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The Impact of Networks on the Legitimacy of the Emerging Bioenergy Systems

A Socio-technological Comparison of the Emergence of the Bioenergy Systems in Sweden and in the UK

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Abstract

Purpose: This thesis, first, sets out to identify how the collective action strategies of prime movers and the manner in which they form networks affect the legitimacy of a "newly emerging" bioenergy system. In light of this information, the second purpose is to see if it is possible to provide some lessons and good examples of networking strategies for "prenatal or infant" bioenergy cases from more "mature" and expanding bioenergy markets.

Design/approach/methodology: This thesis is an in-depth multiple case study examining the bioenergy network formations in the UK and in Sweden. It has a specific focus on political networks which are analysed from the standpoint of their functions to facilitate the diffusion of new technological systems. The study is carried out via several in-depth interviews and a literature survey.

Findings: The differences in the network formation during the infant years of bioenergy in Sweden and in the UK indicate that the way that the networks are established and function has a major impact (1) on their effectiveness in supporting the emergence of a new industry; and, (2) on the pace of legitimacy that is created for it in the eyes of the society, government and other industries. In Sweden, the concerted, focused, and organized structure of the collaboration around bioenergy could create an environment of knowledge, understanding and acceptance for it more easily in the eyes of the stakeholders. Hence, the collaboration facilitated the market formation more effectively. However, in the UK, the fragmented, poorly coordinated and competing character of bioenergy networking cannot effectively assist the infant bioenergy industry. The network is limited in its capabilities in producing and spreading information and knowledge; and creating an environment of trust, which impedes its level of understanding and acceptance by the stakeholders.

Originality value: This thesis has two originality values. First, it contributes to uncovering some vibrant dynamics in the diffusion of new technologies, beyond the policy support, by highlighting the important functions of networking. Second, it goes one step further and casts light upon how these networks are formed and how their structures influence their effectiveness in facilitating the emergence of a new industry.

Key words: Industrial legitimacy, industrial networking, bioenergy industry

Executive Summary

Just like any new technological system, the commercialization and diffusion of bioenergy systems would not be easy and quick, especially, in a rooted environment of incumbent technologies. The initial market formation phase of bioenergy is embedded into a number of uncertainties and risks, which increase the transaction costs for the prime-movers and put them in a more fragile position vis-à-vis the accommodated systems. For that reason, especially, during its "gestation/prenatal" and "infant" periods, the bioenergy system founders should strive for (1) reducing the risks and uncertainties; and (2) increasing the cognitive legitimacy (level of understanding and knowledge) and socio-political legitimacy (level of acceptance) of the new system in the eyes of the society, decision-makers and other industries.

Lundvall (1992) highlights the interactive nature of an innovation system by defining it as "the elements and relationships which interact in the production, diffusion and use of new and economically useful knowledge, in the form of products and services". The complicated nature of bioenergy innovation system (having several different resources and feedstock suppliers, different logistics providers and options, varieties of technologies, fuel diversity and the variety in end-uses) make the need to interact and collaborate among the prime movers even more vital towards reducing the risks and uncertainties; and increasing the cognitive and socio-political legitimacy of the bioenergy system.

This thesis compares and analyses the collective action strategies of prime movers and the manner in which they form networks affect the pace of legitimacy of a "newly emerging" bioenergy system in Sweden and in the UK. Under the light of these case studies, recommendations are derived for the actors of a newly emerging bioenergy industry. Yet, the author reckons that actors of other "prenatal or infant" industries, which seek to gain cognitive and socio-political legitimacy, might make use of them as well.

Bioenergy networking strategies and their impact on the legitimacy of bioenergy in Sweden

During the initial market creation period for bioenergy in the 1980s-1990s, the system founders' interaction in Sweden had a distinctly collaborative character. There was an organized and concerted support from the whole value chain towards the establishment of a market and an overarching lobby organization. The presence of leading organizations in the collective action, and known faces to society such as local authorities accelerated the process of gaining respect, credibility and a more "taken for granted" status for the industry's offerings. These organized actors with a widespread outreach also facilitated the promotion of bioenergy to the society, government and other industries, as well as the spread of knowledge and information at the national and local level.

This character of the bioenergy system founders has incorporated into the Swedish Bioenergy Association, Svebio, as a bioenergy-focused "meeting forum" and "lobby organization". Under the light of the findings of this study, Svebio came out as an organization, which has gained respect, trust and legitimacy in the eyes of the stakeholders. This powerful collective action facilitated the initial market formation not only by creation of "internal" trust among the value chain and by reducing the risks along with the transaction costs; but also by gaining "external" respect for the new industry by lobbying and spread of knowledge.

Bioenergy networking strategies and their impact on the legitimacy of bioenergy in the UK

The structure of interaction among the actors in the UK appears to have had both a fragmented and individualistic character. There are a number of networks, but the interaction among these is minimal, and insufficient to lead the bioenergy to a level of "taken for grantedness". Indeed, there is notable competition among the actors, including companies, universities and networks, for scarce resources such as capital grants, respect and attention from the stakeholders like the government and the public. The knowledge and experience flow among the networks, universities and companies is limited, generally one way and poorly coordinated. The information flow to the society is not adequate to create a knowledge and understanding; and to clarify the confusion about what bioenergy is.

In addition to this general picture, the networking strategy followed by the bioenergy system founders to gain legitimacy might also pose some problems to the development of "new bioenergy technologies". In the UK, all renewable energy sectors, including the bioenergy sector, has been merging under one organization called the Renewable Energy Association, REA. This Association, which is composed of nine staff, seeks to be the sole representative for all renewables, also for the bioenergy. Hence it constitutes the "corresponding organization" in the UK to Svebio in Sweden. It manages different fields of renewables by dividing them into Resource Groups. However, the very broad scope of this collective action might lead to a potential fundamental problem of being short of covering and dealing with the bioenergy with all its complexity, as opposed to the desperate need of bioenergy to be promoted and advertised in the UK regarding the misconception and the lack of knowledge about it in the society.

At the local level, the bioenergy prime movers mostly establish networks, which are more project-oriented and have narrow geographies. Although, the scope of this thesis was initially limited to the nation-wide, large and representative political networks, the weak connection between the nation-wide and local networks created a knowledge gap on what was going on at the local level and made it necessary to cover this aspect as well. Moreover, these networking cases provided important input to the study as they appear to be successful in increasing the cognitive and socio-political legitimacy of the bioenergy, yet with limited multiplying effects.

This poorly coordinated and fragmented structure of bioenergy networking in the UK, which are either "too broad to grasp it all" or "too narrow to multiply it", appear to remain insufficient to facilitate the market formation and diffusion of new bioenergy technologies at a broader level through the creation of an environment of cognitive and socio-political legitimacy in the eyes of the society, government and other industries.

Networking and market formation propositions for emerging bioenergy industries[1]

1. The Swedish and the UK cases verify that the bioenergy industries in which the founders encourage convergence around a dominant product/service design appear to gain cognitive legitimacy more quickly than others.

2. As the evidence shows in the UK case, if the newly emerging bioenergy industry has diverse product or service designs, public awareness and promotion by the founders gain more importance to create the grounds for cognitive legitimacy for bioenergy.

[1] The propositions one, three (except the sub-propositions), four and five are based on Aldrich and Fiol, 1994.

3. As the creation of a collective action by the founders is vital, the character and the structure of the collective action are also crucial for its effectiveness on serving its function of increasing the socio-political legitimacy of the infant bioenergy system.

3.1. Including the whole value chain in the collective action is important if socio-political legitimacy for the emerging industry is to be achieved effectively.

3.2. Obtaining the support of strong intra-industry organizations in the collective action eases the information flow and mobilization of actors, and hence accelerates the legitimacy of the emerging bioenergy industry.

3.3. Including the grassroots actors or organizations such as forest owners and farmers in the collective action facilitates the trust-building between the supply and the demand, reduces the risks and transaction costs, and hence accelerates the legitimacy of the infant bioenergy industry.

4. Bioenergy industries in which founding firms promote their activities through third-party actors seem to gain cognitive legitimacy more quickly than others.

5. The evidence from the Swedish and British cases show that bioenergy sectors in which founding firms negotiate and compromise with other industries might sometime gain socio-political legitimacy more quickly than others.

6. When there are economic benefits from the growing bioenergy industry for the existing industry, the process of gaining socio-political legitimacy seem to be easier.

7. Bonding onto existing infrastructure and technological system appear to provide quicker legitimacy to the new bioenergy system.

8. The stipulation of the local (economic) benefits seems to accelerate the process of gaining socio-political legitimacy for bioenergy more easily.

9. The incremental deployment of bioenergy technological system, rather than radical, seems to help it to gain both cognitive and socio-political legitimacy more easily.

Specific propositions to the bioenergy networks in the UK

1. In order to avoid further fragmentation and competition with the local networks, it appears that there would be a value in attempting to appeal to, and include them in the nation-wide networks.

2. The information flow between the national and local networks should be improved by further interaction, as well as the information flow among the members of the networks.

