from waste schemes this is the preferred organizational model. The waste company incinerate waste to produces heat but cooperate with an energy company who are placed in charge of handling heat distribution. Clive Barber, states: “*Our competence is with treating waste not to supply energy*”.²⁴⁹

²⁴⁷ Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

²⁴⁸ Svend Frederiksen, Professor Lund University, Department of Energy Sciences

²⁴⁹ Clive Barber, Business Developer Scotland at Viridor Waste Management, 2009-04-24

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

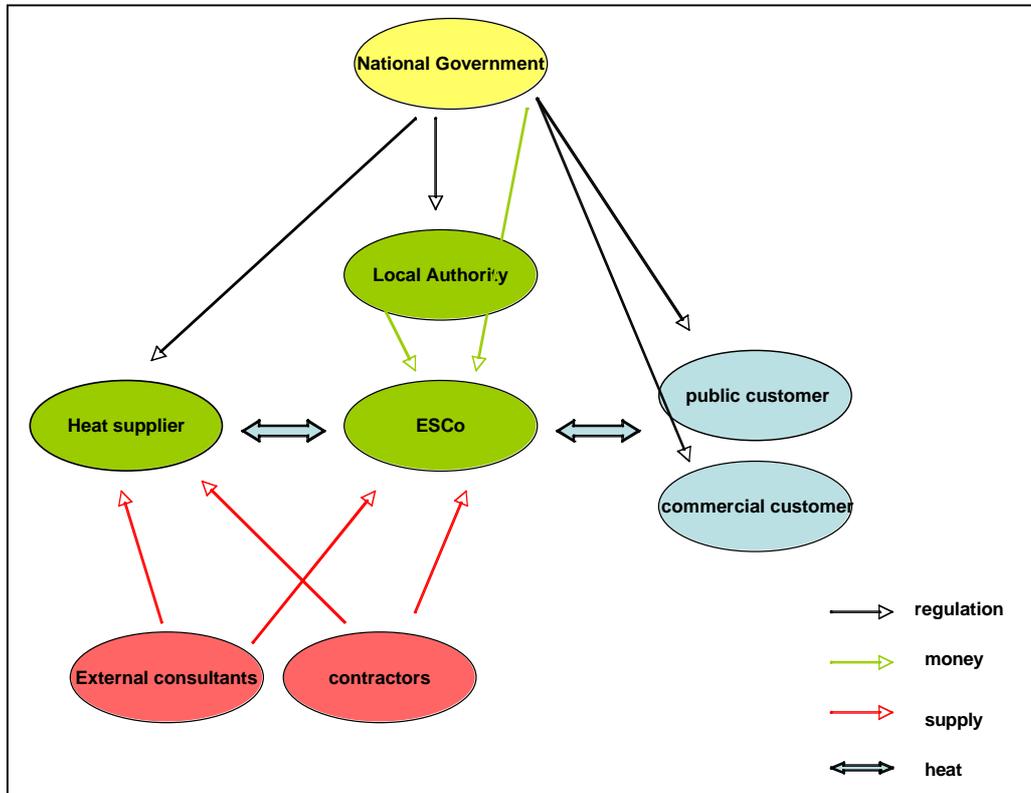


Figure 29. The multi-organization of a district heating scheme

There are a scarce number of privately owned schemes such as Southampton and Citigen, but even in those situations the local authority tends to play a principal role. The Southampton scheme is portrayed as being a private-public partnership with the public sector being the sole initiator.

11.2.1 National Authority - Government

As described in the surrounding environment, an important mission for the Government is creating strategies and incentives that drive the development of district heating schemes. These incentives are usually of a general nature, but it is important to discuss their plausible effect on the market. The national Government sets targets, which are forwarded to local authorities, strengthening the relationship between the two. Over the last few years, governmental energy strategies have focused prodigally on greener and more efficient energy sources. Wide scale district heating proposals are yet to surface from the national Government, thus limiting their interference and influence on the subject. The Government are under pressure to reach not only their own but EU wide targets. Stronger incentives are looming on the horizon and the

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

hope is that they will contribute to the development of district heating, for example the much anticipated Renewable Heat Incentive.

The strongest force which the Government can implement is various grant programs that are an important ingredient in the realization of a scheme. The Government holds the possibility of giving local city planners planning power over property developers. The national Government entertain direct relationships with property developers through requirements on energy declarations of properties. These requirements are enforced with the aid of Energy Performance Certificates and Building Regulations, which encourage the pursuit of energy efficient buildings.²⁵⁰

Another role which the Government has attempted to embody is aiding scheme developers and owners in overcoming the very dominant and hindering lack of knowledge present on the market today. They have the ambition to give developers the tools required to successfully develop district heating schemes. Apart from the subsidies listed and discussed in Chapter 10.2 the Government make sizable investments in education. This can be done through direct encouragement of specific schemes or through arrangement of Local Authority Summits where knowledge between scheme developers can be transferred.²⁵¹

11.2.2 Local Authorities – City Councils

In the Heat and Energy Strategy Consultation, local authority participation in district heating schemes is deliberated. Successful cases of district heating schemes have required involvement and encouragement from local authorities.²⁵² From the cases studied it becomes apparent that local authorities play an essential role in the development of both public and private schemes. Many of the cases present a project champion from the community council as the actual driver of the development of a scheme.

The UK financial system differs notably from the Swedish system and community councils do not have the financial means required for a formidable long-term investment in an energy system. In the UK such infrastructure is regularly owned by the private sector and hence, most of the cases studied have a public ownership structure. For some of the schemes such as Pimlico this dates back to the development of public schemes in the 1950's - 60's. Publicly owned schemes such as Shetland, Aberdeen and the Highlands, have been developed in more recent years but the realization of the schemes has required the drive from a true champion that have been veritably committed to the task. Without Neville Martin ploughing his way into

²⁵⁰ Heat and Energy Strategy Consultation, Department of Energy and Climate Change and Communities and Local Government, UK, February 2009, p103

²⁵¹ Heat and Energy Strategy Consultation, Department of Energy and Climate Change and Communities and Local Government, UK, February 2009, p103

²⁵² Heat and Energy Strategy Consultation, Department of Energy and Climate Change and Communities and Local Government, UK, February 2009, p.103

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

district heating, the Shetland scheme would never have come to be. Most of the project champions we met have themselves retained enough knowledge to drive the schemes forward. When asked how Aberdeen acquired the knowledge needed to create their district heating scheme Janice Lyon explained that she picked up much of her knowledge of district heating when she lived in Norway and she was inspired by the schemes she visited.²⁵³ It becomes apparent that if one single person is stubborn enough to fight for what they want, a district heating scheme can be realized, even entirely through a community council.

Albeit most local authorities do not have the possibility of developing schemes, the DECC recommend that local and regional authorities alike attempt to gain an understanding of the shaping of supply and demand of heat and energy of their area through heat mapping. With heat mapping DECC claims that the potential prospects from private scheme developers are more likely to arise.²⁵⁴

11.2.3 Energy Service Companies (ESCo)

The ESCOs can be owned by either private companies (Utilicom, Citigen) or Local Authorities (Shetland, Pimlico). In the Aberdeen case the ESCo, Aberdeen Heat and Power (AHP), was set up as an independent company without any shareholders. AHP is in charge of both the energy station and the district heating network in itself. All profits made are recycled back into the organization and used to expand and develop the scheme. By way of the ESCo, Aberdeen City Council can avoid being responsible for the financial risk of a district heating scheme, whilst still being able to control what decisions are made and how the scheme is run.²⁵⁵

11.2.4 The customer and the consumer

The consumer and the customer are not always the same stakeholder. For commercial and public loads they often are but for residential areas the housing association is considered to be the customer and residents the consumer.

The customer is an extremely important player when it comes to the development of a scheme. The developer needs to salvage the infallible composition of heat demand and strive for an as even demand as possible. In many of the publicly owned schemes there is a combination between residential buildings and public buildings connected to the scheme in the start-up phase.

The historical background and its impact on the cultural/social side of the surrounding environment, relates to customer perception of district heating. It is clear that this has

²⁵³ Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

²⁵⁴ Heat and Energy Strategy Consultation, Department of Energy and Climate Change and Communities and Local Government, UK, February 2009, p.99

²⁵⁵ Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

affected the general acceptance of district heating. To solve this issue in the long run, an important success factor is to re-establish the good name of district heating in the UK. Looking to the Shetland case, they used a stepwise approach to the development of their scheme. They have chosen to expand gradually and to connect customers as they go. The Shetland scheme has benefited abundantly from word of mouth marketing, due to its contribution in building a positive image.²⁵⁶

The scheme owner's relationship with property developers has proven to play a pivotal role in district heating. Not only establishing favourable relationships and trust funds can aid development, but some locations have started utilizing city planning power as a way of increasing the number of customer connection. The strongest case for planning power is the London Plan, where the Greater London Authority has created a policy where all new developers need to connect to a scheme if it is available or affordable. Similar measures have also been utilized in the Southampton case. In the Heat and Energy Strategy Consultation, the DECC encourage local authorities to develop such planning measures. They suggest that local authorities set Community Infrastructure Levies that can be utilized for planning power.²⁵⁷

Even though planning power has been utilized successfully both by the Southampton City Council and the London Corporation, Andrew Crafter states that the power of such measures is limited. The Citigen scheme is struggling with securing new connections and they are yet to see the effect of such measures due to the long time it takes from planning to the realization of a property.²⁵⁸

In the cases studied the initial connections have for the greater part been Governmental buildings. Local Government is habitually acting as both the initiator of a schemes as well as the introductory customer, which helps to secure heat loads for the scheme developer.

Many community councils have their own housing associations that are considered to be an important customer. In two of the cases housing associations drive development of their own district heating scheme (Pimlico and Scalloway in Shetland). The Scalloway case is a prime example of how a successful scheme can influence others around it to develop their own schemes.

11.2.5 Consultancy services

In private ownership or in public-private partnerships the multi-organization tends to be of a smaller nature and the private owner is easily defined as the centre of the organization and thus the main stakeholder to consider for a company attempting to make an entrance on the market. Projects tend to be easier to manage under public

²⁵⁶ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

²⁵⁷ Heat and Energy Strategy Consultation, Department of Energy and Climate Change and Communities and Local Government, UK, February 2009, p.98

²⁵⁸ Andrew Crafter, London Corporation, 2009-03-24

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

ownership and the accessibility of information and public procurement makes the market more open to establishment than the private market.

In almost all publicly owned schemes there has been the need for external consultancy services to finalize feasibility studies and procurement processes and to identify possible development projects. Qualified engineers seem to be one of the reasons why UK scheme developers are drawn to the idea of hiring Nordic consultants. Some of the public scheme developers require turn-key solutions from their contractors (Highland, Pimlico) while some prefer to manage the scheme on their own to retain control (Shetland, Aberdeen). Aberdeen Heat and Power have chosen to not procure turn-key solutions, as they can save up to 15% of the procurement cost, receiving the best possible price from each contractor, whilst being able to control which labour forces are being used. It is extremely important for Janice Lyon and all of the people involved in the Aberdeen scheme that the scheme benefits the local population and economy.²⁵⁹

The role of an external consultant within the multi-organizational network is to contribute technological knowledge which is often confined within the owner organization. In some of the cases studied the use of external consultants is described as one of the underlying success factors of the development of a scheme. Private schemes such as Citigen have employed PB Energy as an external consultant to present feasibility studies as well as consultations on future development plans.²⁶⁰ On the other hand, the privately owned Southampton scheme claims not to utilize external consultants.

Almost all public developers would prefer to use a Nordic technical consultant over a UK one, an example of this being the London Thames Gateway Project, led by the LDA, which consulted the Danish firm Rambøll.²⁶¹ David Wickersham from the Pimlico case claims that they try to use as fleeting external services as possible and instead build up the knowledge within their own organization.²⁶² David believes that he has attained enough knowledge over the years to run PDHU without difficulties, and bringing someone in from the outside would allegedly do more harm than good.

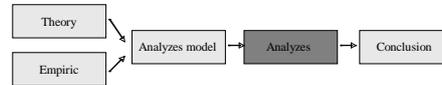
²⁵⁹ Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

²⁶⁰ Andrew Crafter, London Corporation, 2009-03-24

²⁶¹ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

²⁶² David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

12 Analysis: Exploring opportunities



This chapter presents the last stage of the analysis describing how identified opportunities of consultancy service export can be explored.

The market for district heating in the UK is small but none the less vibrant and there are Danish consultants currently selling services to scheme developers. Five out of the nine schemes studied have implemented consultancy services. It is clear that a drive for acquisition of out-of-nation competence exists. There are ambitious target hoping to be reached but not enough strong incentives to pave the way for rapid development of district heating. Most of the people we have spoken to, claim that more than ever changes are occurring in the district heating industry. With the formation of the Heat Energy Strategy, for the first time heat is brought to light on the political arena.²⁶³ It is therefore important for a company with an interest in the market to keep track of not only political strategies, but more importantly, political incentives. If the Renewable Heat Incentive is realized it will function as a strong driver of increased district heating.

The constellation of the multi-organization quite unmistakably differs between projects. The opportunities and ways of selling consultancy services vary between all of the cases studied, but we hope to provide some insight into general opportunities in terms of selling consultancy services.

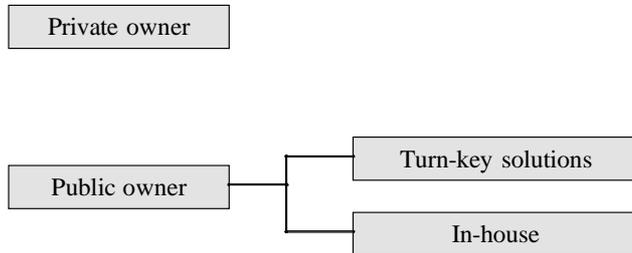
It is important to keep in mind that the scheme owner that is ultimately responsible for the acquisition of consultancy services. A consultant needs to remember that the stakeholder network is complex and the need to cooperate with a more extensive field of the multi-organizational network is inescapable.

12.1 Market segmentation

By segmenting the market we hope to give some general insights to how to determine a beneficial strategic position. Public developers have been distinguished from private developers and each sector represents a segment to consider.

²⁶³ Robin Wiltshire, BRE and IEA, 2009-04-21

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market



Private ownership

Privately developed schemes can be initiated by public and/or private aims. E.ON (Citigen) have made use of external consultants, whilst in the Southampton case, Utilicom have refrained from venturing out-of-house. A private developer tends to have more knowledge and engineering skill and less need for consultancy services. On the other hand a private developer is more likely to develop a handful of schemes and therefore the potential of larger commissions is greater. In the Dunbar case, Viridor Waste Management state that they would rather partner with an energy company than be forced to tackle the heating aspect of their planned waste to energy plant.

Public ownership

Publicly developed schemes tend to require more knowledge and in most cases they are more open to the acquisition of foreign consultants. These schemes are often initiated by a project champion and the organization around the scheme is usually small scale. A key success factor for a consultant entering the market is to be able to recognize and befriend the project champion. All services for a public developed scheme need to be acquired in accordance with an EU standard public procurement process, which could provide a point of entry for the first targeted commission.

Turn-key

If a local authority retains limited knowledge and experience, the developer tends to demand a turn-key solution when developing a scheme. In this segment feasibility studies and procurement opportunities could be carried out for the local authority, but the scheme would eventually end up in the hands of an ESCo and the consultant would have to be prepared for an ownership shift. If a private energy company then takes over the operation consultants have to address their services to a new partner.

In-house

A local authority that wishes to remain in charge of a scheme tends to want to contract all the bits and pieces separately and is in most cases in need of a consultant for the engineering aspects of a scheme. This segment is most likely to form a long-term agreement with a consultant. If an external consultant can develop a mutually lucrative relationship with a contractor on the UK market, their entry position can be significantly improved.

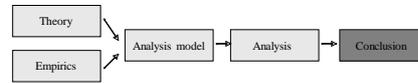
12.2 Identifying the strategic position

Spreading of experiences between scheme developers seems to be deeply rooted in the UK. If a consultant manages to establish a position on the market, chances are that other projects will develop an interest and new opportunities will arise. Highland City Council claimed to consider using the consultant employed by Neville Martin, the waste management company and the energy company on Shetland. Even though most of the scheme developers have been supportive of acquiring knowledge from abroad there are some obvious advantages to being a local player. Developers require knowledge of UK politics and the abundance of funding programs presented by the Government. The scheme owners require assistance in regards to not only technology but management and organizational skills. A strategy suggested by Janice Lyon, Aberdeen City Council, was for foreign consultants to partner with a local player. John Ferguson²⁶⁴ Binn Eco Park claims that a joint venture between a Nordic and local consultant would be most beneficial to the developer, who would then get the best of both worlds.

Another lucrative way of transferring knowledge seems to be meeting with local authorities and scheme developers in Nordic countries. Many of the districts heating developers in the UK have taken trips to Scandinavia in order to find inspiration for their own schemes. Peter North, LDA, claimed it is an efficient way of finding out how it schemes are implemented and operated successfully; thus eliminating the reinvention of the wheel. Neville Martin, Shetland Heat Energy and Power, stated that they were inspired by the Bornholm (Denmark) district heating scheme and that the Shetland scheme has been constructed as a replica of the said scheme.

²⁶⁴ John Ferguson, Director of Strategy at Binn Eco Park, 2009-04-24

13 Conclusion



This chapter summarizes the findings and the analysis made in the previous three chapters.

When examining the district heating market in the UK it has become apparent that something is stirring under the surface. The Government are under undeniable pressure to deliver reliable incentives that will drive CO₂ emission reductions. If nothing changes, import of gas will continue and in the worst case scenario fuel poverty levels will increase.

We entered the field with a focus on identifying possibilities of converting the many inefficient gas and coal fired power stations in the UK into CHP plants. A shift of this magnitude would possibly revolutionize the heating system of the UK but no such trends have been identified on the market.

Instead we have identified an increasing interest in small-scale district heating development and a trend of local authority initiations of district heating schemes. We have also identified that there is no one absolute way of putting together a successful scheme and the variety of stakeholder constellations are as many as the number of schemes.

The purpose of this thesis was to complete the following three tasks: first to describe the surrounding environment and the dynamics of the UK district heating market which has been presented through case studies and analysis of various reports and information collected from the case studies. The second task was to identify the growth potential of the UK district heating market, which we have identified as dependent on the following four criteria:

- ✓ Incentive
- ✓ Sufficient funding
- ✓ Knowledge
- ✓ Customers

The four criteria are very much entangled in one another and without all four criteria present; development of a scheme will be an extraordinary challenge. To start off with it seems that one of the only concrete ways for district heating to de facto take off in the UK is for the Government to push incentives and create funds and trusts that can be tapped into by local authorities or community councils. The experience gained from the various cases studied is that although it seems that there is a shift in public and private view of district heating something concrete needs to be done. There are an abundance of studies, rapports, incentives and legislation pushing for the

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

development of energy efficient heat production in the UK. It is time for the UK Government to put what is already on paper into planned action. Incentives can, as we have seen in cases such as the Aberdeen City Council, be a strive toward reduction of fuel poverty or simply improved local economy. Whatever the incentive, there needs to be a desire for change present in order to convince not only Governments and authorities, but also the general public that the development of a scheme is a good idea.

Entangled in the incentives are the issues of funding. Investments in district heating are substantial and most public organizations do not have funds available to make such an investment. Without an investor or the ability to receive funds from local and/or national government, development of a scheme will remain a mere fantasy. There have throughout the years been several programs which local authorities have been able to tap into in order to fund projects, but many have dispersed and the need for new programs to surface is dire. However funding from grant programs has proven to be insufficient and local authorities need to be able to provide some of the capital costs themselves.