3. The increased intensivity of interaction with the National Farmers Union might assist the REA in, i.e.; promoting bioenergy, outreaching the network of local producers more easily.

4. It might be necessary for the REA to strengthen the structure of the Resource Groups in order to increase their effectiveness as meeting forums and information creation places for the sectors.

5. In order to be able to grasp the whole complexity of bioenergy, it might be necessary for the REA to increase the number of dedicated staff under each resource category.

6. From the Swedish case, it seems that it is important to preserve the sub-sector links. Hence, some effort might be required by the REA, may be in the form of cross-sector working groups, to be able to make these sub-sectors come together and share knowledge and experience.

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1 Introduction

Problems stemming from the current unsustainable structure of dominant energy system are many and address the need to transform it towards a more sustainable system. This chapter starts with depicting these problems and introducing bioenergy as one of the mainstays that can contribute to this transformation. However, this alteration, together with the other alternative energy systems will not be easy and will not realize itself. Hence, later on, the audience will be presented one the "problematic" areas within this process of change, which inspired and guided this study. The questions that made it possible to examine into this "problematic" in a systematic way will also be introduced. In order to facilitate the comprehension of the thesis, the scope together with the explanations of some key terms and the methodology that is used to handle the "problematic"; as well as the limitations to the study and the intended audience for will also be clarified under this Chapter.

1.1 Background

1.1.1 Problems with the current energy system

Energy is the fuel of development (United Nations, 1991). However, continuing along the current path of energy system is not compatible with sustainable development objectives (UNDP, 2004). The statistics and projections on energy consumption show us the fact that the global modern energy system is dominated by the fossil fuels and it will continue to be so. In 2003, world Total Primary Energy Supply (TPES) was 10 579 Mtoe[2], of which share of fossil fuels was 80 % ; oil 34.4 %; natural gas 21.2 %; coal 24.4 %, nuclear 6.5 %, and renewables 13.3 % (International Energy Agency- IEA, 2005). According to the projections, energy consumption will increase by 71% from 2003 to 2030 maintaining the trend and fossil fuels will continue be the dominating energy carrier (Energy Information Administration- EIA, 2006).

There are a number of problems stemming from the current character of the global energy system. The Oil Crises in 1970s and the current rising prices of fossil fuels have been showing that energy security is an important issue and source of political tension given the uneven distribution and non-renewable nature of the fossil fuels. The increasing trend of fuel prices, accompanied by the political power games make the fossil fuel dependent industries worried about the cost effectiveness and the reliability of the fossil fuels.[3] The uneven distribution of these fuels around the world also creates economic and social disparities among the nations. In many developing countries, energy imports represent more than half of all imports, imposing a heavy burden on foreign exchange and contributing to indebtedness (UNDP, 2004). Emissions of anthropogenic greenhouse gases, mostly from the production and use of energy, are altering the atmosphere (UNDP, 2004). Estimates indicate that, by the year 2020, with projected population growth and a rising demand for energy services, there could be an increase of greenhouse gasses by nearly 50% (UN, 1991).The use of fossil fuels is one of the major contributors to serious environmental and health problems (UNDP, 2002).

[2] Million tonnes of oil equivalent

[3] Some of my interviewees from the UK stated that the British industry, which is almost 100% dependent on the fossil fuels, has been worried about security of energy supply and the cost of fuels since the Iraqi War. This worry was coupled with Russia's cutting the natural gas supply to Ukraine, hence cutting the 15% of the gas transiting from Ukraine to Europe for 4 days as a result of Russia- Ukraine gas dispute in 2005-2006.

In order for these problems to diminish, a transformation in the current energy system is needed. Sustainable energy solutions, such as new renewable energy sources, constitute one of the pillars of this transformation. This thesis focuses on the bioenergy innovation system as a part of the solution.

1.1.2 Part of the solution: Bioenergy

According to Silveira (2005, p. 3), the old idea of climbing an energy ladder that gradually goes from biofuels to fossil fuels as a way to access modern energy services has been broken and many countries have realized the need to harness local resources to increase the security of energy supply, reverse fossil fuel dependency and improve trade balance.

Among all of the renewables, biomass is by far the most significant renewable source, representing 10.4% of the world total energy supply (Silveira, 2005, p. 7), and most of which comes from traditional biomass (Johansson et al., 2004).

Bioenergy offers attractive alternatives which are only partially being exploited (Silveira, 2005, p. 15). There are a number of studies carried out on the potential of biomass based on different assumptions. Johansson et al. (2004) highlight a study, among others, which is based on the "ecologically driven assumptions" on the potential of biomass indicating that the share of renewables will be 40% in 2050, and the contribution of biomass to this share will be 30%.

1.1.2.1 What is bioenergy?

Bioenergy is the renewable energy derived from biomass. *Biomass* is any organic material, of plant and animal origin, derived from agricultural and forestry production and resulting by-products, and industrial and urban wastes, used as feedstock for producing bioenergy (for heat, electricity and transport) and biomaterials (OECD, 2004).

1.1.2.2 Why bioenergy?

Bioenergy offers several advantages over conventional energy sources (European Parliament, 2005) and can contribute the transformation of the current energy system. And "biomass technologies can be competitive with fossil fuel alternatives" (Silveira, 2005, p. 15). According to the European Parliament (2005), biomass also has many advantages over conventional energy sources. The list below involves these advantages as well as the others:[4]

- The plant-based biomass is considered to be carbon neutral. When the wood is burned, the CO_2 released into the atmosphere is equal to the amount of CO_2 that has been taken during the photosynthesis. Thus, it contributes to carbon offsetting.

- They are abundant in most parts of the world. Thus, they offer domestic energy opportunities for countries contributing to increasing the energy security and maintaining the balance of payments.

- Various commercially available conversion technologies could transform current traditional and low-tech uses of biomass into modern energy.

[4] Sources; Royal Commission on Environmental Pollution- RCEP, 2004; Johansson et al., 2004; Silveira, 2005; European Parliament, 2005; OECD, 2004.

- Biomass technology is inherently flexible. It can be organized at small-scales and decentralized, from 1 to 100 MW, thus allowing a slow modular increment in energy supply, avoiding stranded investments, and minimizing risks.

- Biomass can be used to produce different forms of energy such as heat, electricity and transport fuels, thus, provides all the energy services required in modern society.

- Unlike any other renewable energy sources, it can be stored and used on demand to give controllable energy.

- Bioenergy market offers new employment and income generation opportunities for rural population and stimulates rural development.

- Bioenergy and biomaterial production offers the opportunity to use (agricultural) waste and reduce costs of their disposal.

However, realizing the potential towards sustainability requires comprehensive management of natural sources such as land and water (Silveira, 2005, p. 5) in order to handle erosion, removal of nutrients from the soil and the potential negative impacts on biodiversity. It is necessary to guarantee that land competition does not jeopardize food production and security (Silveira, 2005, p. 5). Collection, transport and use of biomass also increase the use of vehicles and cause emissions to the atmosphere (Johansson et al., 2004).

1.1.2.3 Barriers to bioenergy as an emerging industry

The potential to realize the benefits of bioenergy partially lies under overcoming many barriers stemming from its nature. Bioenergy has a complex supply chain and a large number of possible combinations of sources, conversion processes and technologies, and delivered services (Carbon Trust, 2005). Each subsystem includes different technologies with individual learning processes for cost reductions (Johansson et al., 2004).

Moreover, the variety in feedstock and technologies give it a crowded character, which complicates the whole supply process; the decision of investment and the communication along the supply chain is more difficult compared to other renewables. The large number of actors involved in the supply chain also makes it more trust-oriented, where all the actors in the subsystems have to make independent investments, but all have to act together and operate smoothly to reap the fruits of these investments. Also, given the fact that it has a fuel cost, it makes it more complicated to make calculations regarding which combination would be the most viable (Carbon Trust, 2005).

In addition to these difficulties, which are embedded in the nature of bioenergy system itself, there is another group of barriers to its diffusion, which are embedded in the process of all emerging industries.

The actions of entrepreneurs, the prime-movers, have an important impact on the path of development of the new technological system (Bergek, 2002) and on its pace of legitimacy (Aldrich and Fiol, 1994). However, they meet some challenges simply sourcing from being "the prime mover" and there are several socio- political barriers to kick-off a market (also see, Section 2.1, Theoretical background 1: Barriers to diffusion of innovations):

- The prime entrepreneurs are few in population, or even alone. Founding a new venture is risky under any conditions, but especially so when entrepreneurs have few precedents for the kinds of activities they want to found (Aldrich and Fiol, 1994).

- An emerging industry and its actors are not well- known. And, most often, the existing environment is sceptical towards new things.

- They have to build "trust, reliability, reputation, and, finally, institutional legitimacy" (Aldrich and Fiol, 1994) to be understood, respected and supported, to change the institutional environment and realize their transactions at reasonable costs.

- An emerging industry needs to gain legitimacy to have access to capital, markets, and governmental protection (Aldrich and Fiol, 1994).

So, what is or what should be the strategy for the (bioenergy) "prime-movers" to be able to create this social context which is essential for the success of innovation system?

The literature on innovation systems and industrial networks (Carlsson and Stankiewicz, 1991; Lundvall, 1992; Jacobsson and Johnson, 2000; Jacobbson and Bergek, 2004) point out that the diffusion of innovations involves a social process of learning, interaction and cooperation with the "others". Carlsson and Stankiewicz's (1991) definition of a technological system as "knowledge and competence networks supporting the development, diffusion and utilization of technology in established or emerging fields of economic activity" reflects the necessity and nature of this interaction. Developing industrial networks is essential to the process, which goes through collaboration rather than pure competition in terms of increasing the knowledge on the business activities. Networking eases and makes the development of the necessary political and social context by helping the new venture to overcome the barriers sourcing from being new and few. Networks of "buyer- supplier, problem- solving or informal networks, or, in most cases, a combination of these" (Carlsson, 1997), will help new ventures share experiences, "combine knowledge, skills and physical assets, access to knowledge spillovers information" (Ahuja, 2000); mobilize sources for lobbying and raise public awareness, in the end to gain attention, respect, trust and legitimacy.

Hence, for bioenergy too, networking is one of the ways to deal with the difficulties connected to being in the "new and alone" phase.

1.2 So, what is our problem?

The diverse, complex and crowded nature of bioenergy makes it more vulnerable to the difficulties stemming from "being new" and harder to communicate, understand and accept for the society, government and industries. This feature of bioenergy makes collaboration among the actors even more necessary and networking more vital to be able to better explain, promote and be understood on the way to commercialization. The Swedish experience of bioenergy networking around an emerging industry in the 1980s seems to verify the literature highlighting the positive implications of industrial collaboration.

However, most of the literature on the diffusion of bioenergy and other renewable energy systems identify and scrutinize the policy needs, political barriers, policy successes and failures vis-à-vis the ones examining into social aspects of the issue, such as social acceptance, the interaction and networking among the stakeholders.

More over, to the author's knowledge, there are not many studies investigating into how bioenergy networks are established; what the opportunities and barriers to bioenergy networking are; what roles they have; how effective they are or they can be; and if it is possible to drive lessons from different bioenergy networks or not, for each other.

In this thesis, we will look into the issue of diffusion of bioenergy from a socio- technological point of view and examine the role of networks in promoting bioenergy and the structures and factors that might affect their effectiveness based on two different country examples.

1.3 Why bioenergy in Sweden and Britain?

The primary reason for choosing these two countries is their different levels of maturity of the bioenergy industry and business. Sweden is a leading country in modern commercial bioenergy applications, and in the UK bioenergy is in its "prenatal" or "infant" phase. The contribution of bioenergy into TPES in Sweden is 17% (Swedish Energy Agency, 2005b) while in Britain it is around 1% (Biomass Task Force, 2005), even lower than the EU average of 4% (EC, 2005). This difference in shares, which are indicators of levels of "maturity", is expected to be reflected on the interactions and networking among the actors, as well as on the knowledge and acceptance of bioenergy. This difference would enable us to see the differences and commonalities in the early phases of market formation and if it would be possible to drive some lessons from a "more mature" example for an "emerging" case.

Furthermore, comparing these two countries is also interesting since Sweden's population is almost 6.5 times less than of the UK's and the area is almost double size of UK's. Sweden's population is 8.99 millions (UN, 2005[5]) on an area of 449 664 km^2 and the UK's population is 59.8 millions (National Statistics, 2005[6]) on an area of 242 514 km^2. This fact would also have different implications on the behaviour of all actors in two countries and the nature of interaction.

1.4 Purpose and research questions

The purpose of this thesis is two fold.

The primary aim is to understand how networking strategies of market founders affect the legitimacy of the bioenergy system and the market formation. To provide a background understanding of the bigger context, sub-questions addressing the nature of networks and effectiveness of interaction among the system founders were identifined.

And, the second aim is to see if it is possible to draw some lessons and knowledge from a more mature and commercial bioenergy case like Sweden for an emerging and chaotic bioenergy case like the UK.

Please see, Table 1, on the next page, which shows the purposes, research and sub- research questions that guided this study.

[5] BBC. (2006).

[6] BBC. (2006).

Table 1 Purpose and research questions which guided this study

Purpose 1: To understand how the manner of interaction among the founders/prime movers affect the legitimacy of the bioenergy system and the market formation	Purpose 2: To see if it is possible to draw lessons for the actors in the "prenatal or infant" bioenergy systems
Research question 1: How do the founders of the bioenergy system act to be able to form a market and create legitimacy for themselves? And, how this manner affects the legitimacy of the emerging bioenergy industry?	Research question 2: What could be the ways for founders/prime movers of a newly emerging industry to ease the process of overcoming the barriers in market formation?
Sub- questions: - How do they interact among each other, with other industries, with the regulatory institutions and public? - How do they promote their activities? - What is the structure of networking? - How effective are they?	Sub-question: - Are there any propositions to the founders of bioenergy system in terms of networking and market formation from a more established case?
Supplementary sub-questions: What are the policies affecting the bioenergy market? Who are the important actors? What are their roles? How do they affect the rules of the game?	

1.5 Scope and definitions of some key terms

Scope

The scope of this thesis limited to bioenergy for electricity and heat, excluding transport biofuels. Throughout the thesis, the word "bioenergy" is mainly restricted to these two areas (unless otherwise stated). Besides, due to the fact that both countries have identified solid biomass like wood-based fuels, agricultural residues and/or energy crops as the main domestic biomass fuel, the main focus of the study was around solid biomass (excluding municipal solid waste). Transport biofuels are left out due to their different characteristics of fuel, conversion and combustion technologies, and different services, users and markets compared to solid biofuels for electricity and heat.

The functional unit of the thesis is political networks established by the founders/prime-movers of the bioenergy system, which also act as a meeting forum for these actors. As stated above, networks are many and most of time in an overlapping composition, having common members and activities. However, for the purposes of my thesis and for simplicity, I limited myself to the political lobby organizations representing the largest proportion of all the market actors from feedstock to energy users. Nevertheless, general information on other networks was also collected not to miss other important, may be small, ones.

Not to mention, these networks are part of a bigger picture with other "actors, networks and institutions" (Jacobsson and Bergek, 2004) that together they constitute the components of an

innovation system. Thus, I will picture these components very generally to give the reader an idea about what is going on at a higher level. These components (as depicted in Jacobsson and Johnsson, 2000) are the important actors and networks that have made positive or negative impact on the development of bioenergy system, the policies and public perception. However, the aim of this thesis is not doing an in-depth analysis of these components, except the identified "networks".

Definitions of key terms

Throughout the paper, a number of key terms from the literatures of industrial innovation systems, industrial networking and legitimacy theory were used, which might be useful to define before proceeding further.

Founders/prime- movers means "the firms, or other actors, which are technically, financially and/ or politically so powerful that they can initiate or strongly contribute to the development and diffusion of a new technology" (Johnson and Jacobsson, 2000).

A *network* means "routes for the transfer of tacit (Metcalfe, 1992) and explicit knowledge" (Johnson and Jacobsson, 2000).

A *political network* means "those that have as objective to influence the political agenda" (Jacobsson, 2006).

An *innovation system* means "elements and relationships which interact in the production, diffusion and use of new, and economically useful, knowledge and that a national system encompass elements and relationships, either located within or rooted inside the borders of a nation- state" (Lundvall, 1992).

Legitimacy means "a generalized perception or assumption that the actions of an entity [channel member] are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs and definitions" (Suchman, 1995, p. 574).

Socio-technological regime/approach means "the interaction between the actors and institutions such as producers, users, suppliers, financiers, researchers, societal groups and public authorities, involved in creating and reinforcing a particular technological system" (Foxon, 2003).

Connectivity determines the amount of knowledge and R&D capital that a firm emits to other firms and depends on whether or not the firm belongs to a network (Carlsson, 1997, p. 16).

1.6 Methodology and its justification

This thesis is a multiple case study comparing and analysing the bioenergy network formation in Britain and Sweden, which seeks to see if it is possible to draw lessons that might guide the actors of emerging bioenergy industries.

Data and methodological triangulation methods were used in order to increase the validity of the findings and to be able to cover different facets of the issue. To this end, both qualitative and qualitative methods are used and conducted. Besides, a number of interviews from the different stakeholder groups were conducted and literature review on different theories and studies that might be relevant to this study was carried out together with other documents.

In addition to these, I also participated in the World Bioenergy Conference in Jönköping (2006, 28 May- 1 June) in order to be able to have an insight on the bioenergy innovation system.

1.6.1 Interviews

In order to gather the most relevant and up-to-date data, I conducted semi-structure interviews, mostly held face-to-face and on the telephone. In order to be able to make a sound comparison of two countries, I had a common, but flexible question framework to the corresponding interviewees in both countries. This semi-structured nature of the interviews enabled me to be able to cover different aspects of the issue by giving more flexibility to the respondent within the framework of the predefined questions, while enabling me to be able to follow up the unexpected answers.