An additional instrument on part of society, common in Scandinavia, is the provision of long-term loans by the Government or local authorities at favourable interest rates, allowing for lower levels of interest on loans. Experience shows that securities can pave the way for favourable financing of sound schemes on the international capital market.²⁶⁵

With funding out of the way, one is still faced with the issue of knowledge. What can be seen on the market today is that without a determined and competent local project champion a district heating scheme will struggle to get off the ground. Without commitment from people like Neville Martin, Janice Lyon and John Ferguson the largest and most successful schemes in the UK would never have come to stance. In connection with this comes the importance of spreading information and knowledge. There is a clear lack of knowledge in regards to district heating on the UK market, which must be spread if there is going to be any chance of an energy revolution. The district heating community is keen on spreading information not only to one another but to anyone showing interest in the technology. The UK need to develop their own skilled and knowledgeable workforce. The most successful way of doing this seems to be to learn from the Nordic countries and to work in collaboration with companies who already retain the knowledge needed.

The last and final criterion which ultimately determines the fate of a scheme is the customer. It is all fine and dandy if there are strong incentives, funding and knowledge present to develop a scheme, but without customers the scheme serves no purpose. In order for a district heating scheme to be successful it needs to be connected to customers who can make use of the offset of heat collected and

²⁶⁵ Svend Frederiksen, Professor Lund University, Department of Energy Sciences, 2009-05-26

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

distributed. This has unfortunately proven difficult in many areas of the UK since sufficient energy sources often seem to be isolated from possible and profitable customers.

The unfortunate reputation of district heating is still inhibiting development of schemes and it is therefore important to show the social community and potential customer that it is indeed a reliable heat source providing environmental and economic advantages for the end consumer. This can only be done with the help of good practice, however if engineering fails again there will be no second redemption for district heating in the UK.

Combining district heating with district cooling can be a way of raising the prestige level of district heating. It can be a viable option in larger cities where hotels, office buildings and other buildings with large cooling demands can create a market for cooling services.

The last and final task was to identify possible opportunities for export of consultancy services to the UK district heating market. This too has been compiled in a list of criteria which need to be synced in order for market entry to be deemed profitable.

- ✓ Ownership structure
- ✓ Development process of the scheme
- ✓ Level of knowledge within the organization of the scheme developer
- ✓ The scheme developer's availability to knowledge (is there competition?)
- ✓ Size of scheme and size of consultancy services needed

Many of the privately owned schemes do not bring in external consultants but rather try to keep as much of the work as possible in-house. Depending on the development process of a scheme the possibility for an external consultant to enter varies. In schemes like Aberdeen and the Highlands the possibility for an external consultant to contribute with services is real to say the least. However in schemes such as Pimlico, where the owners want to keep everything within the original organization the chances of entry are slim.

The level of knowledge within the system builder organization is of course a determining factor in regards to if consultancy services are required or not. As it seems on a whole, most of the companies are in need of external input of knowledge and competence. What actually determines the possibility for a consultant to enter is the availability of knowledge. As Clive Barber mentioned, Viridor do not require external Nordic consultants because they have a developed network of contractors and consultants and know where they can acquire the knowledge which they lack. The final determining factor is for an external consultant to look at the size of the scheme and determine if there is enough work to be done that taking on a project would be profitable. What we have come across as a very real opportunity is that once a company has established their position on the market and their relationship with one

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

customer, the chance to be recommended to neighbouring projects is vast. As we have mentioned the district heating community is a very tight knit one and word travels fast between schemes and developers.

Even though many consultants seem to think the current market is too small we believe that VPC need to keep the market under close observation in order to identify upcoming opportunities. Current drivers for an extensive development of district heating are lacking, however there seems to be a political shift about to surface which should help to push the recognition of the potential of district heating in cutting CO₂ emissions. We believe that with the establishment of one investment on the UK market, there is a good chance of it becoming a profitable venture.

13.1 Future Research

The *Industrial Landscaping Model* that has been developed is a good start for mapping the UK district heating market. It was developed with the aid of important characteristics identified on the market and is believed to provide a good picture of the current situation. However it can only be considered a start and it would be interesting to utilize other theories in order to analyze the market.

It would be interesting to see how well the model could be applied to investigations of other geographical district heating markets or if it would be suitable for a non-consultant stakeholder. It would also be interesting to apply the model to another complex market, for example to see the potential of application to the energy sector in general. Reoccurring characteristics, such as a complex ownership structure and a market strongly influenced by Governmental interests, might make the model applicable to other energy markets.

References

Books

- Edvardsson, B. et al. (1992) Internationalisering i tjänsteföretag, Studentlitteratur
- Frederiksen, S. and Werner, S. (1993) Fjärrvärme – Teori, Teknik och Funktion, Studentlitteratur
- Freeman, E. (1984) Strategic Management: A Stakeholder Approach, Pitman, Boston
- Jacobsen, D. I. (2002) Vad, hur och varför? Om metodval i företagsekonomi och andra samhällsvetenskapliga ämnen, Studentlitteratur
- Johnson, G. Scholes, K. and Whittington, R. (2008) Exploring Corporate Strategy 8th edition, Prentice Hall
- Summerton, J. (1992) District heating comes to town – The social shaping of an energy system, Affärlitteratur AB, Linköping
- Svenning, C. (1999) Method 101, Lorentz publishing

Interviews

- Alina Lazar, Environmental Team Greater London Authority, 09-04-20
- Andrew Crafter, London Corporation, 2009-03-24
- Brian Leask, Property Service Manager at Hjalmland Housing Association, 2009-04-29
- Clive Barber, Business Developer Scotland at Viridor Waste Management, 2009-04-24
- Colin McLeod, Manager of Aberdeen Heat and Power, 2009-05-11
- David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21
- Ewan Huc, Waste management officer, Highland Council, 2009-04-27
- Gavin McKenzie, Pimlico District Heating Undertaken, 2009-04-21
- James McKenzie, Policy Officer of Renewable Department at Scottish Government, 2009-04-23
- Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30
- Jason Taylor, Energy Manger at Southampton City Council, 2009-03-12
- John Ferguson, Director of Strategy at Binn Eco Park, 2009-04-24

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Michael King, Combined Heat and Power Association, 2009-04-20

Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

Robert Tudway, Department of Energy and Climate Change, 2009-04-20

Robin Wiltshire, Chairman International Energy Agency and employee at Business and Research Enterprise (BRE), 2009-04-21

Simon Stockwell, Head of National Waste Plan at Scottish Government, 2009-04-23

Steve Vizer, EON UK, 2009-04-22

Sue Kearns, Head of Renewables Strategy & Onshore Renewables, Scottish Government, 2009-03-30

Svend Frederiksen, Professor Lund University, Department of Energy Sciences, 2009-04-17

Reports

Analysis of the UK potential for Combined Heat and Power, Department of Environment Food and Rural Affairs, UK, 2007
www.defra.gov.uk/environment/climatechange/uk/energy/chp/pdf/potential-report.pdf

CHP at the hart of Government: case study Whitehall district heating scheme, CHP Club, UK, 2001

CHP/DHC Country Scorecard: United Kingdom, International Energy Agency and AEA Technology, 2007
www.iea.org/G8/CHP/chp.asp.

Climate Change - The UK Programme, Department of Environment Food and Rural Affairs, UK, 2006

Combined Heat and Power in Aberdeen, Aberdeen City Council and Aberdeen Heat and Power February 2009

Community heating – a guide, Energy Saving Trust, UK, 2004
www.est.org.uk/download.cfm?p=1&pid=337

Consultation on the Form and Content of New Climate Change Agreements, Department of Energy and Climate Change, UK, 2009
www.decc.gov.uk/en/content/cms/consultations/climate_change_agree/climate_change_agree.aspx

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Digest of the United Kingdom Energy Statistics, Department of Business Enterprise and Regulatory Reform, UK, 2008
www.berr.gov.uk/energy/statistics/publications/dukes/page45537.html

District Heating and Cooling country by country/2007 survey, Euroheat & Power, May 2007
www.euroheat.org

Energy services: The development of community heating in Southampton, Energy Saving Trust, 2007
www.energysavingtrust.org.uk

Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2007
www.berr.gov.uk/energy/whitepaper/page39534.html

Geothermie district Heating Scheme: Southampton United Kingdom, Energie-Cités in collaboration with the City of Southampton, UK, 2001
www.managenergy.net/products/R124.htm

Guidance on procuring energy services to deliver community heating and power schemes, Action Energy from The Carbon Trust, 2004

Heat and Energy Strategy Consultation, Department of Energy and Climate Change and Communities and Local Government, UK, February 2009

Heat call for evidence, Department of Business Enterprise and Regulatory Reform, UK, 2008

Making ESCOs Work: Guidance and Advice on Setting Up and Delivering an ESCO, London Energy Partnership, The Greater London Authority, UK, 2007

Pimlico District Heating Undertaking: a case study of community heating CE 125, Energy Saving Trust, UK, 2005
www.energysavingtrust.org.uk

Renewable Heat and Heat from CHP Plants – Study and Analysis, AEA Technology, UK
www.berr.gov.uk/files/file21141.pdf

Renewable heat initial business case, Department of Business Enterprise and Regulatory Reform and Department of Environment Food and Rural Affairs, UK, 2007
www.berr.gov.uk/files/file41432.pdf

Response to the consultation paper on the energy review, Combined Heat and Power Association, 2006

Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008

Technology Characterization: as Turbines, Energy and Environmental Analysis, USA, 2008
www.epa.gov/chp/basic/catalog.html

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Technology Characterization: Steam Turbines, Energy and Environmental Analysis, USA, 2008

www.epa.gov/chp/basic/catalog.html

The City of London Combined Heat and Power System, The City of London Corporation, UK
www.cityoflondon.gov.uk/corporation/LGNL_Services/Environment_and_planning/Sustainability/sustainability.htm

The Government's Strategy for Combined heat and Power to 2010, Department of Environment Food and Rural Affairs, UK, 2004

www.defra.gov.uk/environment/climatechange/uk/energy/chp/pdf/chp-strategy.pdf

The London Plan - Sustainable Energy, Greater London Authority, UK

www.london.gov.uk/thelondonplan/climate/sustainable_energy.jsp

The Scottish Government new vision for waste, January 2008

www.scotland.gov.uk/News/This-Week/Speeches/Greener/vision-for-waste

The UK Potential for Community Heating with Combined Heat and Power, Business and Research Enterprise (BRE), UK, 2003

www.energysavingtrust.org.uk/uploads/documents/housingbuildings/UK%20CH%20potential%20report_CTFinal.pdf

Thermal treatment waste guidelines, Scottish Environmental Protection Agency, 2009

http://www.sepa.org.uk/about_us/sepa_boards/the_agency_board/agendas_and_papers/idoc.aspx?docid=e3b3515c-5223-4052-a68e-0b1ae8e550e8&version=-1

Urban Community heating and cooling: The Southampton district energy scheme, International Energy Agency

<http://www.iea-dhc.org/download/KN1640%20Southampton%20v2.pdf>

Articles

Babus'Haq R. F. Probert, S. D. (1996) Combine Heat and Power implementation in the UK: Past Present and Prospective Development, *Applied Energy* 53, p 47-76

Collier, U. Löfstedt, R. E. (1997) Think globally, act locally? Local climate change and energy policies in Sweden and the UK, *Global Environmental Change*, Vol.7, No. 1, p 25-44

Eisenhardt, K. M. (1999) "Building Theories from Case Study Research", *Academy of Management Review*. Vol 14 No. 4. p. 532-550

Fassin, Y. (2009) The Stakeholder Model Refined, *Journal of Business Ethics*, 84:113–135

Greener homes for the future, The Department for Communities and Local Government, 2008

Harvey, K. (1994) The development of combined heat and power in the UK, *Energy Policy*, February, p. 179-181

Jick, T. D. (1979) Mixing qualitative and quantitative method: triangulation in action, *Administrative Science Quarterly*, Vol 24 No. Dec, p. 602-611

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

McNaught, C. (1998) A UK strategy for combined heat and power, *Developments in Combined Heat and Power Into the Millennium* (Ref. No. 1998/226), IEE Colloquium, 20 May

Roberts, S. (2008) Infrastructure challenges for the built environment, *Energy Policy* 36, 4563–4567

Roloff, J. (2008) Learning from Multi-Stakeholder Networks: Issue-Focused Stakeholder Management, *Journal of Business Ethics*, 82:233–250

Toke, D. Fragaki, A. (2008) Do liberalized energy markets help or hinder CHP and district heating? The case of the UK, *Energy Policy* 36 p. 1449

Walker, G. (2008) What are the barriers and incentives for community-owned means of energy production and use? *Energy Policy* 36, p. 4401–4405

Electronic Sources

Binn Skips, 2009-05-18
<http://www.binnskips.co.uk>

Business Research Establishment
www.bre.co.uk

British Wind Energy Association, 2009-05-17
www.bwea.com

Climate Change Levy
www.bwea.com/business/lec.html

Renewable Obligation Certificates
www.bwea.com/business/roc.html

Carbon Trust
www.carbontrust.co.uk

Central Electricity Generating Board
www.opsi.gov.uk/si/si2001/20013421.htm

Climate Change Agreement
www.carbontrust.co.uk/climatechange/policy/cc_agreements.htm

The Carbon Reduction Commitment www.carbontrust.co.uk/climatechange/policy/CRC.htm

Combined Heat and Power Association
www.chpa.co.uk

Department of Business Enterprise and Regulatory Reform
www.berr.gov.uk
Renewable Heat Incentive:

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

www.berr.gov.uk/energy/sources/renewables/policy/renewableheatincentive/page50364.html

Departments of Communities and Local Government
www.communities.gov.uk

Department of Energy and Climate Change and Communities
www.DECC.gov.uk

Community Energy Saving Programme:
www.decc.gov.uk/en/content/cms/consultations/open/cesp/cesp.aspx

Department of Environment, Food and Rural Affairs
www.defra.gov.uk

Climate Change Agreement:
www.defra.gov.uk/environment/climatechange/uk/business/cca/agreements.htm

Climate Change Act:
www.defra.gov.uk/ENVIRONMENT/climatechange/uk/legislation/provisions.htm

Carbon Reduction Commitment:
www.defra.gov.uk/environment/climatechange/uk/business/crc/about.htm

Energy Saving Trust
www.energysavingtrust.org.uk

Eurosite, 2009-05-18
www.eurosite.org/en-UK/content/eu-funding-overview

Highland Council, waste management strategy
www.highland.gov.uk/yourcouncil/news/newsreleases/2009/March/2009-03-19-00.htm

International District Energy Association, 2009-05-08
www.districtenergy.org/chp.htm

International Energy Agency
www.iea.org

Community Heating
www.energy.rochester.edu/uk/chpa/commheat/ukhist.htm, 2009-05-08

London Development Agency, London Thames Gateway Heat Network
www.ltgheat.net

National Association of Energy Service Companies, 2009-05-18
www.naesco.org/resources/esco.htm

The Office of the Gas and Electricity Markets
www.ofgem.gov.uk

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

Scottish Government
www.scotland.gov.uk

Shetlands Heat Energy and Power
www.sheap-ltd.co.uk

Svensk Fjärrvärme, Sweden, 2009-05-07
www.svenskfjarrvarme.se

Appendix I: Government incentives

Things that have been done to aid progress of CHP and district heating.²⁶⁶

- *“Relaxation of the electricity licensing regime:* Since privatization action has been taken in order to make it easier to export surplus power from on-site generation. The Electricity (Class Exemptions from the Requirement for a License) Order 1995 introduced the following changes which allowed for more CHP operators to escape certain licensing requirements and because of this they can avoid certain levy payments.
 - ✓ Increasing the level of supply at which a generation license is required from 10 to 50 MWe
 - ✓ Allowing the temporary supply of power above 50 MWe in certain circumstances
 - ✓ Extending the transitional exemption granted to certain suppliers at electricity privatization to 31 March 1998
 - ✓ Relaxation of the 51 % own use' rule

Currently DTI and OFFER are consulting on the evolution of the licensing regime post 1998. On 30 April 1996 the DTI announced plans for a further relaxation of the exemption conditions in the run-up to full supply competition in 1998 to allow exempt suppliers to supply on-site, or over private wires, up to 100 MWe to any commercial or industrial customers. Of that amount, up to 1 MWe may be supplied to domestic customers subject to the condition that prices charged do not exceed a certain figure.

- *Relaxation of the resupply of electricity:* The rules regarding the resupply of electricity and multi-occupation have been changed, giving more flexibility for CHP scheme operation and the opportunity for more on-site customers to benefit from CHP.
- *Changes to the on-site supply rules:* The introduction of net trading' means that electricity used on-site does not now have to be sold through the Pool, removing a burden from the CHP operator.
- *Revised arrangements for connecting generating plant:* These have been implemented through the Distribution Code and Public Electricity Supplier (PES) connection agreements which have become more balanced following OFFER determinations. Further consideration is currently being given to the various issues regarding the connection of embedded generation to the PES distribution systems.

²⁶⁶ McNaught, C. (1998)

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

- *Standards of Performance now includes CHP:* The Director General of Electricity Supply has agreed that CHP involving Community Heating, where it displaces electric heating systems, can be supported under the Public Electricity Suppliers' obligations under the Standards of Performance requirements. This is being promoted and overseen by the Energy Saving Trust and the CHPA Agency.
- *Separate treatment for Waste-Fired CHP under the Non-Fossil Fuel Obligation (NFFO):* The NFFO provides long term contracts for electricity from certain renewable sources and aims to create an initial market for this type of power generation. The Government recently amended the Electricity Act so that Municipal Waste-Fired CHP schemes would not be disadvantaged by the NFFO encouraging electricity generation to be maximized at the expense of heat supply. The new arrangements will apply to the fourth round of bids for a share of the fossil fuel levy.
- *Relaxation of capital finance rules:* Relaxations to the local authority capital finance rules are helping to facilitate the development of Community Heating and CHP through partnerships with the private sector. Changes to the rules announced on 21 May 1996 will remove funding restrictions from PFI deals entered into by local authorities with the private sector. Providing schemes meet risk transfer tests and value for money there will be no cost to authorities' capital resources. Schemes will also be eligible for revenue support. Despite the good progress made, meeting the target is still a challenge, and will require continuing effort from both Government and industry, particularly in the period up to complete liberalization.”

Below is a presentation of incentives and regulations that have been brought forth in order to aid UK in their process of attaining a more sustainable way of life. Many of the incentives are being taken by the government itself; however there are an abundance of organizations and communities that are striving towards the same goals.

Conclusions of the Review of Energy Sources for Power Generation, 1998

This review was based on the first Energy White Paper which strongly supported CHP. The paper justified CHP exemption from the gas generation development ban and it predicted possible negative effects that the new trading arrangements could have on CHP and renewable generators.²⁶⁷

Climate Change Levy (CCL), 2001

The Climate Change Levy was introduced on April 1st 2001 and it is a taxation on the use of energy for both business and the public sector. The thought behind the levy is to encourage the industrial sector to become more energy efficient and thus reduce

²⁶⁷ Response to the consultation paper on the energy review, Combined Heat and Power Association, 2006

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

carbon emission. The Government is expecting the levy to cut carbon emission by 3.5 million tons per year by 2010, and has already saved 16.5 million tons between 2001 and 2005. In the year 2001/2002 alone the levy raised close to £1 billion, whereof 100% was recycled back into UK businesses. The money was collected through a 0.3% cut in the employers' Nation Insurance Contributions (NIC) and £150 million which was given by the government as support of energy efficient measures and energy-saving technologies. Businesses will not only benefit from the cut in NICs, but also from the tax exemption for electricity generated from new forms of renewable energy as well as energy generated through good quality CHP. Since 2007 the Climate Change Levy has been indexed to the rate of inflation and 100% of the revenues are still being recycled into business. An analysis made by Cambridge Econometrics showed that the levy has lead to a notable decrease in demand of energy among businesses which in turn has resulted in a decrease of carbon emission. The levy has been described as the "*the most effective instrument to date for reducing emissions in the business sector*".²⁶⁸

Renewable Obligation Certificate (ROCs), 2002

The Renewables Obligation requires power suppliers to derive a certain proportion of the electricity they sell to customers from renewables. When the Obligation was put into force the required proportion was at 3%, rising to 10.4% by 2010 and hoping to reach 15.4% by 2015. The Obligation is guaranteed in law until 2027. ROCs are given to renewable generators for each MWh of electricity they generate, and can then be sold to suppliers in order for them to fulfill their obligation. Either suppliers must present enough certificates to cover their requirements or they can buy obligations to cover any shortfall. The so called "buyout" price is set on an annual basis by Ofgem, and was set to £34.30/MWh in 07/08. The trading of ROCs is administered by the Non-Fossil Purchase Agency, and the proceeds are recycled back to the suppliers. Originally the ROCs were thought-out to increase the uptake of renewables, and have lead to an increase in profitability of renewable energy generation.²⁶⁹

The Energy Review, 2002

In this review it was proven that industrial CHP as well as micro-CHP could make notable contributions to CO₂ reductions.²⁷⁰

Energy White Paper, 2003 and 2007

The Energy White Paper, renewed in 2007, was created by BERR (Department for Business Enterprise & Regulatory Reform) and includes a vision of increased use of decentralized CHP generation by 2020. BERR present a large amount of policy

²⁶⁸ British Wind Energy Association, Climate Change Levy

²⁶⁹ British Wind Energy Association, Renewable Obligation Certificate

²⁷⁰ Response to the consultation paper on the energy review, Combined Heat and Power Association, 2006

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

measures for various CHP markets, however in practice most of these initiatives seem to have fallen through the cracks.²⁷¹

According to BERR England needs to:

- Save energy
- Develop cleaner energy supplies
- Secure reliable energy supplies at prices set in competitive markets

BERR present a list of six main objectives to allow England to reach the three goals presented above²⁷²:

- *Establish an international framework to tackle climate change:* BERR think that the framework should include a vision for how to stabilize the concentration of greenhouse gases currently in the atmosphere. They want the EU Emissions Trading Scheme (ETS) to set a market price for carbon. This price should then be used as the basis for the global carbon market, which would allow for a cost-effective reduction of carbon emission.
- *Provide legally binding carbon targets for the whole UK economy, progressively reducing emission:* The Climate Change Bill has created a new legal framework for the UK to achieve a 26-32% reduction of CO₂ emission by 2020 and at least 60% reduction by 2050. The government will be forced to set five-year carbon budgets which creates limits on aggregate CO₂ emission.
- *Make further progress in achieving fully competitive and transparent international market:* Companies will be able to get access to needed energy resources, creating an effective market. This will then allow for efficient use of resources and a low-cost transition to a low-carbon economy. Further liberalization of EU energy markets plays an important role in this.
- *Encourage more energy saving through better information, incentives and regulation:* Everyone, businesses and individuals, can take the step towards reducing emissions and energy dependence if the barriers to taking up cost-effective energy efficiency measures are lowered or in a best case scenario dispersed.
- *Provide more support for low carbon technologies:* It is not enough that the private sector places investments in R&D, demonstration and deployment of these technologies. Initiatives need to be made for global investments.

²⁷¹ Response to the consultation paper on the energy review, Combined Heat and Power Association, 2006

²⁷² Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2003, Executive Summary

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

- *Ensure the right conditions for investment:* There needs to be a clear and structured regime that which reduces uncertainty for businesses and ensures timely investments. BERR think that the planning system needs to be improved and that more information and better analysis of the long-term energy market trends needs to be carried out in order to make informed purchasing and investment decisions.

BERR's strategy for reducing carbon emission on the short term is to save energy. Saving energy can help to create security of supply and in turn help to reduce fuel poverty. "We will therefore press for higher EU and international standards to improve vehicles' fuel efficiency and increase the energy efficiency of products, including by reducing levels of stand-by power. We support the Commission's proposals to save 20% of the EU's energy consumption through improved energy efficiency by 2020. And we are working with our G8 partners to deliver commitments to promote international cooperation on product labeling and standards."²⁷³

Below is a list of incentives BERR are pushing for in order to increase the use of CHP and allow for development of energy efficient buildings and energy production schemes. They are making a push for saving energy within the following five sectors²⁷⁴:

- *Business:* BERR have decided to introduce a mandatory cap and trade scheme, Carbon Reduction Commitment, applicable to the largest players in the industry (those whose mandatory half hourly metered electricity consumption is greater than 6,000MWh per year). All business premises must have an Energy Performance Certificate when built, sold or rented. The certificates describe a building's energy ratings and gives guidelines for how to improve performance, save energy and reduce energy bills.
- *Households:* Zero carbon homes will be mandatory for new homes from 2016. BERR are working with retailers and manufactures to phase out inefficient light bulbs by 2011. Carbon Emission Reduction Target (CERT) will aid in changing the way suppliers view their relationship with their end consumer, make a shift toward provision of energy services, rather than just selling units of energy. BERR are launching an online CO₂ counter to let consumers know how much they contribute to emissions. Real time display was implemented in 2008, and made available free to everyone who requests one. Energy Performance Certificates are a requirement for all newly built and existing homes. The hope is that within 10 years all homes should have reached their cost-effective energy efficiency potential.

²⁷³ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2003, Executive Summary

²⁷⁴ Energy White Paper – Meeting the energy challenges, Department of Business Enterprise and Regulatory Reform, UK, 2003, Executive Summary

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

- *Public sector:* Carbon Reduction Commitment scheme requires large public sector organizations to reduce carbon emission. All new social housing and all new homes developed by English Partnerships have to comply with “level 3 of the Code for Sustainable Homes”. Public buildings larger than 1,000 m² will be required to display a Energy Performance Certificate. There are energy efficiency standards set for all new products and services that the Government produces since 2008.

The CHP Strategy, 2004

This strategy presented in 2004 gave the indication that the targets of decreasing CO₂ levels by 2010 would be under-achieved by as much as 20%. There were no suggestions made of actions to alleviate this risk.²⁷⁵

Climate Change Programme, 2006

The Climate Change Programme was created in 2006 to set forth the policies and priorities for action in both the UK and internationally. The UK are striving to secure action globally as well as making commitments at home and demonstrating that climate change can be handled without devastating impact on the economy.²⁷⁶

However £10 million that were put forth by Defra in 2004, have been withdrawn. The funding was supposed to promote the only government program which promotes efficient use of heat.²⁷⁷

Climate Change Agreements, 2006

As an aid for the Climate Change Levy, the Climate Change Agreements were developed for the most energy intensive industries in the UK i.e. aluminum, cement, ceramics, chemicals, food & drink, foundries, glass, non-ferrous metals, paper and steel. The Agreements are negotiated between the industry and the Government for additional CO₂ targets, and are expected to save 2.8 million tons of carbon dioxide annually by 2010.²⁷⁸ The Government has decided to give the businesses who manage to meet these targets an 80% discount on the Climate Change Levy.²⁷⁹ There are two parts of the agreement, known as umbrella and underlying agreements. The umbrella agreements are created on a sector-level and exist between Defra and the sector or the trade association, whereas the underlying agreements are made between Defra and the operator of the facility. “The umbrella agreements set out sector targets, the obligations on the sector and the Secretary of State, and the procedures for administering the agreements. The underlying agreements set out the targets to be met

²⁷⁵ Response to the consultation paper on the energy review, Combined Heat and Power Association, 2006

²⁷⁶ Climate Change - The UK Programme, Department of Environment Food and Rural Affairs, UK, 2006

²⁷⁷ Response to the consultation paper on the energy review, Combined Heat and Power Association, 2006

²⁷⁸ British Wind Energy Association, Climate Change Levy

²⁷⁹ Carbon Trust, Climate Change Agreement

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

by the target unit, the obligations on the operator and the Secretary of State, and the procedures for administering the agreements.”²⁸⁰

The current Climate Change Agreements will expire in March 2013, but the Government has announced a prolongation of the scheme which will last until 2017. There will be some alterations made to the current Agreements in order to create greater coherence with other relevant policies as well as simplifying the Agreements for the benefit of business.²⁸¹ The proposals for changes have been made and are currently being reviewed by the Government who must respond by June 2009.²⁸²

Climate Change Act, 2008

The Climate Change Act introduces the world’s first long term legally binding framework on how to deal with the dangers caused by the current climate change. The bill was introduced in Parliament on November 14th 2007 and was passed as a law little over a year later. The two main goal of the act are to improve carbon management enabling a transition to a low carbon economy and to demonstrate that UK has taken responsibility for lowering their impact on global emissions. The key provisions of the act are summarized below²⁸³:

1. The act presents a legally binding target of an 80% emission decrease of greenhouse gases by the year 2050, which needs to be achieved by action taken both in the UK and abroad. This target is accompanied by a goal of reducing CO₂ emission in the UK by a minimum of 26% by 2020. The reduction is calculated in comparison to emission levels registered in 1999.
2. A carbon budgeting system will be introduced in the UK. Each budget will run over a five-year period, setting three budgets at a time until 2050. The budgets will be set by Parliament and the Government must develop policies and proposals which meet these budgets as soon as possible.
3. The Committee on Climate Change had been created as an advisory body to the Government. The Committee must advise the Government on carbon budgeting as well as cost-effective savings, annually presenting reports on progress made towards targets and budgets. Annual responses from the Government on these reports will be made in order to create transparency and accountability.
4. When setting targets and carbon budgets emissions from international aviation and shipping must be taken into consideration, and the Committee on Climate Change must advise the Government on the possible effects of this. If international aviation and shipping emissions are not included in the Climate

²⁸⁰ Department of Environment Food and Rural Affairs, Climate Change Agreement

²⁸¹ Consultation on the Form and Content of New Climate Change Agreements, Department of Energy and Climate Change, UK, 2009

²⁸² Department of Environment Food and Rural Affairs, Climate Change Agreement

²⁸³ Department of Environment Food and Rural Affairs, Climate Change Act

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

Change Act the Government will be forced to explain the underlying reasons for this to Parliament by December 31st 2012.

5. For each presented carbon budget the Committee on Climate change must advise the Government on the appropriate balance between action taken on a domestic, European and an international level. The Government must set a limit on the purchase of credits of each budgetary period with the aid of the Committee's advice.
6. "Further measures to reduce emissions include powers to introduce domestic emissions trading schemes more quickly and easily through secondary legislation; measures on bio fuels; powers to introduce pilot financial incentive schemes in England for household waste and powers to require a minimum charge for single-use carrier bags (excluding Scotland)"²⁸⁴.
7. At least every five years the Government must present a report on the risks the UK is exposed to through climate change and present a programme to deal with the impacts of these changes. The Government will be given the power to demand public bodies and statutory undertakers (utilities companies which provide a public service) to carry out risk assessment and to develop plans for alleviation of these risks.
8. To give advice to and scrutiny of the Government's adaptation work an Adaptation Sub-Committee will be created.
9. By October 1st 2009 the Government must present guidelines for the ways in which companies are required to report their emissions of greenhouse gases. They must also, by December 1st 2010, review the contributions that company reporting could make to reducing emissions. By April 6th 2012 the Government must mandate reporting under the Companies Act.
10. The creating of a Community Energy Saving Programme is supported.
11. New requirements have been created for the annual publication of a report regarding the efficiency and sustainability of the Government estate.

Code for Sustainable Homes, 2008 (Zero Carbon Homes)

The Code for Sustainable Homes was brought forth by the Department of Communities and Local Governments in order to create a national standard for sustainable design and construction of new houses. All new homes will be rated against the Code for Sustainable Homes and must have a Code certificate in the Home Information Pack. The Government believes that by building in accordance with Code standards a more environmentally friendly future lies in Britain's future. For housing industry members, adopting the Code is an important step towards reaching the national target that all new homes built from 2016 must be zero carbon rated.²⁸⁵

²⁸⁴ Department of Environment Food and Rural Affairs, Climate Change Act

²⁸⁵ Greener homes for the future, The Department for Communities and Local Government, 2008

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

The homes that abide to the Code will be energy and water efficient and produce fewer carbon emissions and thus be more environmentally friendly. The Code homes should be build using sustainable resources, and should help to encourage the home owners to lead a more sustainable life. The Code helps to minimize the environmental damage cause by the construction process and creates an opportunity to revolutionize house design in the UK.²⁸⁶

The Carbon Reduction Commitment (CRC), 2010

This new trading scheme has been created as an incentive to reduce carbon emissions in the service and public sector as well as other less energy-intensive industries, for example supermarket chains, hotel chains, office-based corporations, government departments and large local authorities. The incentive was presented in the reviewed version of the Energy White Paper in 2007. The goal is to reduce carbon emission by 1.2 million tons per year by 2020 as a result of energy efficiency measures encouraged by this scheme.²⁸⁷ The scheme, including around 20,000 organizations, creates financial incentive to CO₂ reduction by putting a price on emission. The participants have to buy allowances which equate to their annual emission. A cap is placed on the total allowance available to the participants, which allows for the reduction targets to be met. Within the overall limit it is up to each participant to determine their own cost-effective mean of reducing emission. The revenues created through the use of the scheme will be recycles back to the participants, along with a bonus for the participant who manages to reduce their emissions the most. In order to create cross-organizational competition the participants will be ranked according to their performance, and the table will be made available to the public. The thought is that through financial and reputational incentives encourage organizations to develop better energy management strategies as well as creating emission awareness on a more senior level. The hope is to create a higher awareness regarding both environmentally and financially efficient energy production.²⁸⁸

Community Energy Saving Programme (CESP)

The governmental Community Energy Saving Programme is a new programme up for consultation at this moment, (May 2008). The programme target households and aims to reduce fuel bills but also tackle climate change through reduction of CO₂. The program aims to deliver £350 million of energy efficiency programmes. Ofgem is the institution that will administrate the CESP.²⁸⁹

²⁸⁶ Greener homes for the future, The Department for Communities and Local Government, 2008

²⁸⁷ Carbon Trust, Carbon Reduction Commitment

²⁸⁸ Department of Environment Food and Rural Affairs, Carbon Reduction Commitment

²⁸⁹ Department of Energy and Climate Change and Communities, Community Energy Saving Programme

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

Renewable Heat Incentive (RHI)

The UK Government has a renewable heat target of 15% in 2020 and the current renewable heat contribution is only 0,6%. They have come to the conclusion that there need to be an incentive that can contribute to reach to the binding EU target.²⁹⁰

The RHI is a proposed incentive that will have the first consultation in summer 2009 and the RHI is expected to be in place by April 2011. The system is similar to the ROCs except that it refers to renewable heat instead of electricity.²⁹¹

The incentive payments will be funded by a levy on suppliers of fossil fuels for heat. These are mainly licensed gas suppliers – but could also include suppliers of coal, heating oil, LPG etc.²⁹²

²⁹⁰ Department of Business Enterprise and Regulatory Reform, Renewable Heat Incentive

²⁹¹ Department of Business Enterprise and Regulatory Reform, Renewable Heat Incentive

²⁹² Department of Business Enterprise and Regulatory Reform, Renewable Heat Incentive

Appendix II: Relevant organizations in the UK

The Combined Heat and Power Association (CHPA)

The Combined Heat and Power Association (CHPA) works with promoting wider use of both CHP and community heating. In order to achieve this they work together with association, Government and other non-Government organizations. The CHPA work to address barriers that are currently facing CHP and community heating, and that when Government policies are developed they make sure that CHP and CH play their full role in delivering economic, social and environmental benefits to the UK. The CHPA also work to both educate and inform the Government, businesses and various communities about the benefits of CHP and the show them the potential that exists within the UK and what can be done to take advantage of this potential.²⁹³

The Department of Business, Enterprise and Rural Reform (BERR)

The Department of Business, Enterprise and Rural Reform (BERR) have set out a strategic program which they set out to follow. The main goal of BERR is to promote the creation and growth of business and a strong enterprise economy, which includes working to strengthen the UK's enterprise culture and environment, simplifying business support and delivering stronger regional economies. BERR also work to reduce the regulatory administrative burden which is placed on businesses by 25 %, ensure that the enforcement of regulations is consistent and that new regulations are only brought in when the benefits outweigh the costs. The BERR place large efforts of working towards free and fair, liberalized international markets. They work to support development, develop rules in order to maintain competition, promote completion in the UK and the EU and to empower employees and consumers.²⁹⁴

The International Energy Agency (IEA)

The International Energy Agency (IEA) is an intergovernmental organization founded in 1973-74. The original role of the IEA was to coordinate measures in times when the supply of oil was uncertain. Since there had been a shift in the energy market the IEA has adapted its purpose and now acts as an energy policy advisor to the agencies 28 member countries. The IEA aid the countries in their efforts to ensure reliable, affordable and clean energy for their citizens. The IEA focus on climate change policies, market Reform, energy technology collaboration and outreach countries such as China, India, and Russia.²⁹⁵

²⁹³ Combined Heat and Power Association

²⁹⁴ Department of Business Enterprise and Regulatory Reform

²⁹⁵ International Energy Agency

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

The Business Research Establishment (BRE)

The Business Research Establishment (BRE) provides a wide range of services, including consultancy, testing and research, which cover all aspects of the building environment and other associated industries. In addition the BRE contribute to the development of national and international standards and codes for construction and fire safety. Together with BRE Global, the BRE provide certification of fire, security and sustainability products and services.²⁹⁶

The British Wind Energy Association (BWEA)

The British Wind Energy Association (BWEA) was formed in 1978 and is the leading renewable energy trade association in the UK. The BWEA's main purpose is to promote the use of wind power both onshore and offshore in the UK. The BWEA have expanded their mission to become "champion wave and tidal energy and to use the Association's experience to guide there technologies along the path to commercialization". The BWEA can be seen as a central point of information and a group which lobbies for the promotion of wind energy and marine renewables to the Government.²⁹⁷

The Energy Saving Trust (EST)

The Energy Saving Trust (EST) is a non-profit organization which provides advice on how to save money and fight climate change by reducing harmful CO₂ emissions from private homes in the UK. The EST funds studies and work that deals with the development of district heating schemes.²⁹⁸

The Department of Communities and Local Governments (CLG)

The Department of Communities and Local Governments (CLG) strive to achieve "confident, vibrant and sustainable communities where everyone has a say in shaping their environment". In order to achieve this, the CLG work to offer choices and better quality in terms of public services and address the issues of climate change. The CLG encourage local authorities to work closely with their communities in order to create a sustainable environment. They do this by creating opportunities for local and regional partners to promote innovation, securing smart investments and high-quality partnerships and by concentrating on the resources which are most needed.²⁹⁹

²⁹⁶ Business Research Establishment

²⁹⁷ British Wind Energy Association

²⁹⁸ Energy Saving Trust

²⁹⁹ Departments of Communities and Local Government

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

The Carbon Trust (CT)

The Carbon Trust (CT) is an independent company which was created by the Government in 2001. The aim of the company is to accelerate the move to a low carbon economy. The CT works with various organizations in order to reduce CO₂ emissions in the UK as well as developing commercial low carbon technologies.³⁰⁰

The Department for Environment, Food and Rural Affairs (Defra)

The Department for Environment, Food and Rural Affairs (Defra) is an organization which is responsible for the enforcement of a variety of legal obligations, such as the renewable obligation certificates. According to Defra, their purpose is to “secure a health environment in which we and future generations can prosper”. They are the leaders for the government on policies regarding the natural environment and DECC’s key delivery partner for policies on climate change. Defra’s main tasks are to secure a healthy natural environment, to deal with environmental risks, to promote a sustainable, low-carbon and resource-efficient economy and to ensure that the farming sector is thriving and thus creating a sustainable, healthy and secure food supply for the UK. Defra strive to attain the following strategic objective:³⁰¹

- A society that is adapting to the effects of climate change, through a national program of action and a contribution to international action
- A healthy, resilient, productive and diverse natural environment
- Sustainable, low carbon and resource efficient patterns of consumption and production
- An economy and a society that are resilient to environmental risk
- Championing sustainable development
- A thriving farming and food sector with an improving net environmental impact
- A sustainable, secure and healthy food supply
- Socially and economically sustainable rural communities
- A respected department delivering efficient and high quality services and outcomes

³⁰⁰ Carbon Trust

³⁰¹ Department of Environment, Food and Rural Affairs

Industrial Landscaping of District Heating
Opportunities for knowledge transfer to the UK market

The Office of the Gas and Electricity Markets (Ofgem)

The Office of the Gas and Electricity Markets (Ofgem) works towards promoting competition and attempting to regulate monopoly companies who own gas and electricity networks. According to themselves they work first and foremost to protect the customer. Ofgem also strive to fight climate change and lobby for sustainable development by helping gas and electricity industries achieve environmental improvements and taking into consideration the needs of customers who have a hard time making themselves heard, such as elderly or those with low incomes.³⁰²

The Central Electricity Generation Board (CEGB)

The Department of Energy and Climate Change (DECC) was created in 2008 combining energy policy and climate change migration policy, which were previously part of other departments. The DECC was created to tackle the unprecedented challenges which face our environment, our economy and the security of our energy suppliers. The DECC have set forth three main objectives; ensuring secure, affordable and efficient energy, aiding the UK in their transition to a low-carbon economy and lastly they are striving to reach an international agreement on climate change at a conference in Copenhagen in December 2009.³⁰³

³⁰² The Office of the Gas and Electricity Markets

³⁰³ The Central Electricity Generation Board

Appendix III: Case studies Scotland

Dunbar

Clive Barber (Business Developer Scotland at Viridor Waste Management)³⁰⁴, gives the following information about the Dunbar waste to energy plant. Pennon Group Plc are the owner of Viridor Waste Management who in turn are the developer of the Dunbar site. Viridor Waste Management is a UK wide waste company. The Dunbar case is not their only case of waste to energy development.