I conducted approximately 30 interviews. I consider this number of interviews is reasonable to provide a good understanding of the structure, nature and the legitimacy of the networks.

I identified my interviewees from different components of the innovation system, as listed below, to be able to obtain information on the whole picture. After identifying a number of key actors, I used the snowballing method to increase the number of interviews. This method was very helpful to identify the relevant persons and ensured the possibility to conduct quality interviews with relevant people.

The interviewees were selected from:

- *Government departments,* since they set and shape the institutional environment, which frames all the transactions held and affects the behaviour and decision of the players. Furthermore, in Britain I also conducted interviews with the respondents from the *Local authorities*. This pillar was essential for the British case regarding the fragmented administration system of the country and the low connectiviy between the national and local networks.

- *Business and industry,* having transactions in the bioenergy market to observe their motivations and demotivations; barriers and opportunities faced.

- *Academics,* who have works on the innovation policy and industrial organizations to have an in-depth understanding of both the theory and the reality.

- *Networks such as trade associations and local bioenergy networks,* in order to have an in-depth story of the network formation, the reactions of the actors, barriers and opportunities faced, which constitutes one of the main sources for the understanding and the analysis of the interactions among the actors.

- *Consultancies,* who act as the mediators among inbetween the business and industry actors, know the business negotiations and policy risks in order to have a better overview of transactions and the market.

- *NGOs,* as "watchdogs" of the policies and as a part of the public opinion.

This diversity of interviewees provided me a range of different views and chance to verify and/or double-check the information I collected from each, especially about the policies and vested interests of the business.

For the summary of interviews, please see, Appendix 1: Summary of the interviews- Sweden and Appendix 2: Summary of the interviews – the United Kingdom.

For the remarks from the interviews, please see, Appendix 3: Remarks from the interviews.

1.6.2 Literature and document survey

For the secondary data gathering, I benefited from academic books, articles, reports and their reference lists, as well as, official documents and other published information written by key actors and organizations.

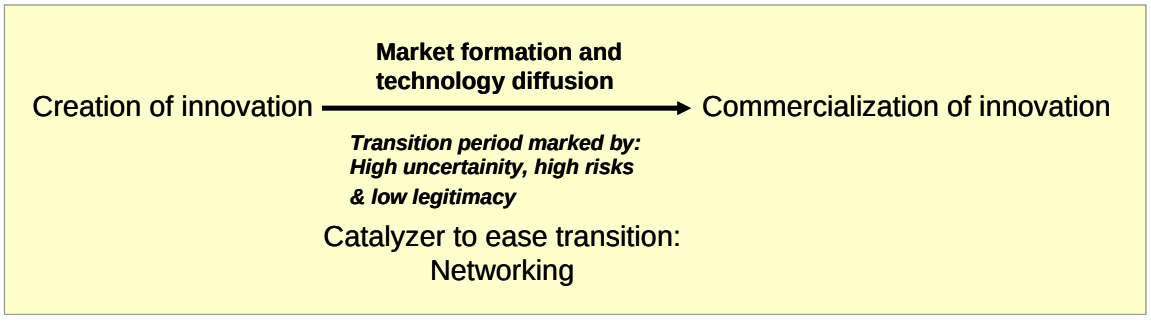
In order to better comprehend the problematic area and to be able address the research purposes, I defined the following thematic areas as important components of my research, and gathered data around them as shown in Table 2.

Table 2 Thematic areas, Research engines and Key words that guided the literature review

Thematic area	Research engines	Key words
Technological innovation	ELIN, Google Scholar, Libris and reference lists	"innovation", "innovation" and "technology", "innovation theory", "technological innovation"
Market formation and technology diffusion	ELIN, Google Scholar, Libris and reference lists	"market formation", "technology diffusion"
Industrial legitimacy	ELIN, Google Scholar, Libris and reference lists	"legitimacy" and "industry", "industrial legitimacy"
(Industrial) networking	ELIN, Google Scholar, Libris and reference lists	"networking" and "industry", "industrial networking"

Figure 1, shows the relationship between the thematic areas that I mainly carried out the literature survey.

Figure 1 The relationship between the thematic areas



For the EU documents, I mostly used the EU website[7], Eurolex[8] and EurActive[9].

I also provided some very recent interview transcripts from Perry Miles, a PhD student at Imperial Collage London, who studies on co-firing in the UK. He provided me with the transcripts of the interviews that he carried out with the energy companies employing co-firing of biomass with fossil fuels, which are of relevant to the topic at hand. This gave me the opportunity to have additional up-to-date information and insight on the UK bioenergy business.

1.6.3 Participation in the World Bioenergy Conference

In addition to interviews, on 29 May- 2 July 2006, I participated in the World Bioenergy Conference in Jönköping organized by Swedish Bioenergy Association (Svebio). The Conference had a major role in providing my first encounter with different technologies, different raw materials and actors. Also, the international nature of the Conference provided me with a global outlook to bioenergy on technologies, barriers, opportunities, and players and gave me an overview about what was going on on a wider scale.

1.7 Limitations

As indicated above, within the framework of this study, bioenergy networking in two countries were examined. While claiming generalizability of the results and recommendations for newly emerging bioenergy industries, it should be acknowledged that no information on other country cases was obtained. Besides, although, there might be general patterns of "effective" networking, I also recognize the fact that each case has its own unique features that give the fine differences to its functioning.

In order to be able to gather information on the history of the networks, their effectiveness and the levels of legitimacy, as well as on the background dynamics, several interviews were carried out. Although, efforts were made to increase the quality and reliability of the information, there is always a "standard error" regarding the data provided during the interviews due to the vested interests of the persons and the institutions.

Moreover, especially in Britain, the renewable energy issue and the related policies are like a "boiling pot" that has the potential of going through changes in a short period of time and what has been written in this thesis might face the risk of being obsolete after a short time. For example; when most of the primary data was collected, the authour was informed about a future major change in the structure of the bioenergy networking.

It should also be noted that the framework that is used to provide background information to the reader such as the main actors and policies affect bioenergy markets do not aim an in-depth analyses. Rather it aims to give the reader an idea about the common perceptions by the stakeholders regarding these items. Hence, to be able to give this general picture, only the central drivers and outstanding actors that are stressed commonly during the interviews are covered, and the rest remains as an area of future research.

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[7] Europa. (2006).

[8] Eur-Lex. (2006).

[9] EurActiv. (2006a).

Last, but not least, the focus of the thesis is "the diffusion of new technologies", thus the aspects such as cost to the society or costs to the government remain as an area for future research.

1.8 Intended audience

There are two major intended audience groups of this thesis.

The first major intended audience group consists of the "founders of a new industry" who aim to kick-start market formation and move towards. This thesis would contribute to the knowledge and understanding of entrepreneurs on the social aspects of diffusion of new technologies by bringing in "networking and collective action point of view" tested with case studies.

The second major intended audience group includes the local or nation-wide political networks around emerging technologies that are under the process of establishment; or, about to be established, or the actors who will to establish such a network. This thesis, by introducing two case studies of networking from two different countries, might be useful for other cases on the way of their formation regarding some common problems.

The other group of intended audience mainly covers the academics and researcher community:

- working in the fields of (renewable) energy technologies, technological system analysis and technology and/or industrial networking;

- seeking to identify barriers to the diffusion of new technologies and solutions to overcome these barriers; such as the Bioenergy Network of Excellence[10].

This thesis is also relevant to decision-makers as the policies and their decisions on whether to support or not to support emerging technologies have vital impacts on the acceptance and expansion of new innovation systems, as well as on how the market actors behave such collaborating or competing. Thus, the decision-makers having the power to be the catalyst to motivate the market actors to act collectively towards achieving the commercialization of marginal technologies might extract some ideas about what the role of the central and local authorities could be concerning the establishment of intra and inter-industry links.

1.9 Outline

Chapter two introduces the theoretical background and the analytical framework that inspired and guided this study. Before, examining the country case studies, Chapter three will describe the European Union regulatory framework, which influence the bioenergy policies and targets in Sweden and in the UK. Chapter four and Chapter five are dedicated to the bioenergy political networks with a wide background provided on where bioenergy stands within the energy system, the biofuel potential, the main actors and major policies, and the general public view on bioenergy in these countries. Chapter six provides a cross-country comparison and analysis on the dynamics and bioenergy networks in two countries. And, finally, Chapter seven presents the general conclusions and the propositions derived for the political networks in the infant bioenergy markets.

[10] Bioenergy Network of Excellence. (2006).

2 Theoretical background and analytical framework

Chapter two will present the theoretical background and the analytical frameworks, which systematized this thesis. The theoretical background is examined into two parts. The first theoretical background helps defining the main issue that the thesis addresses- the diffusion of new technological system. The second one addresses one of the ways to deal with this "problematic"- networking. Later on the analytical frameworks, on which the theory is applied is introduced.