Viridor Waste Management plan to build a waste to energy plant at their site in Dunbar, provided the necessary statutory permits are granted. The development of waste to energy has been incentivized by the increasing landfill tax, and the reason why CHP and heat recovery is being investigated is due to the SEPA “guidelines on thermal treatment of waste”. Viridor have already contacted neighboring farmers who may wish to connect to the scheme. The problem according to Clive, is that until they have “an operational plant on the ground and have started generating heat; Viridor can’t promise anything to anyone”.

The Dunbar site is located 4 kilometers outside of the town of Dunbar. There are two heat users located in close proximity to the site who have shown interest in using the excess heat from the waste plant; a fish farm and a soft fruit grower. The site at Dunbar is set to burn 300,000 tons per annum and Viridor are hoping to use low grade heat from the end of the generating process to heat green houses and fish farms. SEPA guidance wanted a plan to produce high grade heat and high grade electricity, which is according to Clive an “impossible request due to thermo dynamics”. The site has plans to generate 28 MWe of electricity and 17MWe of low grade heat. The Dunbar site will handle municipal and commercial waste, to be brought in both by rail and road.

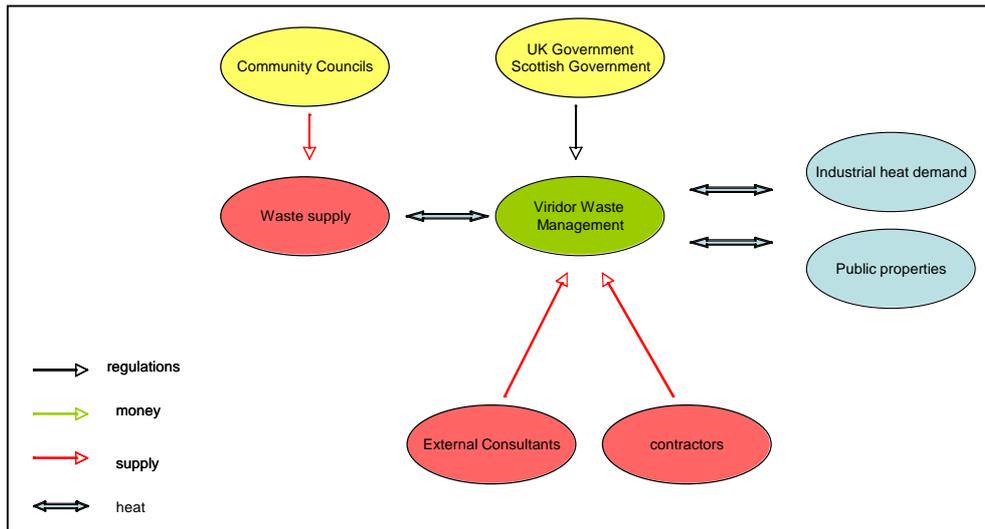
Business model

Within Pennon Group Plc there is considerable experience in civil engineering construction and pipe work. Viridor, however, has no power of entry to third party land, like a Local Authority. Even to just lay pipes up the road they need to ask the Local Authority for permission. The ideal arrangement would be to attract a utility company that are willing to take care of the heat from the CHP incineration, Viridor is a waste management company and does not have the necessary in-house expertise in laying and maintaining underground pipework required for district heating. Hence this is the constellation that Viridor would prefer but the current constellation is described by the figure below. The EU, UK and Scottish Government have a large influence in environmental policy and SEPA develop the necessary regulatory guidelines. It is the case that Local Authorities need to be more on side when developing planning/transport and infrastructure strategies and has to be remembered

³⁰⁴ Clive Barber, Business Developer Scotland at Viridor Waste Management, 2009-04-24

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

that the Local Authority are also customers of waste management services. The bulk of waste management infrastructure in the UK is owned by the private sector. Viridor have no problems with district heating schemes; if they can sell the heat to an end user it makes the plant more efficient.



Development of district heating

The development of district heating according to Barber, is constrained by the location. A site can be surrounded by three or four land owners who, unless they are all in agreement with one another, can be the lead to complications when wayleaves are needed to cross their land. This is going to remain an inhibition factor unless the Government (from community to central UK) gets involved. Waste is compartmentalized. “You get these huge targets for climate change which should technically be synthesized with those of waste management.”³⁰⁵ There seems to be a fear of the waste debate in the UK and it has therefore not received the attention it needs.

The UK needs to change the way in which its people are educated in environmental matters.

Too many people still believe waste generation and its management has nothing to do with them.

Viridor have trialled various forms of gasification and anaerobic digestion and have had some success in doing so. The predicament here is that most of these experiments only work with uniform waste forms. Recycling can deliver these pure streams, conversely the worse the remaining materials becomes for treatment. Once all stages

³⁰⁵ Clive Barber, Business Developer Scotland at Viridor Waste Management, 2009-04-24

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

of recycling have been carried out the only option left for the discarded materials is incineration since the calorific value of the “residue” is below a useful calorific level for other forms of co-combustion.

Clive started that “if you are an energy producer you need to burn something that has a calorific value of X. X needs to be high enough to get a worthwhile heat output.” Viridor, however, are on the other end of this; they need to get rid of all their “residues” whilst at the same time producing electricity and heat as useful byproducts.”³⁰⁶ It is clear that there are a number of obstacles for Viridor to overcome until it is realizable to put up a district heating scheme.

External consultants and Scandinavian best practice

There is limited competence within Viridor itself to develop a district heating scheme. According to Clive Viridor would definitely be a need to look outside the UK and bring in contactors who can present a turnkey solution. Viridor procure the necessary competence that they themselves lack; they call in experts wherever needed. In terms of information regarding development plans and staking out new opportunities, everything is done in-house. Clive sees large potential for Swedish, or other Nordic companies to enter the UK district heating market, but the regulatory system needs to be refined and the true potential understood before the market blossoms. Perhaps the present role for these companies is to inform the debate within the UK so any future strategy is based on sound science.

Aberdeen

During an investigation carried out in 1999, the Aberdeen City Council found that they had very low energy ratings for their flats in multi-storey blocks. By investigating various options of residential heating with the aid of whole life costing the Aberdeen City Council came to the conclusion that CHP and district heating would be the best option with which to replace electric storage heating. Today Aberdeen has a total of three CHP plants linked to district heating networks that deliver heat to 850 flats and 8 public buildings. The schemes are constantly developing and future plans include connection of the three schemes. Aberdeen have been able to reduce their overall CO₂ emissions by 2200 tonnes per annum since the installation of the CHP/DH schemes and tenant fuel costs have been cut by 50%.³⁰⁷

Aberdeen Heat and Power, an independent non-profit ESCo set up by the council, chose to construct the scheme gradually. Development of the schemes was kick-started with the installation of the CHP plant in Stockhill in 2003; consequently the first to deliver heat. The installation costs amounted to £1.6 million, whereof 40%

³⁰⁶ Clive Barber, Business Developer Scotland at Viridor Waste Management , 2009-04-24

³⁰⁷ Combined Heat and Power in Aberdeen, Aberdeen City Council and Aberdeen Heat and Power February 2009

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

were a subvention from the Community Energy Programme. The second CHP plant was installed in the boiler room of the Hazlehead academy. Lastly the third CHP plant was constructed in Seaton. The combined capacity of the three schemes is 1,5MW of electricity and 2,6MW of heat.³⁰⁸

The schemes are connected to both residential buildings and public facilities such as leisure centres and swimming pools. The public buildings are an important part of the mix as they even out daily heat demand and provide boilers which can act as back up during peak demand.³⁰⁹

Incentives and initiation

The main incentive behind the development of the Aberdeen district heating scheme was the low energy performance of the council housing multi-storey block. Due to a gas explosion in a multi-storey building in London in the late 1960's, most multi-storey block in the UK are heated with inefficient electric storage heating. The Scottish Quality Housing Standard, a standard of rating housing energy efficiency, rated the Aberdeen blocks at 4.1. The standard is set on a 10 grade scale where 5 is considered to be so called "decent standard". Today the rating of the blocks has improved to 7.1 simply with the aid of the district heating connection.³¹⁰

The other incentive which demanded action from the community council was extremely high levels of fuel poverty of tenants in the multi-storey block. Aberdeen City Council owned a total of 59 multi-storey blocks containing 4500 apartments out of which 70% of the tenants were in fuel poverty.³¹¹ The district-heating scheme in Aberdeen was a way of improving the energy rating of the properties and at the same time overcome some of the extreme fuel poverty.³¹² The scheme has been a success among tenants, mainly due to the fact that instead of a charge of £25 per week, the tenants are now paying no more than £8.30 per week to heat their units.³¹³

A third and final incentive driving the district heating scheme was as a response to the Government's and the Scottish Executive's consultation documents on climate

³⁰⁸ Combined Heat and Power in Aberdeen, Aberdeen City Council and Aberdeen Heat and Power February 2009

³⁰⁹ Janice Lyon Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

³¹⁰ Janice Lyon Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

³¹¹ Janice Lyon Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

³¹² Combined Heat and Power in Aberdeen, Aberdeen City Council and Aberdeen Heat and Power February 2009

³¹³ Janice Lyon Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

change.³¹⁴ The project was incentivized on a Governmental level but more importantly on a local level by Janice Lyon, who is responsible for Economic and Environmental Sustainable Leadership at Aberdeen City Council. For the Aberdeen scheme Lyon can definitely be seen as the project champion and the major driving force behind the realization of the project. Lyon's own explanation as to why she was successful in her strives for change is her own stubbornness and with that her knowledge of district heating which she picked up whilst residing in Norway.³¹⁵

Business model

Aberdeen City Council set up Aberdeen Heat and Power in 2002 as an independent, non-profit organization to run the energy stations and the district heating grid. Aberdeen Heat and Power recycles all profits back into the organization and uses the funds to expand and develop the scheme further.³¹⁶

As seen in many of the other cases studied the council itself does not have the possibility to invest in a district heating scheme due to the lengthy paybacks. The majority of the capital funding needs to be presented upfront and taking a loan for such a hefty investment is not a viable option. The Community Energy Programme (issued by EST) was a vital part of each of the three CHP stations providing a total of £2.6 million, close to 40% of the investment costs. CERT provided another £280,000 and the rest was funded by the council as an investment in reduced energy bills for heating the public buildings connected to the scheme.³¹⁷

Lobbying organizations are also an important factor in the development of district heating. For Aberdeen City Council the two most important associations were Energy Action Scotland and the CHPA. Both these two associations are members of the Board of Directors for Aberdeen Heat and Power.³¹⁸ Energy Action Scotland lobby for measures to decrease fuel poverty, and hold a fair amount of influence over the Scottish government. Even though the CHPA's lobbying position as a UK-wide organization is weaker than that of locally present Scottish organizations, they play an important part in driving district heating in the UK.³¹⁹

Aberdeen Heat and Power do not procure turn-key solutions; instead they find contractors for all the different parts of the scheme which according to Lyon can save them up to 15% of the cost. This enables them to find local agreements for the labour,

³¹⁴ Scottish Government, Scottish Executive's consultation documents on climate change

³¹⁵ Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

³¹⁶ Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

³¹⁷ Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

³¹⁸ Colin McLeod, Manager of Aberdeen Heat and Power, 2009-05-11

³¹⁹ Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

which is in turn beneficial to the local economy.³²⁰

For the first procurement of the CHP scheme, the city council was open to consider different business arrangement. They put out tenders to get suggestions on how to manage the scheme. A consultant from the south-west coast of England called Integrated Energy Utilities were chosen to assist Aberdeen Heat and Energy who at the time bestowed limited engineering skills. During the procurement process they asked the tenders if they were able to implement the scheme, but also if they could show where they had done so previously. Bill at Integrated Energy Utilities was the only consultant with reliable references and could show off previous work which had been carried out in Farkhill, Glasgow and other parts of the UK. Colin McLeod, manager of Aberdeen Heat and Power, confirms that the engineering part of the scheme is extremely important and that finding the right competence is vital but at the same time one of the largest risks in the project, if done incorrectly. The faith in Bill was the reason why the consultant solution was chosen to provide engineering competence. It has since proven to be a good decision because the Aberdeen scheme has yet to encounter any major heat delivery failures. The Aberdeen project was suited to public but independent ownership with the aid of consultants wherever needed. If the scope of the project had been larger, the possibilities for a turn-key energy provider might have been a reality.³²¹

Lyon is content with their cooperation and the consultant is knowledgeable in CHP engineering, can provide feasibility studies and assist in the procurement processes of contractors. Thus far the council is satisfied with the knowledge acquired; however Lyon claims that these resources are limited and could do well to be complemented with competence coming in from the North. Lyon's believes the best constellation would be a joint venture between a Swedish consultant and an established UK one in order to create and draw benefit from synergies.³²²

McLeod also stated that they are interested in gaining knowledge from Nordic countries. Aberdeen Heat and Power are applying for EU structural funding through the Interreg IV programme³²³. If the application is approved they will have funding available for knowledge transfer between European Union countries.

The following figure illustrates the constellation of the multi-organization of the Aberdeen district heating scheme.

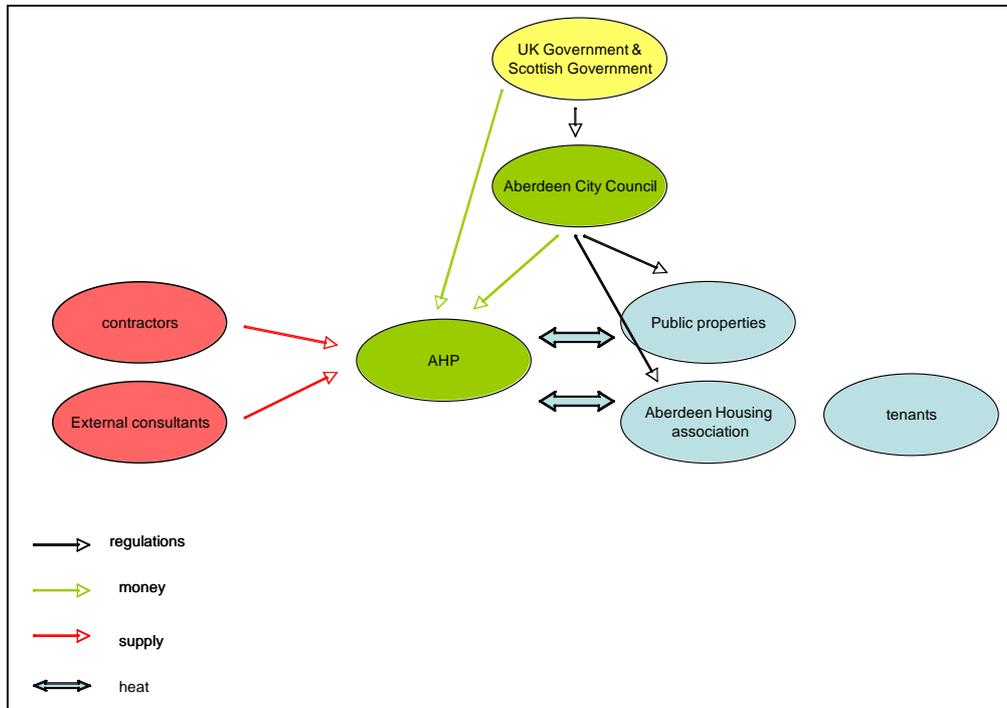
³²⁰ Janice Lyon, Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

³²¹ Colin McLeod, Manager of Aberdeen Heat and Power, 2009-05-11

³²² Janice Lyon Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

³²³ Eurosite, 2009-05-18

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market



Development Plans

The scheme has been growing over the past few years and the plan is to keep this development constant in the future. So far Aberdeen Heat and Power have focused on public sector customers rather than commercial ones. The business model is built on keeping risks to a minimal level and the commercial sector is believed to be far less reliable than the public one. Lyon stated that there are future considerations to connect commercial premises as well.³²⁴

The plan is to reinvest profits from Aberdeen Heat and Power and meanwhile applying for grant funding to finance future development. The Community Energy Programme which was originally an important source of funding has unfortunately been dispersed. Lyon hopes that the new funding system via CESP will provide 25% of the investments cost needed for future development plans.³²⁵

The UK governmental incentives for renewable electricity generation (ROC) and the

³²⁴ Janice Lyon Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

³²⁵ Janice Lyon Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

upcoming Renewable Heat Incentive (RHI) provide incentives for the replacement of gas driven CHP engines with engines driven on biomass. Using biomass is a way of gaining independence from gas prices and thus avoiding affects of the spark gap.

Spreading the word

The business model for Aberdeen City Council has proven to be very successful thus far. Lyon explains that the council receive many visitors who in one way or another are inspired by their scheme. Sadly few of the visiting councils are able to realize their plans due to the severe lack of competence within district heating in the UK. Lyon believes that there needs to be a Governmental department which can aid these community councils in setting up the same model or at least something similar to what has been built in Aberdeen. “It has been hard work and there is no point in others reinventing what we have already created”.³²⁶

The targets for cutting CO₂ emissions are increasing for community councils across Scotland. For example the Scottish Quality Housing standard has set a target that all housing needs to reach the decent home standard with a minimum rating of 5 by 2015. The targets main focus is on Victorian stone houses and multi-storey blocks, where energy performance is generally low. From 2012 the EU Climate Change Act will be applied to public bodies and thus include community councils. Lyon believes that trading with CO₂ emissions on a public scale might incentivize a more powerful change in the heating system of housing.³²⁷

Shetland Islands

Shetland Heat Energy and Power (SHEAP) has been providing Lerwick with district heating to both domestic and non domestic properties since 1998. The heat is generated at a waste to energy incinerator located in the outskirts of Lerwick. It is a 6.5MW waste to energy plant, which incinerates 22,000 tonnes of domestic and commercial waste from Shetland, Orkney and the offshore oil industry. The purpose of the schemes is twofold; reducing the amount of waste going to landfill and generating environmentally friendly and affordable heat. The scheme has about 900 connections receiving heat through 30 km district heating grid.³²⁸

Incentives

In the 1970's oil was found in the northern North Sea. The oil was pumped to Shetland for further transportation and the Shetland Islands Council got oil disturbance money from the oil companies operating in the area. The Shetland Charitable Trust was founded and the money was to be used for investments that

³²⁶ Janice Lyon Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

³²⁷ Janice Lyon Economic and Environmental Sustainable Leadership, Strategic Leadership, Aberdeen City Council, 2009-04-30

³²⁸ The Shetland heat Energy and Power website, www.sheap-ltd.co.uk

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

would benefit the Shetland economy and the inhabitants of the islands.³²⁹

By building the waste to energy plant the community council could handle some of their waste problems but at the same time help their inhabitants to reduce their heating costs. Shetland is not connected to the main gas grid and most heat is derived from oil or electricity. Even though the area is not extremely dense the climate and the displacement cost for other heating alternatives makes district heating an economically appealing alternative.³³⁰

Apart from funding from the Charitable Trust, the scheme was originally financed by way of the European Regional Development Fund (ERDF) and the European Thermie Fund. Later SHEAP received three grants of in total of £1.5 million from the UK Community Energy Programme. The grant funding has of course been an important ingredient in the development of the scheme. The hope is that the Carbon Emissions Reduction Target (CERT) and Community Energy Savings Programme (CESP) will enable funds to be available for SHEAP to use for upcoming development plans.³³¹

Neville Martin, district heating manager at the SHEAP, has been the champion of the development of the district heating scheme. The inspiration for the development of the scheme comes from the Nordic countries and in particular from Bornholm, Denmark. The Bornholm scheme was designed by the consultant COWI and Neville and his team visited the scheme and saw potentials of replicating the Bornholm scheme in Shetland. As far as possible Danish practice has been used as the model for how the scheme has developed and run.³³²

Without the initiative from the Charitable Trust the scheme would probably never have been realised. There needs to be an initial capital funding and Neville believes that the Government need clearer strategies to make this happen nation wide. He also believes that if district heating is to become a more common heating technology, waste is the most potential driver of change. He believes that the increasing landfill taxation can instigate a change and SEPA's encouragement can help promote the use of district heating.³³³

Business model

The Shetland Charitable Trust set up Shetland Heat Energy and Power as an ESCo to run their district heating scheme. The waste to energy plant is run by Waste Services section of Shetland Islands Council (SIC). Heat recovered from the incineration

³²⁹ Interview, Neville Martin, District Heating manager, Shetland Heat Energy and Power, 2009-04-28

³³⁰ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³³¹ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³³² Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³³³ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

process is sold by SIC to SHEAP.³³⁴

The scheme was set up to benefit the Shetland economy and commercial rates of return were not a driving force in the development process. The initial capital for the district heating part of the project came from the Charitable Trust and the £8 million invested in the first 6 years have been written off and today the scheme is being developed on a commercial rate of return on future investment.³³⁵

According to Simon Stockwell, Scottish Governmental Waste and Pollution Reduction Division, this kind of public ownership is an unusual one and he believes that the ownership of similar schemes in Scotland will be private in the future. He states that the reason for the public ownership is the profitable economy of the Shetland Island, which is hard to find in other areas around Scotland.³³⁶

District heating, being a niche technology in the UK, makes it difficult to access the knowledge needed to develop a scheme. Neville agrees and claims that UK engineering skills are not sufficient and he had to learn a lot about the technologies himself. Shetland Heat Energy and Power have hired a consultant company COWI and their Danish office at Aarhus, to carry out feasibility studies for further development. Neville is satisfied with COWI and states that he wouldn't use a UK company to provide the engineering part of the project unless it had staff with Scandinavian experience of district heating.³³⁷

SHEAP procure all the equipment and installations used for the scheme. They use Vital Energi to supply equipment such as the thermal storage tank and other specialist equipment and Logstor (via Vital Energi) supplies them with piping. Pipeline design is done in-house and whenever something needs fixing they look to local contractors since they often require a rapid response to their demands.³³⁸

The major difficulty in dealing with non-UK companies is to understand UK contracts in particular when it comes to claims. Neville recommended Swedish companies to ally with a local partner.³³⁹

Neville talks about the power of NGO's. The aversion to energy from waste in the UK is partly to be blamed on green organizations such as Greenpeace who influence people to be afraid of waste to energy plant emissions. Neville claims that organizations who would rather talk about the disadvantages than the benefits of a new technology get a lot of publicity in UK media. These organizations are

³³⁴ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³³⁵ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-03-25

³³⁶ Simon Stockwell, Waste and Pollution reduction division of the Scottish Government, 2009-04-23

³³⁷ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

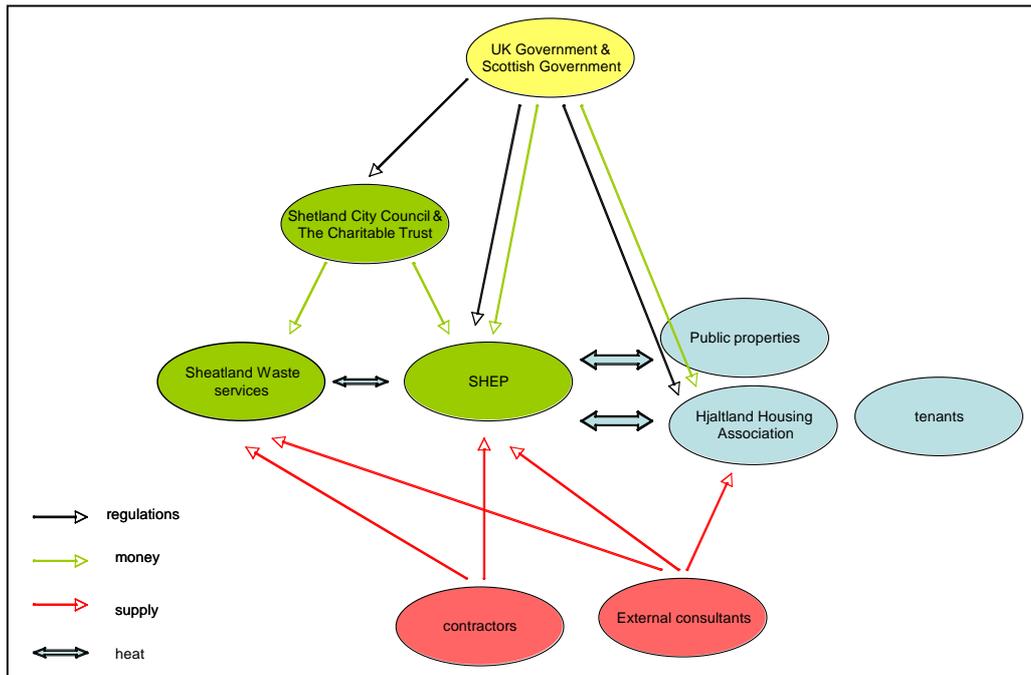
³³⁸ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³³⁹ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

responsible for publishing misleading information on energy from waste plants.³⁴⁰

The following figure illustrates how SHEAP fits into the organizational structure.



Development plans

As the number of customers increase, the requirement for a complimentary energy source is essential. SHEAP have exceeded the output from the incineration plant during winter. To increase the capacity they installed a 15MWh hot water storage tank in 2006 to even out daily heat demand. Another 6.5 MW boiler has been installed to give a total back-up capacity of 15 MW. Using customers former boilers as additional back-up, there is a further 6 MW of boiler capacity being spread around Lerwick.³⁴¹ This has resulted in that they now have to burn 900 tons of oil in the back-up boilers. The future plan is to further develop the district heating scheme but at the same time get away from oil. Therefore development plans for finding green energy sources of heat is being explored.³⁴²

The long-term plan is to build a CHP station to replace the current power station. The reconstruction is planned for 2015 but Neville is eager to continue developing the

³⁴⁰ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³⁴¹ Shetland Heat Energy and Power

³⁴² Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-03-25

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

scheme while the customers are waiting. The scheme will be built to last and energy source will change over the time.³⁴³

One plans for the future is to recovered oil from oil drilling mud. SHEAP should get it at a discounted price compared to oil and the oil companies have difficulties in getting rid of their excess products.³⁴⁴ Other options being considered are the possible installation of wind turbines producing up to 4.6MW of heat and will come with thermal storage. The wind factor on Shetland is very high and using wind as a source of heat could help supply heat when the demand is at peak time which is often when the wind chill factor is high.³⁴⁵

SHEP are also looking at utilizing industrial surplus heat but the plan is low on the priority list. There is a plastic box producer that they could recover 0.5MW from but the owner is reluctant to commit to the long-term agreement required since it can change quickly when alternative energy prices fluctuate.³⁴⁶

The potential of importation of wood pellets for use in boilers is also an option for the development of the scheme. The Hjaltland Housing Association is looking at the feasibility of a wood pellet fired boiler station and considering import of wood pellets however the step for SHEAP to import would be small. The Carbon Trust is investigating the potential for import of wood pellets to Shetland.³⁴⁷

Neville says that it is unusual in the UK that a district-heating scheme serves such a small town as Lerwick. Neville also stated that they are hoping to eventually serve all of Lerwick. Larger schemes, comparable to Lerwick, usually serve larger cities, however they limit themselves to supplying only parts of the city such as city centre large users or housing tower blocks rather than supplying an entire, smaller scale, city.³⁴⁸

Customers

In Shetland there is no mains gas to compete with which might be one of the reasons why the scheme has been so successful. In other locations the existing gas system is the biggest obstacle for district heating development. The high cost for alternative heating solutions drives the customer to connect to the scheme. Being on an island and trying to be self-sufficient with both energy supply and waste disposal has been one of the drivers for developing a full covered scheme. The inhabitants are very positive towards the scheme because it has proven to be reliable and aided in cutting

³⁴³ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³⁴⁴ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³⁴⁵ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³⁴⁶ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-03-25

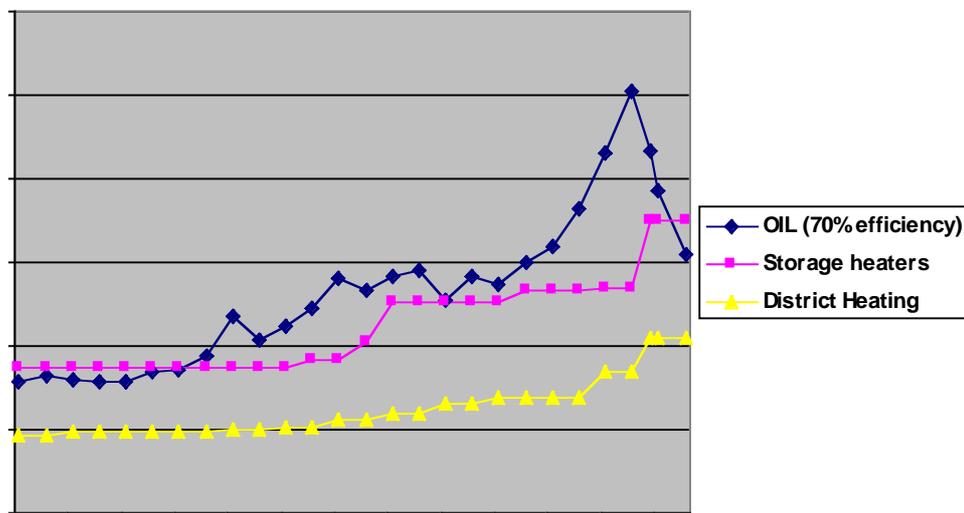
³⁴⁷ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³⁴⁸ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-03-25

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

heat costs for the customers.³⁴⁹

The customers pay a low connection fee for a system so that it is no more expensive to install than an oil system. The connection cost is £550, which is only about 15% of the average real cost. The running cost is significantly lower than the oil price, which is the incentive for the customer to connect to the grid, see the figure below. With a great offer and a good reputation SHEP have good coverage wherever they decide to expand the scheme. They need 70-80% connections for developing streets but at the moment the demand is exceeding the capacity and new requests for connections are put on hold.



Cost of different heating sources³⁵⁰

The islands have a lot of public properties with an impressive numbers of leisure center and swimming pools, he largest located in Lerwick. In addition there are two hospitals, three schools including the main secondary school serving most of the islands and three care centers. The scheme requires connections to theses centers to even out the demand over the day and the thermal storage has proven to be an important investment. The average residential house uses 17MWh of heat per annum although the newest house with better insulation uses about 8MWh. The houses in

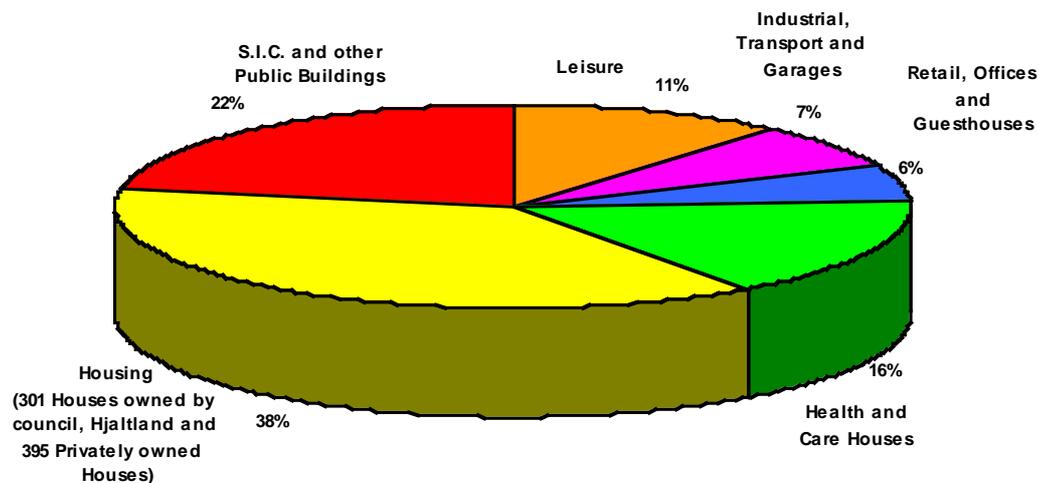
³⁴⁹ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³⁵⁰ Power point of Shetland District Heating, distributed by Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Lerwick are very varied; many being over 100 years old. A lot of buildings were built in the late 70s and early 80s with the coming of the oil industry. Most of the latter are timber framed with block work outer walls. Many of the most recent developments such as the Quoys Housing Scheme of 120 houses are mainly all timber construction.³⁵¹

In the figure below the heat distribution to different customers is presented.



Breakdown of percentage customer type on district heating scheme by usage³⁵²

Spreading the word

The Shetland case is seen as good practice of waste to energy in the UK. Many people visit the scheme to be inspired and Neville has given presentations to both Scottish and UK Government representatives. There are specific fortune factors that make the development model of the scheme so successful in Shetland. If it is applicable in other regions in the UK remains uncertain. Simon Stockwell claims that the Shetland case is an exemption and larger scale development needs to be initiated by private management companies.³⁵³ There are still projects that are developed in public ownership and Highland Waste Management claims that they are inspired by the Shetland model and say that they see similarities to Shetland in their communities.³⁵⁴

The Hjaltland Housing Association, through its tenants, is one of the larger customers of the district heating in Lerwick. They have had positive experiences dealing with

³⁵¹ Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-03-25

³⁵² Power Point of Shetland District Heating, distributed by Neville Martin, District Heating Manager, Shetland Heat Energy and Power, 2009-04-28

³⁵³ Simon Stockwell, Waste and Pollution reduction division of the Scottish Government, 2009-04-23

³⁵⁴ Ewan Huc, Waste management officer, Highland City Council, 2009-04-2

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

the district heating scheme and are now planning their own wood pellet fired boiler in the town of Scalloway. A new development of housing is the incentive for the development of the scheme. Public properties are also planned to be connected to the scheme, among them a school and a swimming pool.³⁵⁵

The same consultant used by SHEAP, COWI, have made a feasibility prospect for the project. The calculations show that the project will be able to be financed without external support. The calculations are based on 20-year loan with an interest rate of 5%. Brian Leask, Property Service Manager at Hjaltland Housing Association, says that they will be able to get grants for the projects and can thus lower the running cost for tenants.³⁵⁶

The Scottish Housing Association Grant will cover 50% of the cost for the investment of a conventional heating system in the new houses. This will cover 25% of the investment cost for the biomass scheme. On top of that they will probably get grants for the carbon efficient biomass boiler.³⁵⁷

We think that this project shows that there are possibilities for a housing association to find a long-term economic solution within district heating. There just has to be a certain aspect of awareness and commitment present among the people responsible for the heating solutions in such associations. The Shetland Charitable Trust has shown that it is possible and others are following in Shetland's footsteps.

Binn Eco Park

Binn Skips, a estate owner, retains a large piece of land secluded in a valley outside of Perth. Binn Skips³⁵⁸ has his own waste management company called Binn Waste Management, located on the estate. Close to Binn Waste Management there is a landfill site managed by SITA UK. There is also an energy station which uses landfill gas for power generation and an in-vessel composting site owned by the Canadian company TEG located close to the site.³⁵⁹

John Ferguson, Director of Strategy at Binn Eco Park, is a true visionary within waste management and district heating in Scotland. He has worked for the Scottish Environmental Protection Agency, SEPA, for many years now and is taking a year off to work at the Binn estate. Ferguson's plan is to coordinate the businesses on the estate and his vision is to develop an attractive Binn Eco Park. Ferguson believes in

³⁵⁵ Brian Leask, Property Service Manager at Hjaltland Housing Association, 2009-04-29

³⁵⁶ Brian Leask, Property Service Manager at Hjaltland Housing Association, 2009-04-29

³⁵⁷ Brian Leask, Property Service Manager at Hjaltland Housing Association, 2009-04-29

³⁵⁸ Binn Skips, 2009-05-18

³⁵⁹ John Ferguson, Director of Strategy at Binn Eco Park, 2009-04-24

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

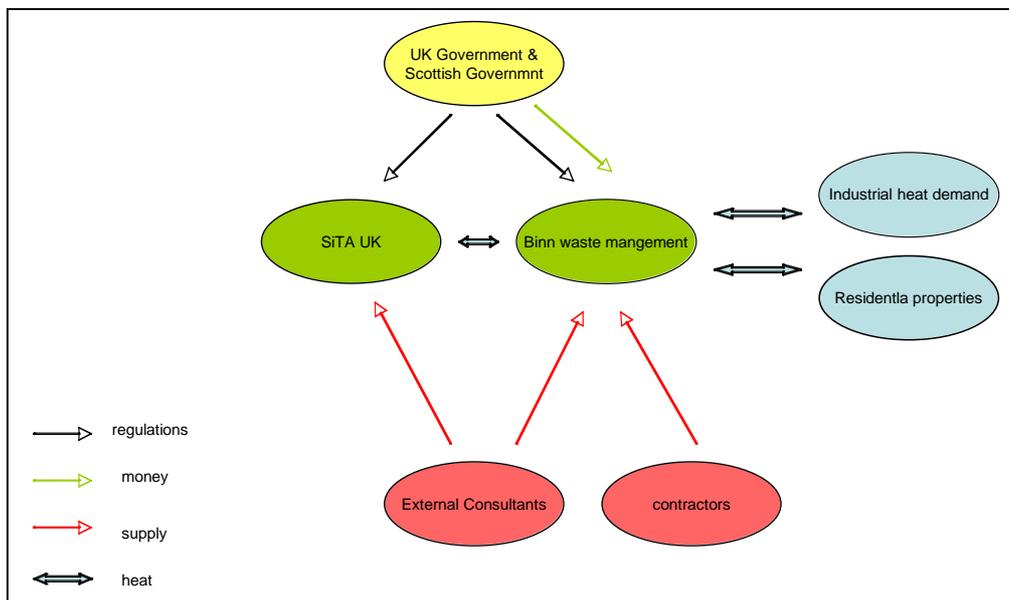
energy efficient waste treatment and a waste incineration plant will replace the land fill site. First, all of the recyclables will be separated and all the organic compounds will be treated with anaerobic digestion to generate biogas. The fractions that are left will be incinerated at the new CHP station that will treat approximately 60,000 tonnes annually. In the future the landfill gas can be used for generation of both electricity and potentially 4-5MW of heat.³⁶⁰

The estate is located outside of Pert and the piping distance is too vast, but they site still needs offset of the heat generated. Ferguson's plan is to build an Eco Park for food production and has attracted food producers to come to the estate where heat can be utilized for food production. The residue from the digestion plant can be used as bio fertilizer for the surrounding farmland.³⁶¹

A new residential property development is planned on the other side of the hill, 8 km away and the plan is to connect them to the scheme as well.³⁶²

Ferguson also hopes that the Binn Eco Park will be an innovation park and hopes to attract technology developers of for example bio fuels.³⁶³

Below is a representation of the multi-organization of Binn Eco Park.