2.1 Theoretical background 1: Barriers to diffusion of innovations

Innovation is an important source of economic growth (Rosenberg, 1982, p. 55; Mokyr, 2002[11]) and a key source of new employment opportunities and skills, as well as providing potential for realizing environmental benefits (Foxon et al., 2005).

Authors examining the innovation systems (Edquist, 1997; Rosenberg, 1987; Carlsson, 2002; Bergek, 2002; Jacobsson and Bergek, 2004) point out that the creation; introduction and commercialization of new ventures are not easy and quick, especially, in a rooted environment of incumbent technologies. The survival and success of a new technological system depend on the existence and realization of several factors, positive feedback loops (Bergek, 2002) and a subtle interplay between the actors and networks since the early stages of market formation is embedded into a number of uncertainties and risks. These uncertainties and risks increase the transaction costs (Skjoett-Larsen, 2000) for the entrepreneurs and put them in a more fragile position vis-à-vis the accommodated systems. For that reason, especially, during the "gestation and prenatal" (Rosenberg, 1982) and its infant (Jacobsson and Bergek, 2004) periods, innovation faces two main challenges to initiate a market for itself (Aldrich and Fiol, 1994; Jacobsson and Bergek, 2004):

1) reducing the risks and uncertainties;

2) increasing the legitimacy of the new system at the formal and informal levels.

So often the existing technologies do not welcome the newcomers. An innovation, in order to be able to penetrate in the market, has to compete with the existing technologies including the institutional and cultural environment that are built and rooted around it. There are several differences between the incumbent and new technologies that put the latter in a tough position to find itself a place on the market (Bergek, 2002, p. 9-10):

- New technologies are more expensive than the incumbent ones, much due to the fact that the improvement in price/performance is closely intertwined with the process of diffusion.

- New technologies are different from the established technologies in terms of scale.

[11] Cited in Foxon et al., 2005.

- Establishes energy system is associated with established lobby groups and institutional framework that lobby against the development and diffusion of new technologies.

- The established energy system is associated with an established innovation system, which may be expected to be the source of many obstacles to the new technologies.

- There are no obvious strong proponents of the new technologies.

In addition to the challenges from the accommodated system, another source of challenge for a new technology might be the other newly emerging alternative technologies. They might be striving for the same scarce resources such as market, capital, customers and try to gain acceptance at the political, public and industrial level.

2.2 Theoretical background 2: Overcoming the barriers; a socio-technological look

According to Jacobsson and Bergek (2004), during the formation and infant phase of a new technology, the institutions play a vital role providing a "nursing environment for them during which the risks and uncertainties are reduced, financial and political support is provided, the arguments of strong anti- lobby groups is counterbalanced" (Bergek, 2002) and the cultural environment that the new system will flourish into.

Similarly, the risk-takers strive for reducing the business risks and overcoming the barriers. However, one of the barriers could be the "bounded- rationality"[12] of firms in an environment of uncertainties and risks, which slows down the commercialization process. Networks can partly compensate for limitations in the firms search on account of both bounded rationality and vision (and) it may also improve the source base and degrees of freedom (Jacobsson and Johnson, 2000). Prime movers are key actors in creation of new technological system (Jacobsson and Johnson, 2000); hence, the strategies of the founding firms will have a decisive impact on the development and diffusion of technology (Bergek, 2002, p. 14) too. Aldrich and Fiol (1994) go one step further by saying an industry of which its founders push for interaction and networking, gain legitimacy more quickly than the others.

Further, Hughes (1987, p. 52) points out because technological systems are invented and developed by system builders and their associates, their components[13] are socially constructed. Holmen and Jacobsson (1998) also argue that firms are tied together not only by market transactions but also by network of relations which may give raise to significant positive externalities in form of knowledge spill-over. For example; "interactions between users and producers facilitate a flow of information and knowledge linking technological capabilities to user needs" (Lundvall, 1992) and helps the supply and demand and create a market. The degree of connectivity in existing networks influences the amount of info and knowledge that is diffused in the system. A high connectivity is not automatically created by

[12] Bounded rationality indicates that although, actors try to act rationally, they are restricted by their intellect, or their inability to communicate their knowledge or options to others (Skojett-Larsen, 2000).

[13] Components defined in Hughes (1987) as physical artifacts, organizations and legislative artifacts.

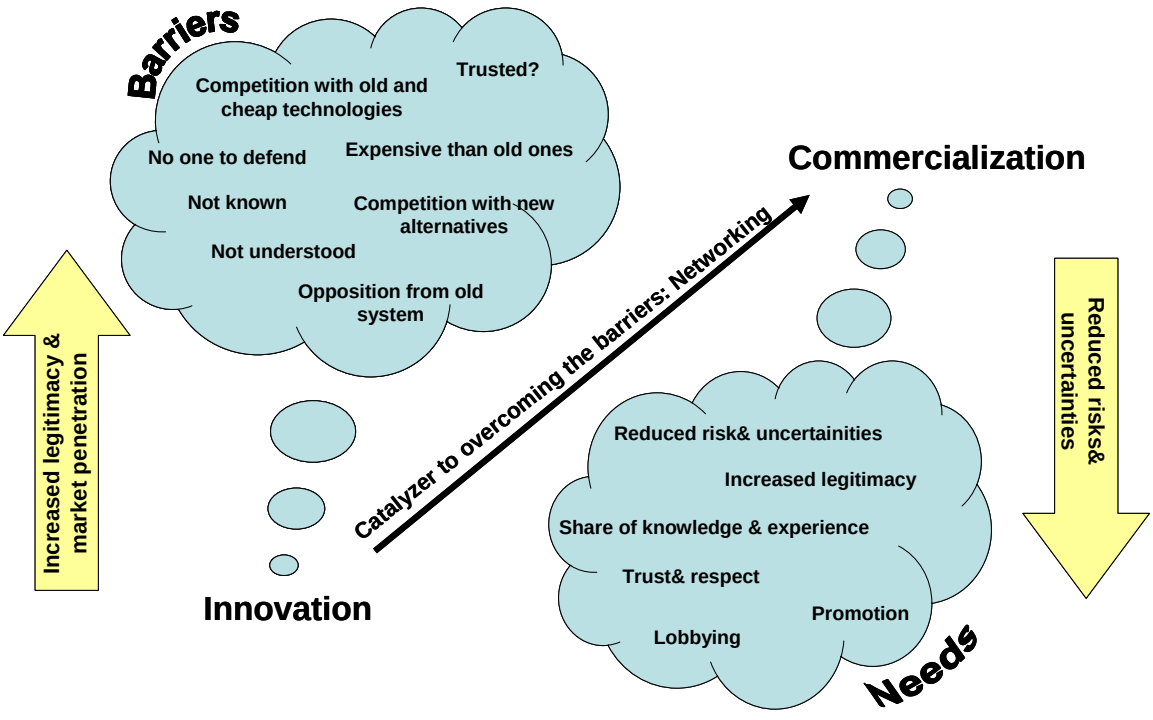
market forces but is based on the development of trust and collective identity (Jacobsson and Johnson, 2000).

By establishing networks, entrepreneurs share risks, information and knowledge, develop shared norms and language that ease legitimacy, transfer goods, services, social processes and go through a mutual modification process of structures and administration (Ahuja, 2000; Knight, 2002; Carlsson, 2002; Andersson & Mölleryd, 1999, Skojett-Larsen, 2000).

The rate and direction of technical change- the process of technological choice- is decided in competition between technological systems, both existing, fully developed and emerging ones (Jacobsson and Johnson, 2000). And, it will only overcome the barriers to the degree that it increases its knowledge and acceptance at the formal and informal levels of the society.

Hence, the literature highlights barriers for the diffusion of a new technological system and the facilitator function of networks vis-à-vis these barriers (See, Figure 2 The relationship between the theoretical backgrounds). This thesis would contribute to the knowledge gap of how these networks might be formed, and what roles they might have in the diffusion of new technological systems by looking into two different political networking cases.

Figure 2 The relationship between the theoretical backgrounds



2.3 Analytical frameworks

As discussed so far, in addition to political and economic dynamics, there are also the social dynamics that influences the penetration level of a new technological system. Bioenergy in the UK and in Sweden are at different stages due to their different dynamics that all act in combination. Hence, a socio-technological analysis needs a background overview of the other factors as well. To be able to achieve that I utilized what I call "background analysis frameworks" and "main analysis framework".

2.3.1 Background analysis frameworks

According to Carlsson (2002), technology is the nucleus of the system, but it is human beings, organizations and institutions, interacting with the technology and with each other, that set the system in motion. To be able to understand and analyse the legitimacy of the bioenergy systems in two countries, we should understand who sets the system in motion and how. Jacobsson and Bergek (2004) provide a framework to delineate the main elements of a technological system and to identify the policy challenges. According to them, the main elements of a technological system are "actors, networks and institutions". To break down the bioenergy systems in two countries, I presented:

- the important actors who have the power to affect the development of bioenergy industry and commonly mentioned during the interviews;
- networks of large political lobby organizations where most of the actors come together;
- institutions, (1) how the present regulatory framework can/could overcome main policy challenges to assist a new technological system to grow (without an in-dept analysis), (2) public opinion on bioenergy.