³⁶⁰ John Ferguson, Director of Strategy at Binn Eco Park, 2009-04-24

³⁶¹ John Ferguson, Director of Strategy at Binn Eco Park, 2009-04-24

³⁶² John Ferguson, Director of Strategy at Binn Eco Park, 2009-04-24

³⁶³ John Ferguson, Director of Strategy at Binn Eco Park, 2009-04-24

The Highland

The Highland Council has various plans for district heating in the region. Both biomass and waste treatment are drivers for the development. We have focused to investigate the plans for waste to energy but the biomass scheme in Wick is also an interesting project that is important for district heating in the region.

From the following quoting it is evident that there is a focus on waste treatment in Highland and the Skye plans that later are described describes how the council are thinking of realizing their plans.

*“The joint waste management strategy will enable Highland and Moray to meet targets set by the Scottish Government under its policy for zero waste. The strategy also supports Highland’s commitment to increase the amount of waste recycled to 40% by 2010 and put measures in place to reach 50% recycling by 2013. Our officers will continue to work with Moray Council to identify opportunities that enable both authorities to meet the Government’s targets for zero waste.”*³⁶⁴

The profile of district heating has taken a hard blow due to the problems encountered by the Caithness Heat and Power (CHaP) scheme in Wick which was developed a few years back. A district heating scheme was developed to use waste heat from the Wick distillery plant to heat council housing around the area. A woodchip gasifier was also purchased to provide additional heat to the network. Due to technical instabilities in the gasifier, they have been forced to heat the connected houses with oil which has had a negative impact on the affordability of the scheme. The management has been taken back in by the council, in order to try to fix the problems.³⁶⁵

Isle of Skye scheme

Looking at the waste side of things a strategy has been set out for both the Highland and the Moray council. The two have been working together to develop joint strategies for the past four years. They are currently looking at four, small scale, energy from waste projects. Portree, in Isle of Skye, will be the smallest of the four, and is the only one that is currently in development. The Highland Council operated a landfill site at Skye until 2007 when legislative changes forced the closure of the site, leading to all waste being transported off the island. The community on Skye wants to deal with their own waste, which is right now being transported 400 km to a landfill site outside the highlands. Skye have looked to Neville’s scheme in Shetland and seen they should be able to create something similar.³⁶⁶

³⁶⁴ Highland Council, waste management strategy

³⁶⁵ Ewan Huc, Waste management officer, Highland Council, 2009-04-27

³⁶⁶ Ewan Huc, Waste management officer, Highland Council, 2009-04-27

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

When considering the development of the scheme the council first looked at the environmental side of things, and determined that local energy from waste was the best way to go. Some rough calculations were carried out in order to get a sense of what a scheme would cost. The Highland Council has hired consultants to look at the district heating part of things; the design and construction of the scheme and the potential costs. The next step is to engage consultants to look at the technological side of things to try to figure out what technology will be best suited for this specific scheme. The council is counting on their own accommodation (i.e council housing) demanding about a third of the heat load and public council owned buildings to cover another third, leaving one third available for private householders/developers.³⁶⁷

Development of district heating

According to Ewan Huc, waste management officer at the Highland Council, the main driver of change is carbon management, both on a council housing and council property level. “There is no mains gas in Skye, right now the mix is oil, coal and electric panel heating, which from a carbon point of view isn’t something that’s efficient.”³⁶⁸

A considerable barrier to the development of district heating is private housing developers. There are currently thousands of houses are being built in the outskirts of Inverness, but the planning authorities appear unable to oblige developers to incorporate district heating, and the developers are unwilling to develop them on their own. Planning power needs to come from the Scottish government.³⁶⁹

Ewan believes that the UK has been unsuccessful at integrating industrial sites that provide surplus heat, into areas where the heat could be put to use. The council is looking into placing housing development sites closer to energy from waste plants. The detail within this type of planning is extremely important because at present strategic policies are advocating change, but individual planning submissions have yet to incorporate these changes. Within the UK it is often cited that there seems to be large opposition to locating energy from waste close to residential areas. Ewan believes that this opposition is principally a perception on a political level, and not something that is fundamentally present in Scottish society.³⁷⁰

Ewan identifies opportunities for the councils and social housing sectors to carry the financial risk of developing district heating networks, and perhaps getting the Government to legislate for the development of district heating within the private sector.³⁷¹

³⁶⁷ Ewan Huc, Waste management officer, Highland Council, 2009-04-27

³⁶⁸ Ewan Huc, Waste management officer, Highland Council, 2009-04-27

³⁶⁹ Ewan Huc, Waste management officer, Highland Council, 2009-04-27

³⁷⁰ Ewan Huc, Waste management officer, Highland Council, 2009-04-27

³⁷¹ Ewan Huc, Waste management officer, Highland Council, 2009-04-27

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

For each of the four plants the council is anticipating district heating schemes, but it is only the Skye scheme that is developed enough thus far to find housing potential connections. The scheme at Skye is likely to be heat only because it will only handle approximately 8,000 tons of waste per year. It is still to be decided whether the other locations will be CHP or not. The low density between developments in the Highlands will increase pipe costs. Hopefully, with the connection of four smaller scale schemes, the council will be able to get a heat load high enough to make the investment worthwhile. The real issue will lie with the reliability of the technology, to avoid meeting the same fate as the Wick scheme.³⁷²

Government incentives and policies

The subsidies presented by the government seem to be, according to Ewan, dependent on what is the flavor of the month. No one seems to be looking at the overall costs for district heating and trying to find a way of dealing with these large scale investments. Ewan believes that in order for something to actually happening within district heating in the UK there need to be rules instead of guidelines. There is a possibility that developers will try to get around what is actually being legislated for, instead of trying to reach what the targets and incentives set out to achieve.

With regards waste treatment technologies, subsidies are being offered to certain thermal technologies in preference to others. For example, gasification gets 2 ROC's for their electricity, due to a perception that it delivers a better environment option than conventional combustion technologies. The incentives have skewed the market towards gasification making it a financially beneficial waste management technology, even though there may be technical issues with this technology solution.³⁷³

The Strategic Waste Fund and its successor, the Zero Waste Fund has driven recycling management and spurred on the development of high recycling rate targets. To date, almost all efforts have been focused on providing segregated waste collections, with far less attention to the actual handling and processing of the waste. The recycling targets are very optimistic and have encouraged focusing on immediate, short term targets to the detriment of longer term development plans. The next move needs to be in waste treatment and technology on the ground. There is a real barrier in getting significant capital investments for the energy plant and the district heating network to create a functional energy from waste system.³⁷⁴

External consultants and Scandinavian best practice

The Highland Council has put out a tender for consultants to support them in terms of technical specification for both the waste treatment plant and the district heating network. Ewan thinks that finding the right consultant will be difficult. The benefit of Scandinavian consultants would be for the technical side of things, since there is a definite lack of expertise within the area in the UK. The downside is that a Swedish

³⁷² Ewan Huc, Waste management officer, Highland Council, 2009-04-27

³⁷³ Ewan Huc, Waste management officer, Highland Council, 2009-04-27

³⁷⁴ Ewan Huc, Waste management officer, Highland Council, 2009-04-27

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

company may not know what the UK market looks like and what rules apply. There are an abundance of subsidies and policies in the UK that need to be considered, which a Swedish company may be unaware of. Ewan believes that there needs to be synergies between UK and Scandinavian firms.³⁷⁵

Ownership structure

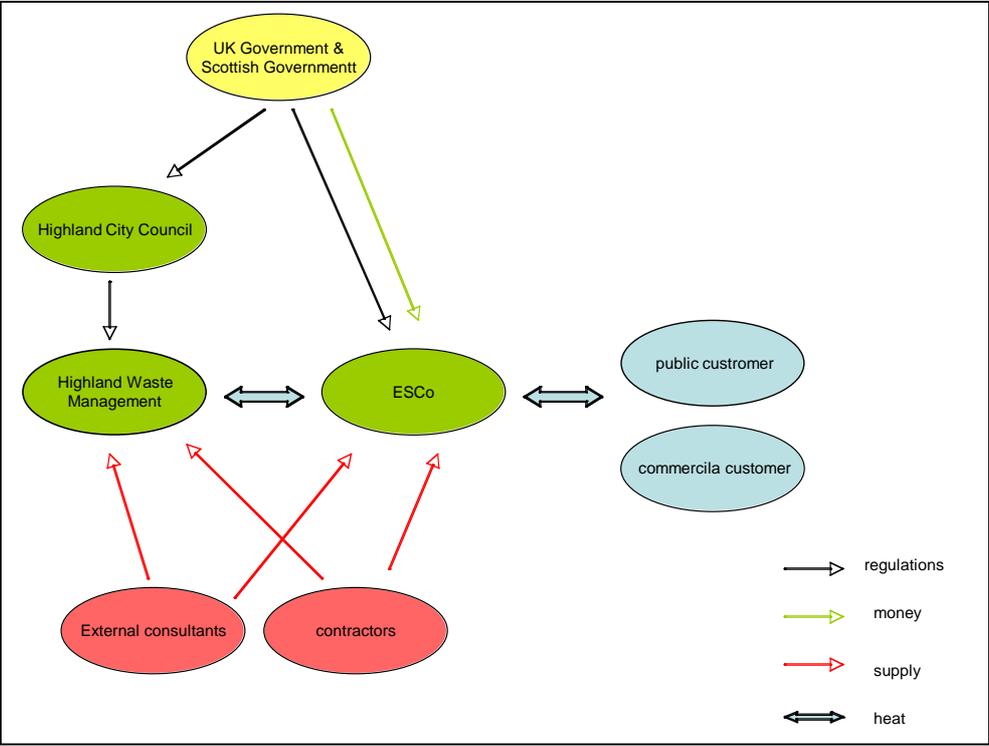
The scheme will be of conventional design and build. Ewan is hoping to acquire a technology supplier as an owner during the scheme's testing period and then buy the complete, functional package back into the council once everything is up and running. Under a so called "design, build, operate and transfer" (DBOT) contract the council will take ownership of the scheme once all the kinks and quirks have been worked out. Ewan believed that acquiring a turn-key solution for the start-up phase of the project would be optimal. Ewan represents the Waste Management Section of The Highland Council and they feel it would be preferable for the district heating to be developed in partnership with an energy company. If it is going to be publicly or privately owned he can't say.³⁷⁶

The following figure illustrates the multi-organization of The Highland Council in the Skye scheme. It is though likely to be replicated for the following three waste to energy schemes that are planned.

³⁷⁵ Ewan Huc, Waste management officer, Highland Council, 2009-04-27

³⁷⁶ Ewan Huc, Waste management officer, Highland Council, 2009-04-27

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market



Appendix IV: Case studies England

Citigen

The Citigen district heating and cooling scheme is one of the largest in the UK. It is a gas/gas-oil fuelled CHP station with 31MWe of electrical capacity, 25MWh of heat and 6.5MW of cooling.³⁷⁷ There are 3.6km of district heating and 2.4km of district cooling pipe distributing energy to both public and private customers and buildings. During the start-up process, CoL (Corporation of London) put out a call for proposals on building the district heating system.³⁷⁸ They originally commissioned PowerGen to build the system in 1990, but through acquisition of PowerGen in 2002 E.ON now retain 100% ownership of the Citigen scheme. The mains were put into place during '93-'94 and the CHP plant was up and running by 1996.³⁷⁹

The Corporation of London is a local authority which operates from Westminster in central London. Along with being the key stakeholder, CoL is the main customer of the Citigen district heating/cooling scheme. The constellation works in a variety of ways. CoL has partnered with E.ON UK and aids them in finding new customers and location for new and extended pipe works. CoL own most of the land on and around which Citigen operates and thus hold the capability to help E.ON expand the network.³⁸⁰ The Corporation's role in the scheme is to promote the use of district heating and plan the system around supplying heat to local government buildings. E.ON own the scheme and are thus responsible for its design and development. The Corporation wanted a private partner in the development of the scheme in order to displace the financial risk and allow for distribution of knowledge and management skills regarding the running of the scheme.³⁸¹

Since E.ON's takeover of Citigen, the scheme has not been profitable. A large part of this is due to faulty engineering of one of the CHP engines. Citigen is currently running on back up capacity, and are forced to spend large sums on oil to generate enough heat to supply the existing scheme. Large amounts of time and energy have been spent on trying to get the engines up to a reasonable reliability level. The availability of the engine today is at about 90 percent. Currently it is only viable to run one of the engines, but if the economics allow then Citigen can bring the second engine back shortly and allow for double output. At current size one engine provides enough heat to cover the entire district heating scheme. The main difficulty for Citigen is predictability. Steve Vizer, employee of Citigen Ltd, stated that "if you say that you are going to produce 15 MWh over the next ten hours then you have to produce 15 MWh.", which is something Citigen are not capable of doing at the

³⁷⁷ Andrew Crafter, London Corporation and Steve Vizer, EON UK, 2009-04-22

³⁷⁸ The City of London Combined Heat and Power System, The City of London Corporation

³⁷⁹ Andrew Crafter, London Corporation and Steve Vizer, EON UK, 2009-04-22

³⁸⁰ The City of London Combined Heat and Power System, The City of London Corporation

³⁸¹ Andrew Crafter, London Corporation and Steve Vizer, EON UK, 2009-04-22

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

moment. Contracts are structured in such a way that there is a maximum requirement that Citigen have to be able to handle. They are currently working together with their customer to attempt keeping base and max loads as close as possible to one another. Lost opportunities will be reflected in heat prices that in turn affects the tenants of the scheme negatively. Since Citigen lacks heat storage it is difficult to make use of excess heat.³⁸²

E.ON are currently stuck with an unfavourable situation at Citigen, however according to Steve Vizer there is a plan brewing to resolve this issue. E.ON need to keep a strong customer base through maintenance of existing customers, but also by working closely with CoL to identify customers who are within close proximity to existing mains. The plan is to extend the scheme into areas of high heat and chill demand in order to maximize the load on the system. A customer undergoing refurbishment or in a newly developed unit will pay minimal connection fees. The problem that E.ON faces with development of the Citigen scheme is the costs affiliated with expansion, since a clear positive return on all investments is vital.³⁸³

All the electricity produced at Citigen is sold to the E.ON trading group located in Düsseldorf, who set the prices. This is a large advantage for Citigen, since E.ON are well established and highly knowledgeable in terms of asset management. CHP plants are typically built to follow the demands of the customer. Whatever electricity the customer does not desire is spilled into the grid. However when the new trading arrangements were put into place along with the privatization of the electricity market, CHP plants lost this privilege. If a CHP plant fails to generate enough power they must buy the deviance from the grid. The plant will then be given a discounted power price in relation to how much electricity they are able to sell. Due to their failing CHP engine, Citigen are seen as unpredictable in terms of the amount of power they might need to buy and thus suffer from unfavorable electricity deals. Andrew Crafter, The Corporation of London, pointed out that many of the schemes build in the 1990's were over-dimensioned and produced a large amount of surplus electricity. However, favorably for them, they were able to sell this electricity to the grid without any interference. This option no longer remains and it makes the management of electricity production very difficult for Citigen in their current state.³⁸⁴

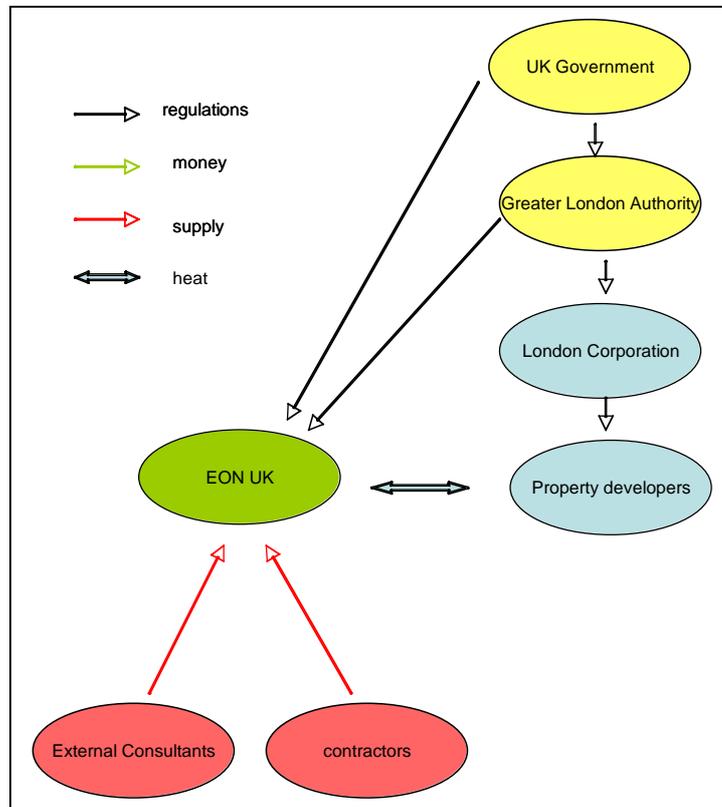
The following figure illustrates the multi-organization of Citigen.

³⁸² Andrew Crafter, London Corporation and Steve Vizer, EON UK, 2009-04-22

³⁸³ Andrew Crafter, London Corporation and Steve Vizer, EON UK, 2009-04-22

³⁸⁴ Andrew Crafter, London Corporation and Steve Vizer, EON UK, 2009-04-22

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market



Governmental incentives for CHP

Andrew Crafter states that there are not many incentives for CHP from the Government, who are currently not promoting energy efficiency but rather focusing on green energy. Crafter confirms the requirement the DECC have placed on developers to investigate the opportunity for CHP when developing power stations. However most of the plants simply discard the possibility of CHP conversion due to the limited offset of surplus heat. Developer are only forced to build CHP if the heat can be sold which initially means an industry which requires process heat or an existing district heating scheme needs to be located in the vicinity of the CHP station. The Renewable Obligation Certificate (ROC) is a much stronger incentive, but the current renewable capacity is less than that of CHP. 7% of electricity generation in the UK comes from CHP and only 3% from renewable sources. According to Crafter the potential for further development of CHP need to be supported by tax incentives or planning requirements.³⁸⁵

³⁸⁵ Andrew Crafter, London Corporation, 2009-03-15

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

District cooling

District heating has a bad reputation in the UK; not due to the principal of a centralized systems but due to the problems which district heating systems experienced in the 1950's-70's. Crafter states that district cooling is very popular and much easier to sell than the heating. District cooling has helped to better the reputation of the complete district energy system. District cooling is popular in new buildings, since it can provide chilled air for central air conditioning. As can be seen across the playing field new buildings have limited demand for district heating since large investments are made to ensure proper insulation. In the UK, district heating is mainly being installed in old buildings where there is need for refurbishment or where existing systems need replacement.³⁸⁶

Customers

As mentioned the local authority is the most important customer for the scheme. There are currently 14 buildings provided with district heating and 6 with district cooling. The only residential building connected to the scheme is a council estate (charity elderly building). The remaining buildings are either local government or commercial buildings. The area around the scheme is scarcely populated due to its central location. Getting offset for the heat has proven to be an obstacle, whereas the demand for district cooling is constantly increasing.³⁸⁷

Development plans and consultancy services

The scheme's development plan is being investigated by an external consultancy company; PB Energy. PB Energy is a large global consultancy company; however the reports are being carried out by their local London office. They will produce a plan for potential areas of pipe work development. The first drafts are planned to surface in May and August and entail a quick, medium and long term (20years) plan for the scheme. In response to this report, a development plan for the energy station will be presented. There are no plans to develop the plant for any other sources of energy.³⁸⁸

There are two lobbying options available to E.ON. The CHPA lobby throughout the industry alongside E.ON themselves. E.ON lobby for generation of heat in terms of putting the right mechanisms in place to pave the way for district heating. CoL has begun talks with the LDA (London Development Agency), who have shown an interest in the scheme and are considering connecting to it. Crafter is hoping that the CoL will be able to tap into the LDA funding pot. There was funding for Citigen in the start-up process (Community Energy Programme) however there seems to be no such funds available for developing schemes today.³⁸⁹

³⁸⁶ The City of London Combined Heat and Power System, The City of London Corporation

³⁸⁷ The City of London Combined Heat and Power System, The City of London Corporation

³⁸⁸ The City of London Combined Heat and Power System, The City of London Corporation

³⁸⁹ Andrew Crafter, London Corporation and Steve Vizer, EON UK, 2009-04-22

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

City planning

Crafter believes that the scheme will expand in the future, partly due to new planning rules set by the Greater London Authority (GLA). Crafter explained that the Mayor of London, Boris Johnson, is dedicated to green energy and planning policy. The outcome of these new planning incentives will take time to settle because the majority of projects that are planned will be realized only in a couple of years. With the looming financial crisis many development projects have been put on hold, so it is difficult to know what type of impact planning power will actually have.³⁹⁰

Future of district heating in the UK

There has not been any major expansion of district heating in the UK and Crafter does not believe in a full revolution. He believes that the ownership structure of schemes in the future will be similar to that of Citigen, with a private-public partnership. The main reason for acquiring a private partner is to provide capital funds and to gain knowledge. If local authorities wish to develop a scheme they will have to invite tenders to design and develop it. The commercial risks connected with developing a district heating scheme need to be passed on to a private company. There will be a competitive public procurement process for the commission and the role of the local authority will be to provide a site for the energy station and to plan and provide offset for the heat. The reasons why other schemes may be structured differently, is because the schemes are old and were constructed prior to the time of privatisation.³⁹¹

Pimlico

The Battersea power station was built in the 1920's in order to meet the rapidly rising demand for electricity in London at the time. Owned completely by the London Power Company, the power station began producing power in 1933. During the first years of electricity production the thermal efficiency of the scheme was extremely inadequate and almost 70 percent of the heat ended up in the Thames. During this time, the air quality in London was alarmingly poor. It was in the winter of 1952/1953 that London suffered record loss of life. Over 7 weeks of that winter 4,000 Londoners died – over and above the normal winter death rate – because there was insufficient wind to clear the City's smoke.³⁹² According to David Wickersham, manager at Pimlico District Heating Undertaken, it appeared that the driving force behind the development of the Pimlico District Heating Undertaking (PDHU) was the disintegrating air quality, whereas on paper it seems that the force was actually cost driven. In the London County Council (General Powers) Act of 1947, Parliament authorised the development of the district heating scheme in order to lower heating costs. The PDHU was used as an inspiration and in fact exemplified in the Act of '47.

³⁹⁰ Andrew Crafter, London Corporation, 2009-03-15

³⁹¹ Andrew Crafter, London Corporation, 2009-03-15

³⁹² Pimlico District Heating Undertaking: a case study of community heating CE 125, Energy Saving Trust, UK, 2005

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

However in the General Powers Act of 1949, the conditions were altered to apply more generally to communities both in and around London.³⁹³

In the 1950's about 1600 homes were connected to the network, along with 400 units at Abbots Manor. In 1984 another 900 homes were identified and connected to the district heating main. In 1980 the Battersea power station was closed and the CHP generator was replaced with a 30 MW coal fired thermal station which solely produced heat, and became gas fired in 1989. The land on which the boiler was located was leased on a thirty year contract, which runs out in March of 2010.³⁹⁴

In 1996, David Wickersham and his colleague Gavin Mackenzie, working at that time for the Westminster Housing Department, were given £17 million in order to completely shut down the PDHU system and install water heating boilers in each of the connected homes. It was true that the scheme was not providing enough heat, but this was simply due to hydraulic construction issues which could be altered for a mere £50,000. With the aid of energy efficiency measures the burn per head was brought down by 30 percent over the next few years, and by 2000 the PDHU was out of the dog house and the reputation of district heating was restored.³⁹⁵

Over the past few years the cost of heating has increased and pushed many of the scheme residents back into fuel poverty. The management focused way too much on revenues and ignored the wishes of the customers. The lack of heat meters contributed to this increase in costs as customers were unable to keep track of their consumption. The heating and hot water charges in the area are higher than they should and the residents are furious. David Wickersham, who is currently getting reinstalled at the PDHU, is placing all his energy in lowering these heating costs. He believes that the engineering in lowering these costs is fairly straight forward and hopes to have all the residents out of fuel poverty.³⁹⁶

Today the PDHU produces heat for 3250 dwellings, 55 commercial premises and 2 schools. The scheme is owned and operated by City West Homes, which in its turn is owned by Westminster City Council. It is a particular situation with the owner of the scheme also being the main customer.³⁹⁷ Through the planning power given by the Greater London Authority the possibilities of connecting to more properties is increasing. David Wickersham also claims that the possibility of applying for funding from via London Development Agency will be explored.³⁹⁸

David states that the PDHU have good technical experience from district heating due

³⁹³ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

³⁹⁴ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

³⁹⁵ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

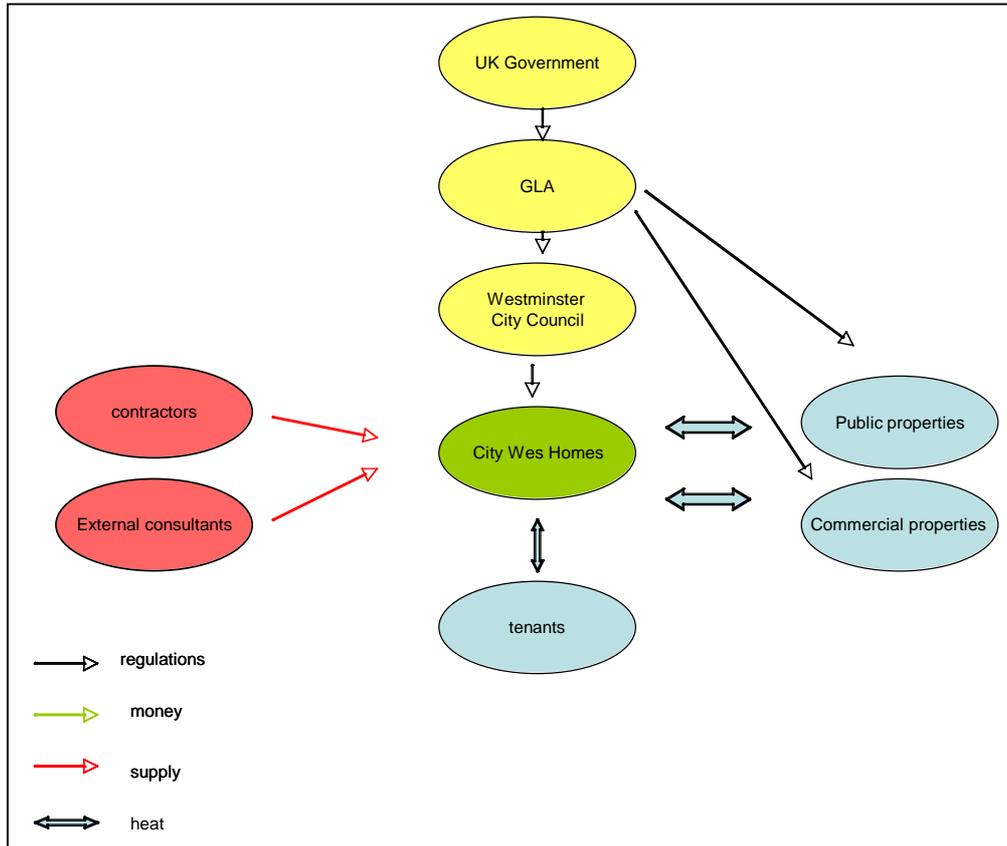
³⁹⁶ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

³⁹⁷ Pimlico District Heating Undertaking: a case study of community heating CE 125, Energy Saving Trust, UK, 2005

³⁹⁸ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

to the long history and claims that they try to avoid the use of external consultancy services and trying to do all in-house.³⁹⁹



Incentives

David believes that the underlying reason for the lack of district heating schemes in the UK is based on issue to do with management investment and funding. In order for district heating to really take off there need to be investments brought forth on a higher level.

The EU emissions trading scheme (ETS) deals with taxation on carbon emissions. If a scheme has an input capacity greater than 20MW, you are in fact subject to the ETS and have to pay for your carbon emission. The PDHU have become subject to the ETS simply due to their extra heat boilers. Currently input capacity at the at the pump house stands at 33MW, however peak output is only 16 MWheat plus 3.2MWelec. The emission cost is set to 12 Euros per ton of CO₂. Gavin believes that this system discourages widespread implementation of DH. Individual users in a DH scheme are

³⁹⁹ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

forced to pay for emissions that individual users outside the scheme are exempt from.⁴⁰⁰

Future development plans

The PDHU were given a grant of £1.2 million, for a total energy centre cost of 7 million, for CHP investment. The initial raising of capital is the factor which determines whether or not a district heating scheme will be extended. Money that can be saved through connecting new customers to the main can be used to pay back the investment. PDHU are and wish to remain the owners of the scheme, because there is additional capacity, which they can use to connect new users.⁴⁰¹ “At the end of the day the PDHU are not around to maximize their investments for some investor somewhere, as it would be if it became privately owned instead of keeping it local”⁴⁰².

David and Gavin alike are convinced that an expansion of the PDHU scheme is the best course of action. There is however a problem in terms of figuring out who is going to be the owner and who will in fact orchestrate the project. Public service is well placed in order to receive funding for the project. What it really comes down to is getting the mains in the ground, making up the extra funding to make the scheme worthwhile in the first place, and having sufficient capacity in order to connect enough people to make the original investments profitable. The main reason why the scheme is not expanding is due to the lack of contractors willing to take on the projects. The most recent attempt to find a contractor to lay pipes to the school just a few meters away failed solely because only one contractor answered to the tender, with a price that was far from the budget PDHU are tied to.⁴⁰³ There seems to be a lack of good enough technology on the market, and it seems that the market is dominated by a few foreign companies, who have no interest in aiding the UK in reaching its environmental targets. If there is no incentive from the construction and energy companies to lower carbon emissions, it will be difficult for the small schemes to expand and show the market what they are capable of.

The largest possibility, as far as development plans for the PDHU, David believes is a connection to the existing scheme at Whitehall.⁴⁰⁴ The Whitehall scheme has been operating since 1996 and is connected to around 3000 semi-detached homes.⁴⁰⁵ If a connection was made to the Whitehall scheme it would open up the possibility for a wide range of new customers. At Whitehall, underneath the Ministry of Defence, a Siemens gas turbine producing 9.5 MW of heat is currently up and running. The turbine only runs 1000 hours a year and is switched off in the summer and replaced

⁴⁰⁰ Gavin McKenzie, Pimlico District Heating Undertaken, 2009-04-21

⁴⁰¹ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

⁴⁰² Gavin McKenzie, Pimlico District Heating Undertaken, 2009-04-21

⁴⁰³ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

⁴⁰⁴ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

⁴⁰⁵ CHP at the hart of Government: case study Whitehall district heating scheme, CHP Club, UK, 2001

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

with electrical heating to heat the building. If the turbine was being used all year round, the savings in carbon emissions could be substantial. The DECC, who own many of the buildings in and around Whitehall, are not connected to their own district heating network. The obvious solution here should be to connect the two schemes in order to make use of the excellent heat load and density. Since PDHU are using their CHP power to maximum capacity at the moment, connecting more customers without expansion of CHP capacity is not an option. The PDHU have gotten requests from private buildings around the neighborhood wanting to connect to the scheme. Some of them have even offered to provide the funding needed to make the connection, but have fallen short. Since the scheme itself does not have the kind of funds available to aid customers in connecting to the scheme, David believes there needs to be Governmental funds that can be tapped into for these types of expansion possibilities. PDHU have been investigating the possibilities of connecting their schemes with LDA funding and hope that through such a connection not just be able to connect the customers who are willing to privately finance their connection, but to make as many economically profitable connections as possible in the area.⁴⁰⁶

Customers

In the area around both PDHU and Whitehall there are properties stuck with malfunctioning boilers. The Institution of Civil Engineers, located just across the street from the Ministry of Defense, is currently considering putting in a site specific gas turbine. There seems to be a lack of communication between not only Government representatives, but between neighboring schemes. Instead of people choosing to put in new boilers, they should look to connect to the local district heating network.⁴⁰⁷ According to Gavin Mackenzie, there is no abundance of space in central London, and tenants should look for opportunities to save space. An existing boiler takes up slots which could be put to much better use; for example more parking spots, common areas or even new apartments.⁴⁰⁸

David mentioned that residents on the scheme were astonished to find out that there were private developers who wanted to connect to the scheme. When someone connects to the PDHU scheme, they buy heat to a meter price. PDHU can sell out to a pretty fair price, but the problem lies in that there are no records of how much heat is actually going into each individual apartment. When it comes down to the extremities people might have to choose between paying for heat and paying for food. 9 times out of 10 people are going to choose food over heat. PDHU fail to provide individual heat metering and thus they do not offer their customers the choice between heat and food. The issue with installment of individual, smart, power meters is that customers might end up paying for heat they are not using. An apartment located in the middle of a housing block is likely to derive enough heat from surrounding apartments without ever needing to turn on their heaters, whereas a poorly situated ground level apartment might need to run its heaters on full most months of the year. David seems

⁴⁰⁶ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

⁴⁰⁷ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

⁴⁰⁸ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

to think that with the aid of heat metering PDHU could reduce the heat usage in the existing scheme buildings by 20% and thus be able to connect another 700 homes without having to bring in another CHP engine.⁴⁰⁹

London Thames Gateway

The London Development Agency (LDA) and the Greater London Authority's (GLA) are responsible for the development of the planned London Thames Gateway Heat Network. It is a 23 km heat distribution network planned to deliver affordable low carbon heat to residents in both public and private housing, alongside larger public and commercial buildings in east London. The heat will initially be provided by Barking Power Station, Tate and Lyle sugar refinery and later converted into a CHP plant in order to capture excess heat from the refinery process.⁴¹⁰

The project is the first large scale district heating project in the UK of its kind and the Barking Power Station Steering Group aims to use the scheme to catalyse a development of increased use of low carbon district heating in London. The Barking Power Station Heat Transmission Line would enable efficient movement of low carbon heat across a large part of east London and provide the foundation for a genuine heat network.⁴¹¹

Incentives and initiation

The incentives driving the development of the scheme are London's 60% CO₂ emission reduction target and direct Governmental incentives such as the EU Emissions Trading System, Climate Change Levy Exemption and policies supporting renewable heat through various tax advantages.⁴¹² Peter North, Head of Decentralised Energy Delivery of London Development Agency, confirms that the LDA's main incentive is CO₂ emission reduction and attempting to do something practical in order to reach the targets.⁴¹³

In the London Climate Change Action Plan, developed by former Mayor of London Ken Livingston in coordination with the GLA, district heating and cooling is brought to light. The LDA is responsible for the realization of the policies and targets set by the GLA. LDA will function as a link between the consumer and the producer of the heat. They will directly contribute to the development of district heating with the London Thames Gateway Heat Network and heat production by converting Barking Power station into a CHP plant. They will at the same time indirectly contribute to development of district heating by encouraging the London boroughs to wherever

⁴⁰⁹ David Wickersham, Manager Pimlico District Heating Undertaken, 2009-04-21

⁴¹⁰ London Development Agency, London Thames Gateway Heat Network

⁴¹¹ London Development Agency, London Thames Gateway Heat Network

⁴¹² London Development Agency, London Thames Gateway Heat Network

⁴¹³ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

possible connect to the London Thames Gateway and by coordinating an energy master plan for London. LDA may assist developers hoping to connect to the scheme and this may involve appropriate financial support.⁴¹⁴

The GLA have set a target that 25% of all London's energy supply should be provided by decentralized energy by 2025, and the LDA are hoping to contribute somewhere around 5% of this. The other 95% has to come from private development or district heating investments from the boroughs and the LDA's energy master planning programme aims to promote this private sector activity.⁴¹⁵

Peter North explains that it is only thanks to the LDA that the London Thames Gateway project is developing further. North says that strategies are not powerful enough to drive a change, there needs to be genuine interest and commitment to CHP district heating in order for something to happen. Peter North stated that Ken Livingston was strongly committed to cutting CO2 emissions and realized that an effective way of doing so was with the aid of energy efficiency. In terms of the London Thames Gateway project, Ken Livingston can be seen as the driving force behind the establishment and development of the principles that supported the scheme's later development. The project is progressing towards construction largely due to powerful support from the GLA and the present Mayor Boris Johnson who has continued to support the development plans.⁴¹⁶

The work the LDA are doing with CHP district heating is not in itself enough to be able to reach the various goals and targets set by the UK government. Our observation is that London Thames Gateway and the LDA's encouragement of the scheme as an incentive can only function in combination with genuine interest from the London Boroughs, property developers and energy suppliers. Without this constellation the obstacles presented by district heating will be strenuous to overcome. There is a need for a spread of project champions throughout the desired expansion area.

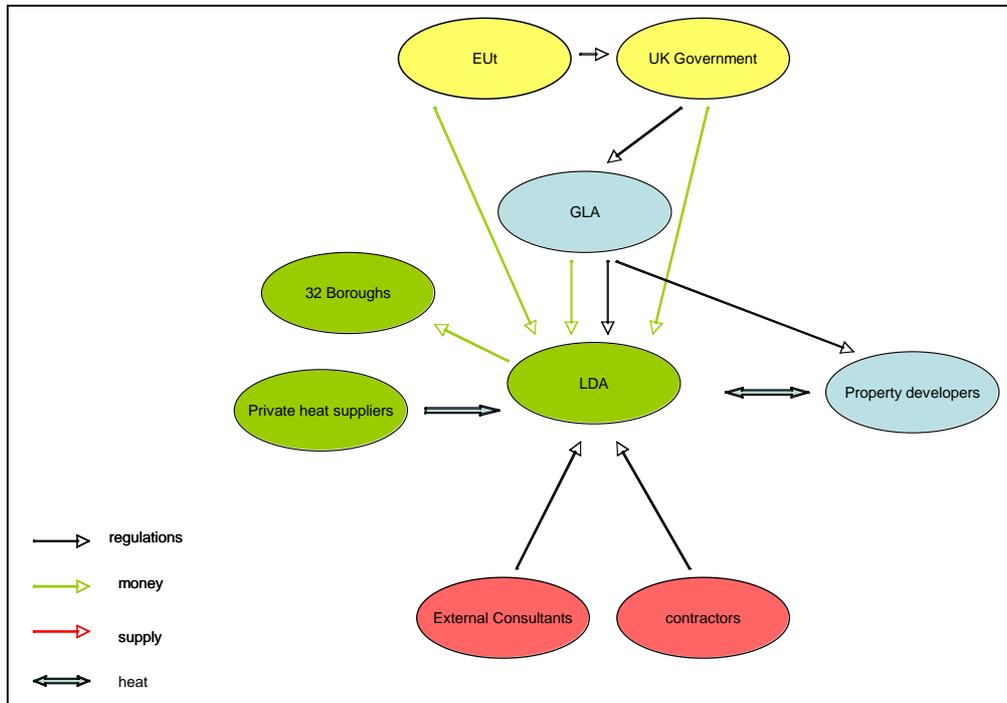
The following figure illustrates the multi-organization of London Thames Gateway district heating scheme.