In addition to this, Johansson et al. (2002), in their analysis of the development of bioenergy system in Sweden, highlight the importance of "structures" (beside policies and actors) such as the resource base, population, geography and industrial and technological structures of a location. According to the authors, these structures might allow (or impede) a rapid response to the policies.

Hence, in order to assist the reader in grasping where bioenergy stands among the other energy sources; under each country case first the structures, actors, institutions will be presented, and then the networks.

2.3.2 Main analysis framework

The framework guided this study to address "the formation of networks" issue and analyse the relation between legitimacy and networking is based on Aldrich and Fiol (1994).

Aldrich and Fiol (1994) emphasize the lack of legitimacy of a new industry in the eyes of decision-makers, other industries and public as one of the most crucial barriers to its establishment and flourishment. If "crucial stakeholders (do) not fully understand the nature of the new ventures, and their conformity to established institutional rules" (Aldrich and Fiol, 1994), the chances for the founders to raise capital, invest, get contracts and operate would be very low.

To gain legitimacy, the founders of a new system should be able create knowledge about the new venture to be able gain acceptance from these formal and informal institutions.

The authors identify two types of legitimacy;

- Cognitive legitimacy: It refers to the degree of the *taken-for-grantedness* of a new venture. When the knowledge spreads and an activity becomes so familiar and well known, the level of cognitive legitimacy of a new industry gets higher. This can be measured by the public knowledge about a new activity.

- Socio- political legitimacy: It refers to the process by which key stakeholders, the general public, key opinion leaders, or government officials accept a venture as appropriate and right, given existing norms and laws. It can be measured by assessing public acceptance of an industry, government subsidies to the industry, or the public prestige of its leaders.

Within that framework Aldrich and Fiol (1994) offer eight proposals on how the founders of a new venture (should) act to gain cognitive and socio-political legitimacy. Out of these eight proposals, I have chosen four of them (propositions 3- 6) related to intra and inter-industry relations to help underpin my work. (For all the propositions please, see Appendix 4: Propositions on increasing the social and cognitive legitimacy of a new industry, Aldrich and Fiol (1994).

Intra and inter-industry relations carry an importance regarding overcoming the barriers related to competition for the market. The founders of a new venture might have to cooperate rather than compete purely in some cases, for the sake of carrying the infant industry to a growth phase.

Let's have look at the propositions defined by Aldrich and Fiol (1994) addressing the issue of intra and inter-industry interactions on Table 3.

Table 3 The framework analysis propositions, Aldrich and Fiol (1994)

	Cognitive legitimacy	Socio- political legitimacy
Intra-industry strategies	Proposition 3: Industries in which the founders encourage convergence around a dominant product/service design will gain cognitive legitimacy more quickly than others: - Each new venture competes for potential customers, investors and others to make their versions accepted. - Reduced set of standards (i.e.; quality, realiability) and convergence around a dominant design in new industries make complex information about the new venture easer to understand in the minds of interested parties. - Industries with imitable innovations are more likely to generate collective action than others, which contributes to the level of stakeholders' awareness and acceptance. It facilitates entry, which may mean proportionately more entrants survive and there will be new knowledge coming in.	Proposition 4: Industries in which founders mobilize to take collective action will gain socio-political legitimacy more quickly than others. - Collective action facilitates flow of information, which helps the new ventures embody a consistent knowledge about the experiences and mistakes. That reduces the probability of failures and help founders gain socio- political acceptance. - The emerging sub-groups around each design may cause confusion and uncertainty for stakeholders.
Inter-industry strategies	Proposition 5: Industries in which founding firms promote their activity through third-party actors will gain cognitive legitimacy more quickly than others. - Established industries that feel threatened by a newcomer may undermine a new comer's cognitive legitimacy through rumours and information suppression or inaccurate dissemination. This may harm the trust and reputation of the new venture. - Trade associations, voluntary organizations, product organizations help firms to formulate product/ process standards through committees, journals, marketing campaigns and conferences. - These parties may have the legal and financial resources to influence the institutional environment such as consultation with government, preparation of legislation proposals. - These organizations can strengthen the position of new comers in times of crises such as conflict with an existing industry.	Proposition 6: Industries in which founding firms negotiate and compromise with other industries will gain socio-political legitimacy more quickly than others. - Emergenge and growth of an emerging industry is partly dependent on severity of attacks from established industries that may resist encroachment. - Implicit or explicit recognition and reliable relations with existing industries are should be created for economic inter-industry transactions.

In order to accentuate the selected propositions, I have asked the questions indicated in the table below.

Table 4 Questions to accentuate the selected propositions

Propositions	Questions to activate the propositions
Intra-industry Strategies	
Proposition 3: Industries in which the founders encourage convergence around a dominant product/ service design will gain cognitive legitimacy more quickly than others.	Is there a dominant service/product design? Is there a level standardization among the products and services?
Proposition 4: Industries in which founders mobilize to take collective action will gain socio-political legitimacy more quickly than others.	What is the level of connectivity of firms? How/where the entrepreneurs meet? Is there any networking and collective action carried out to share information and experience and to lobby? If, yes, how was it established?
Inter-industry Strategies	
Proposition 5: Industries in which founding firms promote their activity through third-party actors will gain cognitive legitimacy more quickly than others.	Are there any representative organizations for the new venture? Are there any cognitive barriers posed by the established system? How are these barriers dealt with?
Proposition 6: Industries in which founding firms negotiate and compromise with other industries will gain socio-political legitimacy more quickly than others.	Are there any areas of conflict with the existing industries? Are there any negotiations and compromise with the existing industries?

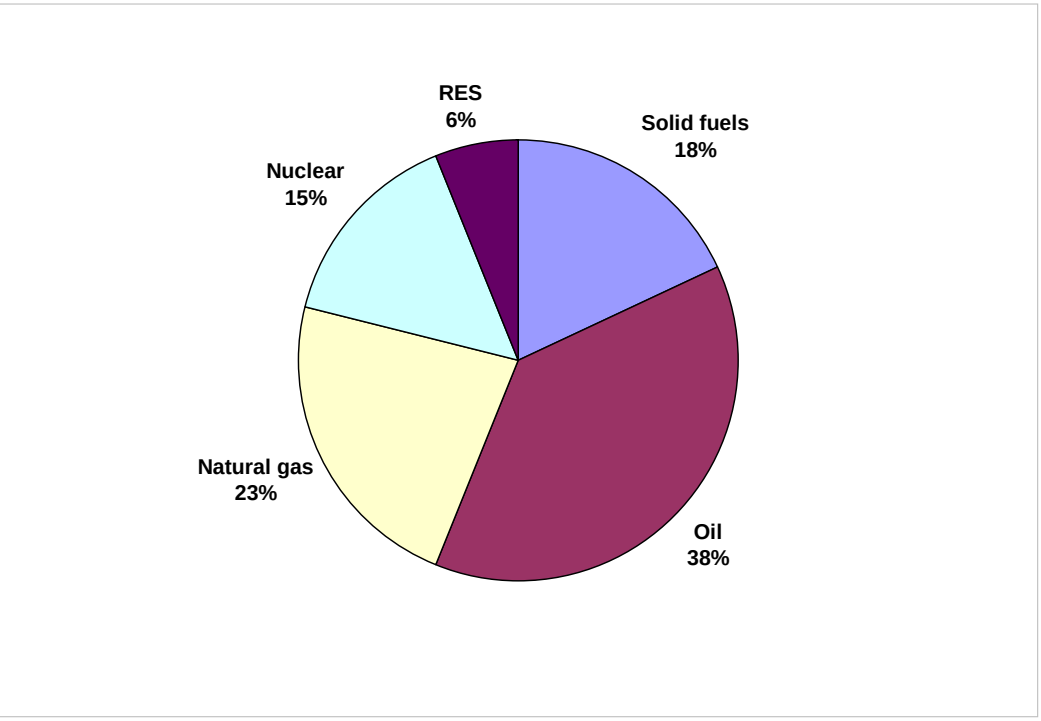
3 Current situation in the EU and the regulatory framework for bioenergy

As the EU provides policy and target frameworks, which the member states either have to be or expected to be in line with, this chapter will briefly introduce this overarching framework related to bioenergy such as the targets, directives and regulations, before starting to examine into the Swedish and the UK cases, which are subject to these articles.

3.1 Current situation and potential

The share of fossil fuels and nuclear in the EU-25 is around 93%; 78% fossil fuels, 15% nuclear (European Commission, 2005). Renewables share is 6%, which biomass contributes to 4% to the current energy needs of the EU (Communication from the Commission COM(2005)628). Figure 3 shows the share of energy sources in the EU-25.