⁴¹⁴ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

⁴¹⁵ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

⁴¹⁶ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market



One important parameters to consider when developing a CHP district heating schemes is finding appropriate funding and subsidies. The LDA are looking to use their capital to seed into the project and to leverage additional capital from various UK and EU sources. In the London Thames Gateway Scheme, the Economic Development Infrastructure Plan (EDIP) is seen as an important mechanism to provide further funding through the Joint European Support for Sustainable Investment in City Areas (JESSICA) fund. This is an example of funding streams, which the LDA hope to access.⁴¹⁷

The planning of the scheme

Barking Power Station is a 1,000 MWe combined cycle gas turbine power station near Dagenham Dock. As with all power stations, it produces a large quantity of low-grade heat as a waste product, with around 400MW of heat currently being discharged into the River Thames.⁴¹⁸

The Danish consultancy company Rambøll were appointed to carry out a feasibility report for the London Thames Gateway scheme. The heat optimization of the scheme is a distribution of 170MW of heat through a 23 km distribution network connected to Barking Power Station. The scheme is planned to connect to 50,000 properties

⁴¹⁷ London Development Agency, London Thames Gateway Heat Network

⁴¹⁸ London Development Agency, London Thames Gateway Heat Network

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

whereof 82% are new developments and 12% are connections to existing buildings. Peter North explains that the new incentives in terms of planning power will aid in increasing connections to the scheme, but the credit crunch has interfered with property development and delayed the development off the scheme's heat loads.⁴¹⁹

While planning the scheme, LDA have visited both Denmark and Finland in order to gain knowledge and inspiration. They have talked to DH scheme developers and authorities in both countries. LDA have chosen to structure the scheme after Finnish principles but have been inspired by the Danes in terms of the policies and domestic experience.⁴²⁰

Peter North says that knowledge of district heating in the UK is limited due to a distinct lack of experience. LDA will encourage the Boroughs and other developers to use Nordic countries consultancy services.⁴²¹

LDA have chosen conventional technologies with gas fired CHP and do not want to invest directly in experimental unproven technologies but rather focus on making the scheme successful. By adapting Barking to become a CHP plant they should be able to able to get a z-factor of 5 (1 unit of electricity and 5 units of heat).⁴²²

The next step for the scheme is to enter the construction planning phase of the CHP Barking station. At the same time, the organizational- and business model of the scheme is being developed. LDA have engaged the consultancy company Price Waterhouse Coopers to develop the investment model and business plan for the scheme and have chosen to use a well-known company within the area that holds palpable knowledge of the UK system.⁴²³

Development of district heating

As the London Thames Gateway scheme and Barking CHP plant is being designed, the LDA is trying to find other energy stations to connect to the scheme. They are encouraging the boroughs of London to develop their own ESCOs to assemble heat loads as well as attempting to attract private developers to connect to the scheme. An existing scheme should provide a strong incentive amongst energy suppliers.⁴²⁴

⁴¹⁹ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

⁴²⁰ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

⁴²¹ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

⁴²² Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

⁴²³ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

⁴²⁴ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

On the other hand Peter North believes that planning power over new developers is an important gateway into getting customers to connect to the scheme. The surplus of governmental buildings in London could possibly provide the head load needed in order to make the London Thames Gateway a larger system than originally planned.

⁴²⁵

District heating is not the only viable solution for CO₂ cutting in London and it is imperative that the heat density is high enough in order to make the investment lucrative and the heat supply competitive against other local forms of heat supply. In terms of future development, the LDA are looking at the possibility of extending the London Thames Gateway heat network towards the Citigen scheme and south of the River Thames.⁴²⁶

The project is the only one of its kind where surplus heat from an existing power station of larger scale is being utilized to heat community housing. Peter North explains that there are not enough incentives for gas or coal fired power stations across the UK to convert to CHP, particularly where they are located in remote areas far from centres of population. There needs to be something or someone who enforces or drives a change of this amplitude. The incentives for energy companies in the UK are nowhere near strong enough to drive an energy revolution and the larger power companies have not shown any real interest in CHP technology for urban applications. The hope is that Barking power station and the London Thames Gateway network might be a start.⁴²⁷

Southampton

The Southampton case is a success story in the history of UK district heating schemes. They themselves explain the success by having avoided the problems which developed amongst district heating schemes dating from the 1950's to the 1970's. Southampton District heating Scheme (SDHS) managed to avoid poor performance, inaccurate meters and the dissatisfaction among tenants.⁴²⁸

The story of the SDHS

In the early 1980's the Department of Energy decided to dig four wells, with the intention of investigating geothermal energy resources in the UK. In Southampton they found an aquifer containing 74°C water, in close proximity to the city centre.

⁴²⁵ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

⁴²⁶ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

⁴²⁷ Peter North, Head of decentralized energy delivery at London Development Agency, 2009-04-20

⁴²⁸ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath), January 2008, p. 2

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

Despite this seemingly extraordinary finding, the geothermal source remained unexplored. Gas was cheap at this time and the initial interest in the well faded. The Southampton City Council (SCC) was excited by the geothermal finding and negotiated with the Department of Energy for rights to dig a second well to further investigate the potential of the geothermal source. The Department of Energy concluded that there was no potential for a larger scheme to be built in connection to the source, but the SCC was not ready to give up quite yet. After a geothermal conference in Florence, Italy, Mike Smith, financial director of the SCC, was introduced to EU funding enabling further investigations of the geothermal finding.⁴²⁹

The main reason why the SCC continued to believe in the opportunity of the geothermal findings was largely due to the “green” minded politicians employed at the City Council in the 80’s.⁴³⁰

There was no knowledge of how to actually exploit the geothermal source within the SCC or anywhere else in the UK either for that matter. So the SCC decided to partner with Utilicom, an energy company owned by the French energy group IDEX, who had already developed several similar schemes around Europe. Utilicom chose to create a local energy company called the Southampton Geothermal Heating Company (SGHC) Ltd. This did not only help SCC to acquire the knowledge needed to start building the scheme they had dreamed of, but it also transferred the financial risk to Utilicom.⁴³¹ Mike Smith made the following comment regarding the SCC’s stand point: *“This isn’t a mainstream area of work for local authorities; they have limited capital resource and find it difficult to subsidise these schemes through council taxes, so there was a need to transfer the risk to a private sector company which had the necessary experience, skills and resources to deliver the scheme successfully.”* Utilicom further chose to set up an Energy Service Company (ESCO) to carry out the development of the scheme.⁴³² An ESCo is usually assigned to a project by request of a customer to help design, develop, finance and operate the scheme. In comparison to a consultancy corporation, an ESCo is contracted to deliver specific, predefined results. ESCos are held accountable for the outcome of their work, much more so than an ordinary energy consultant who is paid by the hour.⁴³³ An ESCo functions as an owner of a scheme and are thus responsible for the profitability of the project. An ESCo sometimes chooses to partner with another secondary stakeholder such as a community council to transfer some of the risks involved⁴³⁴.

⁴²⁹ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008, p. 20

⁴³⁰ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008, p. 17

⁴³¹ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008, p. 25

⁴³² Energy services: The development of community heating in Southampton, Energy Saving Trust, 2007, quoting by Mike Smith former executive director at SCC, p. 2

⁴³³ National Association of Energy Service Companies, 2009-05-18

⁴³⁴ National Association of Energy Service Companies, 2009-05-18

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

The main energy station was completed in 1986, just some 100 meters from the well, and the connections to buildings were built on one by one, the first being a nearby school. One of the success factors of this project was the fact that Utilicom chose to start small and was thus able to demonstrate the benefits of the scheme and then progressively building the rest of the system.⁴³⁵

Negotiation with customers turned out to be something of a battle for the scheme. It required a lot of effort in terms of explaining the benefits of a new heating system. There was resistance due to the uncertainty of a new technological system and the need for well-known patterns of policies and organizations to change. One of the main obstacles to overcome was convincing customers and other stakeholders who calculate on initial capital rather than lifecycle costing that the scheme was in fact a good investment. Bill Clark, one of the project champions and employees of the Southampton City Council, quoted one of Utilicom's customers saying: "*I'm not interested about what it costs someone to live in my house I want to sell it.*"⁴³⁶ Part of the solution to these problems has been to use planning power to show the customer the potential gains that come from connecting to the scheme. With the tool of something called the "Structure and City Development Planning processes" the customers could be encouraged to connect to the system.⁴³⁷ Another one of the major obstacles to overcome was getting the customers to pay for their connection to the grid. Community funding was used to alleviate some of these issues and according to Jason Taylor at SCC, similar planning power is still used today. In something called *Section 106*.⁴³⁸ *Section 106* is a fund created with the aid of finances collected through developers paying the community council for infrastructure which is needed for new development.⁴³⁹

The SCC and Utilicom realized that the geothermal source (which is finite) is not the center of the scheme, in fact the network is, and they therefore started to look at potential sites of heat generation. The project champion, Mike Smith, says that the geothermal resource functions as a catalyst for the entire district heating scheme. Bill Clarke says; "*The catalysts for all these systems is that something was there. For us it was geothermal, for Nottingham it was pipework and for Barnsley it was moving from a coal economy.*"⁴⁴⁰

⁴³⁵ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008, p. 27

⁴³⁶ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008, p. 32

⁴³⁷ Heat call for evidence, Department of Business Enterprise and Regulatory Reform, UK, 2008, p. 69

⁴³⁸ Jason Taylor, Energy Manger at Southampton City Council, 2009-03-12

⁴³⁹ Heat call for evidence, Department of Business Enterprise and Regulatory Reform, UK, 2008

⁴⁴⁰ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008, p. 36

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

To match the growing demand Utilicom developed a 5,7MW CHP plant, Wartsila, at the heat station in 1998. The surplus electricity from the CHP station was sold to E.ON and distributed to the national grid. Distribution to local customers would have been more profitable, but would have required a local wire network.⁴⁴¹ In 2002 a 750kW CHP was installed at the Royal South Hants Hospital, to meet their electricity demand and the excess heat went back to the heating grid.⁴⁴² The CHP investment at the Hospital was aided by funding from the Community Energy Programme.⁴⁴³

In 1996, one of the hotels connected to the district heating system required energy efficient cooling. They chose to develop a cooling system which increased the energy efficiency during summer time when the heat wasn't needed. Surplus heat from the geothermal source was reused through absorption chillers in order to produce cold water.⁴⁴⁴ The cold water was then delivered to the consumer via the district cooling network. The district cooling can replace a conventional electrically driven air conditioner. The district cooling of the hotel acted as a trigger and reference object and opened up opportunities to make the cooling scheme available to other customers. In 2002 a large shopping center opened near the heat station, allowing for a much larger production of cooling. Investments were made in terms of a vapor compressor, which used power from the CHP plant to produce cold water, to meet the growing demand of cold water.⁴⁴⁵

The scheme is currently growing rapidly and the SCC is an important driver in the development of the scheme. With the aid of finances from *Section 106*, the SCC has been able to encourage customers to invest in district heating. When a building is developed the SCC gives developers three options for their energy solution.⁴⁴⁶

1. To connect to the district heating grid,
2. To develop their own CHP station,
3. Or to carry out energy efficiency programs

The Southampton City Council has a say in all actions taken regarding energy solutions in new developments in the private, public and commercial sector. The Council does not only encouraging new developers to connect to the district heating

⁴⁴¹ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008, p. 38

⁴⁴² Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008, p. 40

⁴⁴³ Energy services: The development of community heating in Southampton, Energy Saving Trust, 2007, p. 41

⁴⁴⁴ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008, p. 43

⁴⁴⁵ Heat call for evidence, Department of Business Enterprise and Regulatory Reform, UK, 2008, p.69

⁴⁴⁶ Jason Taylor, Energy Manger at Southampton City Council, 2009-03-12

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

system, but also promote the use of district heating systems where reconstruction is required.⁴⁴⁷

An important lesson learned from the Southampton case is that negotiation with customers is essential along with discussions with developers and architects at the right time before construction. At the same time, commercial customers are more aware of Corporate Social Responsibility (CSR) and environmental issues, which in later years have been used as leverage in negotiation with developers. At the same time governmental and regional legislations are encouraging the development of district heating (Climate change bill, white paper and HECA act).⁴⁴⁸

Facts of the scheme

Southampton has one of the largest district heating schemes in the UK. The scheme delivers 70GWh of heat and 23GWh of electricity annually. The scheme started off as a geothermal source, but has developed to include a gas-fired CHP plant and two conventional backup boilers. About 12% of the heat comes from the geothermal source and the rest from the 5,7 MW CHP plant.⁴⁴⁹

The scheme has also developed to include a cooling system which replaces electrically driven air conditioning and makes the scheme more energy efficient. The scheme has over 11 km of pipes that distribute hot and cold water to connected customers. The SDHS have over 40 customers within both the private and the public sector along with hundreds of domestic customers.⁴⁵⁰ Among these are hotels, the BBC's regional radio and television studios, a food superstore, a large college campus, numerous office complexes, a vast swimming & diving complex, a major city centre hospital and one of the largest shopping malls in the U.K.⁴⁵¹ The annual recorded sales from heating, cooling and electricity have reached over £2 million, and a conservation of approximately 30,000 tons of CO₂.⁴⁵²

The heating grid is located within a 2 km radius of the heat station with just 0.5 °C/km in temperature loss. Overall the heat loss is limited to 5% over the entire span of the grid. Southampton has 2247 degree-days per year (based on 15,5) and the annual mean temperature of the area is measured at 10,8degrees.⁴⁵³

⁴⁴⁷ Jason Taylor, Energy Manger at Southampton City Council, 2009-03-12

⁴⁴⁸ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008

⁴⁴⁹ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008

⁴⁵⁰ Heat call for evidence, Department of Business Enterprise and Regulatory Reform, UK, 2008

⁴⁵¹ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008

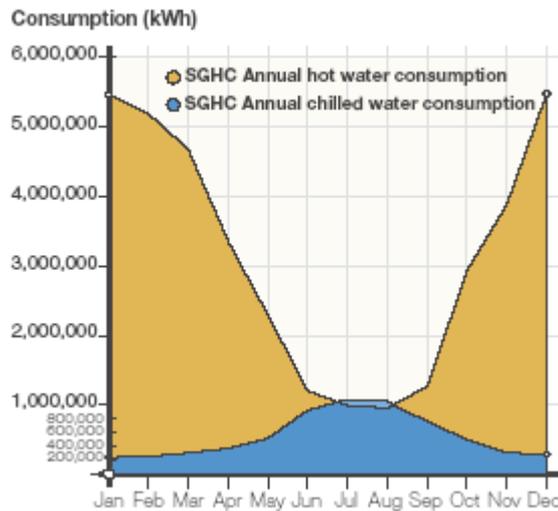
⁴⁵² Heat call for evidence, Department of Business Enterprise and Regulatory Reform, UK, 2008

⁴⁵³ Geothermie District Heating Scheme: Southampton United Kingdom, Energie-Cités in collaboration with the City of Southampton, UK, 2001

Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

The following figure shows the annual distribution of heating and cooling in Southampton.⁴⁵⁴

SGHC Annual chilled water/hot water consumption profile



The private and public partnership of the scheme

The multi-organizational and co-operative structure of the SHDS is seen as one of its major success factors. The main partners of the SDHS are SCC, Utilicom, the European Union and the UK Department of Energy. The UK Department of Energy initiated the drilling of the geothermal source, but it was the SSC who actually encourage the development of the project.⁴⁵⁵ It was the city council who made land available, leased it at a low rate, and granted licenses for laying the heat distribution system. The council was obligated to use the district heating in their own buildings and to promote the scheme to others to the best of their ability. The council put together a team of engineers, planners and legal and financial offers to work on the SDHS whilst the European Union provided financial support.⁴⁵⁶

Financial model

Utilicom have taken the entire financial risk of developing the Southampton district heating scheme, whilst SSC have taken on the reputational risk. Even though Utilicom is responsible for the scheme, the council is obligated to support them in every way possible since it is in fact the inhabitants of the community who benefit

⁴⁵⁴ Urban Community heating and cooling: The Southampton district energy scheme, International Energy Agency

⁴⁵⁵ Geothermie District Heating Scheme: Southampton United Kingdom, Energie-Cités in collaboration with the City of Southampton, UK, 2001

⁴⁵⁶ Energy services: The development of community heating in Southampton, Energy Saving Trust, 2007

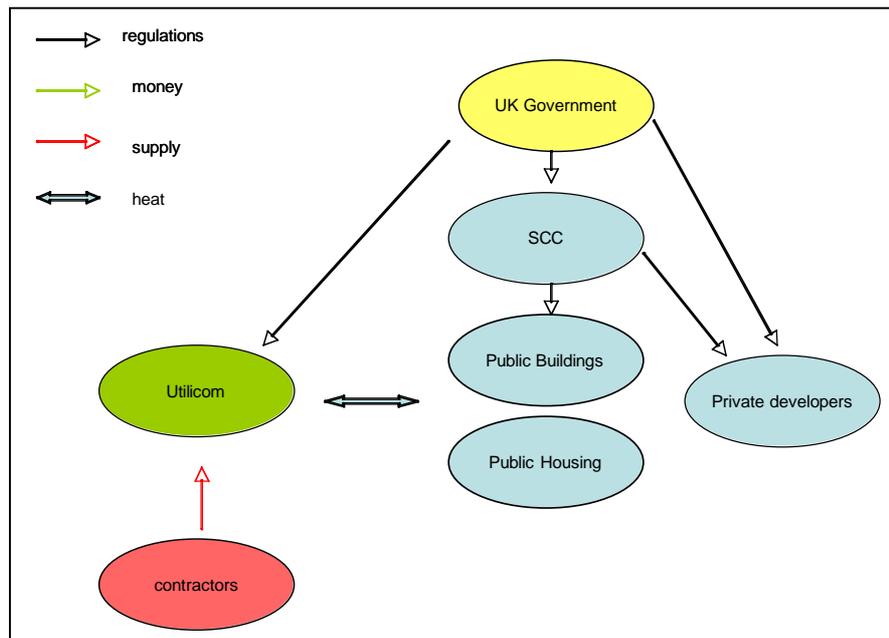
Industrial Landscaping of District Heating Opportunities for knowledge transfer to the UK market

from the scheme in terms of receiving inexpensive heating. It is therefore the SCC's role to boost the market through regulatory means and negotiations.⁴⁵⁷

A lot of the national funding that was used in the development of the Southampton scheme is no longer available. However, there are constantly new funding incentives being created. Jason Taylor believes that the funding for district heating will grow larger in the future due to the pressing CO₂ emission requirements presented by the Government.⁴⁵⁸

The Southampton scheme has been so successful that it is being replicated in Birmingham (operated by Utilicom) and Eastleigh. It is not just the actual physical scheme which is being replicated but the organizational structure, the financial model and the entire development process. The SSC have sought to influence Government policies, providing input to both the White paper energy act and the Local Government Act.⁴⁵⁹

Below is an illustration of the multi-organization at Southampton.



⁴⁵⁷ Geothermie District Heating Scheme: Southampton United Kingdom, Energie-Cités in collaboration with the City of Southampton, UK, 2001

⁴⁵⁸ Jason Taylor, Energy Manger at Southampton City Council, 2009-03-12

⁴⁵⁹ Southampton District Energy Scheme – A story of collaboration and steady ambition, Margaret Gearty (University of Bath UK), January 2008

Abreviations

BERR	Business Enterprise & Regulatory Reform
BRE	Business Research Establishment
CCL	Climate Change Levy
CEP	Community Energy Programme
CERT	Carbon Emission Reduction Target
CESP	Community Energy Saving Programme
CHP	Combined Heat and Power
CHPA	Combined Heat and Power Association
CoL	Corporation of London
DECC	Department of Energy and Climate Change
DEFRA	Department of Environment, Food and Rural Affairs
DH	District Heating
EDIP	European Development Infrastructure Plan
ERDF	European Regional Development Fund
ESCo	Energy Service Company
EST	Energy Saving Trust
ETS	Emission Trading Scheme
GLA	Greater London Authority
IEA	International Energy Agency
JESSICA	Joint European Support for Sustainable Investments in City Areas
LDA	London Development Agency
NGO	Non-Governmental Organization
NPV	Net Present Value
Ofgem	Office of Gas and Electricity Markets
PDHU	Pimlico District Heating Undertaken
RHI	Renewable Heat Incentive
ROC	Renewable Obligation Certificate
SCC	Southampton City Council
SDHS	Southampton District Heating Scheme
SHEAP	Shetland Heat Energy & Power
SIC	Shetland Island Council
VPC	Vattenfall Power Consultant