Figure 3 The share of energy sources in the EU-25



Source: European Commission, 2005

According to European Commission (COM(2005) 628) the EU can double the biomass use by 2010 as of today. Table 5 shows the potential of biomass by resource and year based on the following assumptions:

- no effect on domestic food production for domestic use;
- no increase in pressure on farmland and forest biodiversity;
- no increase in environmental pressure on soil and water resources;

- no ploughing of previously unploughed permanent grassland;
- a shift towards more environmentally friendly farming, with some set aside areas as ecological stepping zone;
- the rate of extraction from forests adapted to soil nutrient balance and erosion risk.

Table 5 EU biomass production potential

Mtoe	Biomass consumption, 2003	Potential, 2010	Potential, 2020	Potential, 2030
Wood direct from forest (increment and residues)	67	43	39-45	39-72
Organic wastes, wood industry residues, agricultural and food processing residues, manure		100	100	102
Energy crops from agriculture	2	43-46	76-94	102-142
Total	69	186-189	215-239	243-316

Source: Biomass Action Plan, Communication from the Commission COM(2005) 628 final.

3.2 EU Regulatory Framework

In 29 April 1998, the EU signed the Kyoto Protocol. Council Decision 2002/358/EC of 25 April 2002 approves the Protocol on behalf of the Community. According to this Act, the EU member states should work collectively to reduce the CO_2 emissions by 8% below the 1990 level between 2008 and 2012.

So far, there is a regulatory framework for renewable electricity and liquid biofuels, but not for renewable heat in spite of the targets. Currently, the Commission works on a directive for heat from renewables as declared in the Biomass Action Plan (COM(2005) 628 final). Table 6 shows the targets for renewables in the EU.

Table 6 Targets for EU 15

	1997 results	2002 results	2010 target	Bioenergy increase
RES electricity*	337 TWh	380 TWh	84- 93 Mtoe 630-660 TWh 22.1% electricity	
Of wich bioelectricity	24 TWh	44 TWh	162 TWh	+ 118 Mtoe 32 Mtoe*
RES heat	38.7 Mtoe	43.3 Mtoe	68- 77 Mtoe	
Of which bioheat	38.04 Mtoe	42 Mtoe	66 Mtoe	+24 Mtoe
Liquid biofuels	0.2 Mtoe	0.8 Mtoe	19 Mtoe (5.75% of fuels)	+18 Mtoe
Total			182 Mtoe	
Of which biomass		56 Mtoe (in 2001)	130 Mtoe	+74 Mtoe

* means that 32 Mtoe of biomass is needed to produce 118 TWh

Source: AEBIOM, 2005

This section will present the current main directives and the papers that draw the framework for the deployment of bioenergy in the member states.

3.2.1 White Paper

In 1997, the European Commission published White Paper (COM (1997)599), "Energy for future: Renewable sources of energy", which sets the target to increase the share of renewable energy from 6% to 12% by 2010. In specific for biomass, the Paper establishes the overall increase in biomass utilization for energy generation as 135 Mtoe by 2010 and sets the target of 10 000 MWh_{th} of biomass installations.

The fulfilment of this target depends on if the member states will be able to meet their national targets for renewable electricity, and transport biofuels. According to AEBIOM (2005), with the current trends the 12% share will not be reached, and the level will range between 8-10%.

3.2.2 Directive on renewable electricity

Directive 2001/77/EC of the European Parliament and the Council provides the regulatory framework for the promotion of renewable electricity (RES-E). It sets the target to increase the share of RES-E from 13.9% (in 1997) to 21% by 2010.

It defines the renewable energy sources as wind, solar, hydroelectric power, biomass, landfill gas, biogas and sewage treatment gas energy, geothermal, wave and tidal energy.

The directive obliges the member states to set indicative targets for themselves to be fulfilled by 2010 and defines guidance on target setting. The member states have to publish monitoring reports in every five years beginning from 2002. If the member states are likely to fail meeting the targets, the Council can call for mandatory targets.

Member states should guarantee the origin of green electricity and guarantee that the certificates must be reciprocally recognized. The operators also have to guarantee access to transmission and distribution for green electricity. If the electricity system permits, they will provide priority access.

In 2004, the Communication from the Commission on the share of RES (COM (2004)366) reported that the member countries are not in line with their targets and not all has taken active policy measures. And, with the current situation only 18-19% will be achieved, which would correspond to 10% of the EU's total energy demand, as opposed to 12% set out in the White Paper.[14]

3.2.3 Biomass Action Plan

The Biomass Action Plan (COM(2005) 628 final), sets out some 30 measures to increase the development of biomass energy from wood, wastes and agricultural crops in heating and cooling, transport and electricity generation by creating market-based incentives to its use and removing barriers to the development of the market. The main objective of the plan is to double the share of biomass by 2010.

According to the Plan, the increased use of biomass would bring the following benefits to the Community in 2010:

- diversification of Europe's energy supply, increasing the share of renewable energy by 5% and reducing reliance on imported energy from 48 to 42%;
- a reduction in greenhouse gas emissions of 209 million tonnes CO_2 a year;
- direct employment for up to 250-300 000 people, mostly in rural areas;
- potential downward pressure on the oil price as a result of lower demand for oil.

Under the assumption that fossil fuel prices about 10% lower than today's, the Plan estimates the cost of reaching the target as around € 9 billion per year.

The Plan also points out the need for renewable heat directive and states that the Commission is working on it, as well as the "forest biomass action plan".

3.2.4 Common Agricultural Policy

Common Agricultural Policy aims at securing food supplies, increasing productivity and output, stabilising markets, ensuring affordable prices for consumers and ensure certain life standards to the rural community.[15] CAP used to take some 70% of the EU budget.[16] In 2006, this amount is reduced to 37%.[17] The Biomass Action Plan (BAP) for Europe outlines how to achieve the targets for bioenergy and energy crops defined by the European Commission and member states

[14] EurActiv. (2006b).

[15] Biz/ed. (2006).

[16] Wikipedia. (2006).

[17] Wikipedia. (2006).

(McCormick et al., 2006). However, it is the Common Agricultural Policy (CAP) that shapes the utilisation of agricultural land (McCormick et al., 2006).

As a result of the CAP Review in 2003, money will be shifted from the first "pillar" of the CAP (direct aids and market support) to the "second pillar" of rural development, as an instrument to "green" the common agriculture policy.[18] Non-food production on agriculture land has only been a minor aspect in the CAP (Ruoff, 2003[19]). However, recent CAP reforms support the harvesting of energy crops (McCormick et al., 2006).

Under the new CAP, farmers who would like to plant energy crops will be able to get subsidy of €45/ha.[20] It also allows the energy crop plantation on the set-aside land, but in that case energy crop premium is not applied.[21] The farmers receive "single decoupled farm income payment from 2005 onwards"[22] instead of separate payments, which will not be linked to the volume of productions any longer. And, in order to be able to receive single payment, the farmers have to be in line with the statuary legal standards (environment, food safety and animal welfare).

3.2.5 Waste Directive, Waste Incineration Directive and the Animal By-products Regulation

Council Directive on waste 91/156/EC defines waste as "any substance or object in the categories set out in Annex I which the holder discards or intends or is required to discard." two of the examples that are defined by Annex I and might have a negative influence on their use as bioenergy are residues of industrial processes and products of which the holder has no use of it such as agricultural residues.

The Council Directive on the incineration of waste 2000/76/EC aims to prevent or to limit as far as practicable negative effects on the environment, in particular pollution by emissions into air, soil, surface water and groundwater, and the resulting risks to human health, from the incineration and co-incineration of waste. Some waste is exempt from the scope of the Directive, including plants burning only animal carcasses, vegetable and wood waste. However, tallow meat and bone meals and product of animal origin such as foodstuffs or catering waste is subject to the requirements of the Directive.

The Regulation (EC) no 1774/2002 of the European Parliament and of the Council laying down health rules concerning animal by-products not intended for human consumption regulates the collection, transport, storage, handling, processing and use or disposal of animal by-products (ABP), to prevent these products from presenting a risk to animal or public health. Although, much of the animal by-products are exempt from the heavy controls of the Waste Directive, plants which burn ABP (i.e.; meat and bone meal, tallow, manure) are still subject to the Waste Directive (DEFRA, 2006).

Biomass Task Force Report (2005) indicates that these directives pose tight emission controls and restrictions on use of biomass waste, which could have a use value, and limit the possibility to utilize them as energy source. For example, where the higher emissions standards required by the

[18] EurActiv. (2006c).

[19] Cited in McCormick et al., 2006

[20] University of Helsinki. (2006).

[21] University of Helsinki. (2006).

[22] University of Helsinki. (2006).

Waste Incineration Directive are acting as a block to co-firing with non-waste fuels, and the recent change in the interpretation of waste legislation which has resulted in ash, arising from the incineration of poultry litter and related agricultural biomass, and which was previously used as a fertilizer, being re-classified as a waste product (BTF, 2005).

The Commission is currently working on the definition of waste; when it ceases to be subject to the waste-related directives and regulations.

3.2.6 European Technical Specifications on solid biofuels

It is important to have feedstock which are fit for purpose and delivered to a quality standard and specification, to create consumer confidence (BTF, 2005). There a number of "pre-standards" created by the European Committee of Standardization (CEN) on solid biomass as a mandate by the European Commission. Thus, the member states should make these standards as national standards, but it is up to the business actors to follow it or not, unless they are adopted by law (Sjöberg, 2006, interview).

Appendix 5 shows the list of published standards of technical specifications. Sjöberg indicates that these standards are what is called "pre-standards", hence it is not obligatory to implement it for the member states. When they are upgraded to the real European Standards, the member states will be obliged to implement them (Sjöberg, 2006, interview).

4 Country study 1: Sweden

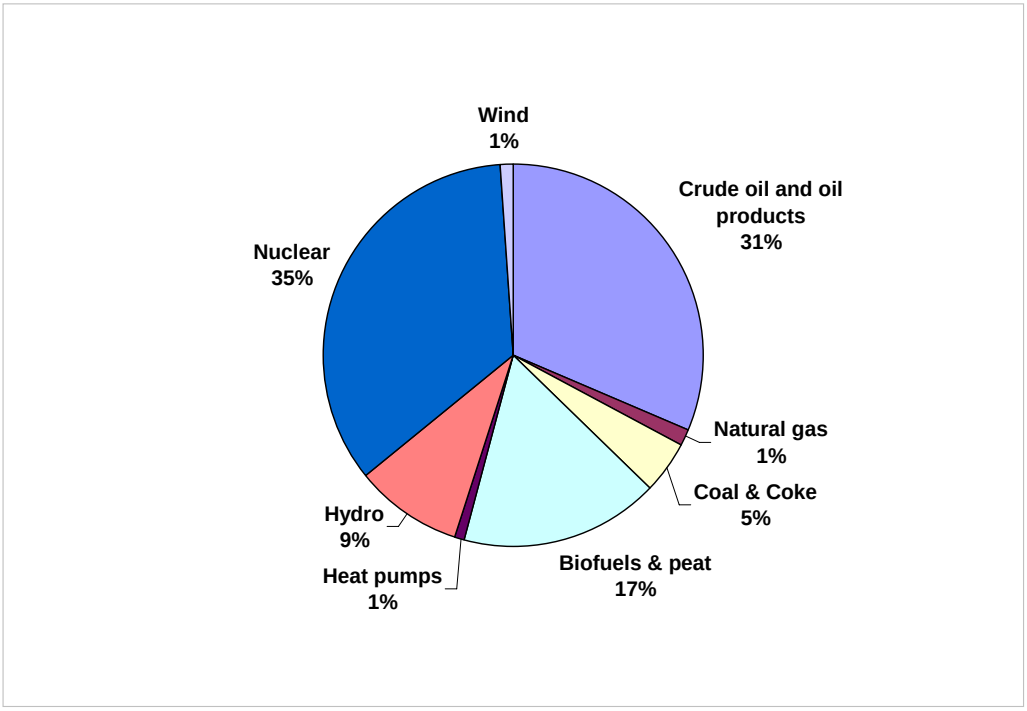
Sweden is one of the leading industrialized countries regarding the high levels of deployment of bioenergy. This chapter will first prepare the grounds for understanding the dynamics behind this fact. It will present the current energy situation and how bioenergy fits into the whole picture. Then, it will provide an overview of the central actors and institutions that have had major impact on the development of bioenergy. And, second, it will look into the core of this thesis and examine into the networking strategies of the founders of the bioenergy industry during its infant years. Finally, it will conclude with the analysis of the impact of these strategies on the legitimacy of the newly emerging bioenergy during its "formation years"[23].

4.1 Structures

4.1.1 Current energy situation

Oil dominates the biggest proportion in contribution to energy production in Sweden (see, Figure 4). However, during the last 30 years it demonstrated that it was possible to reduce oil dependency remarkably from as demonstrated in Figure 5. In 2004, Sweden's total energy supply was 647 TWh (around 55 Mtoe) and total final use was 405 TWh (STEM[24], 2005b). Contribution of bioenergy to this 647 TWh was 17% (STEM, 2005b); whereas the EU average is around 4% (Eurostat, 2005).

Figure 4 Contribution to energy production by source in Sweden

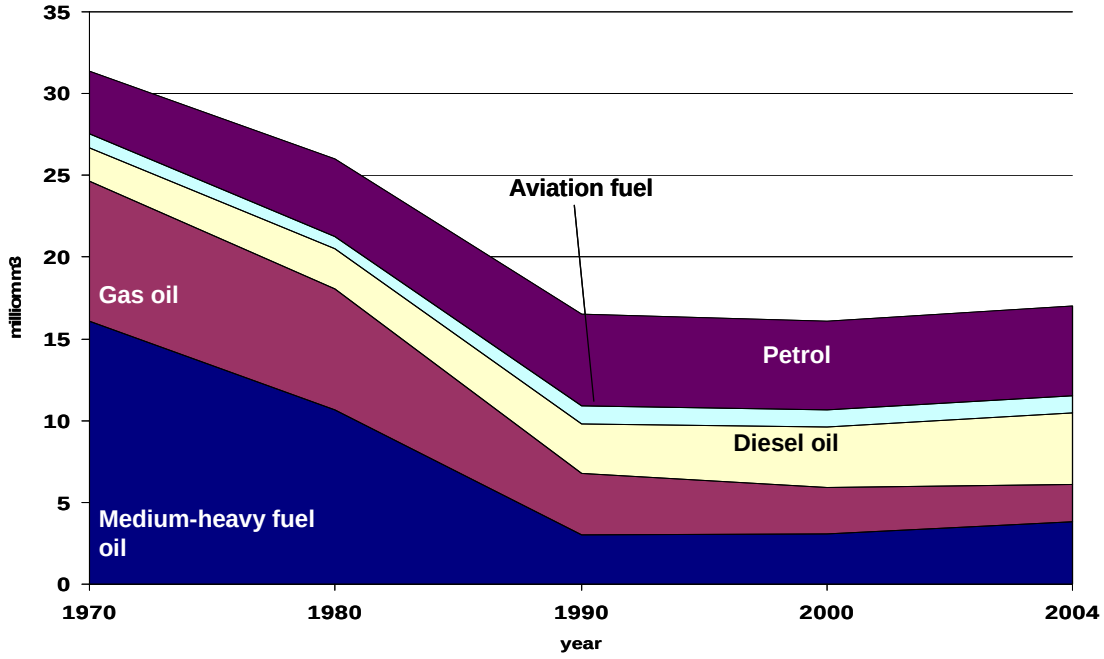


Source: STEM, 2005b

[23] Term from Jacobsson and Bergek, 2004.

[24] Swedish Energy Agency

Figure 5 Use of oil products in Sweden, including international bunkers, 1970-2004



Source: STEM, 2005b

4.1.2 Energy history in brief

The literature points out the shifts in the Swedish energy policy (Nilsson et al., 2004; Ericsson et al., 2004; Bjorheden, 2006).

- Beginning with the Oil Crises (1973 and 1979), the focus has been to reduce the oil dependency. Since then, there has been a broad political support for bioenergy (Kåberger, 2006, interview).

- During 1970s and 1980s, twelve nuclear power plants were commissioned. However, the political resistance to nuclear power grew in the 1970s and the Three Miles Island accident triggered the 1980 referendum on nuclear power (Nilsson et al., 2004). The parliament decided to phase out nuclear power until 2010 based on the results of a referendum held in 1980. This policy has been "revoked, mainly motivated by the negative impacts on industrial competitiveness" (Nilsson et al., 2004), and so far only 2 stations were closed (Barsebäck 1, closed in 1998; and Barsebäck 2 in 2005).

- These nuclear plants were commissioned based on an overestimated capacity, which led to an over supply of electricity and pulled down the electricity prices (Kåberger, 2006, interview; Ljungblom, 2006, interview). From mid-1980s on to early 1990s, electricity replaced oil heating and almost bioheat as well. [25] The bioenergy business almost came to a halt. Ljungblom (2006, interview) calls those years "Black Years" of bioenergy in Sweden.

[25] To be able to create demand for the over supply of electricity, the nuclear power generators wanted to introduce electricity resistant heating (Kåberger, 2006, interview). During the same years, the government passed a law banning the construction of

- From 1990s and on, climate change issue marked the energy policy. In 1991, the government introduced the Carbon Tax, which is a turning point for the increased utilization and the accommodation of bioenergy into the modern energy system of Sweden.[26] The implication of this taxation for the bioenergy sector was the increased competitiveness of biofuels such as woodchips, vis-à-vis fossil fuels. Moreover, the Swedish government committed itself to reduce the CO_2 by 4% of the 1990 levels between 2008 and 2010, although, Kyoto Protocol allowed it to increase its emissions by 4%.

- And, recently, in 2005, the government declared the target of breaking the oil- dependency by 2020, which would further the deployment of alternative energy technologies, including the renewables.

4.1.3 Fuels and potential[27]

4.1.3.1 Fossil fuels

One of the drivers for Sweden's desire to break the oil dependency is the fact that she does not have domestic production of fossil fuels and their increasing prices. As shown in Figure 6, the use of fossil fuels decreased considerably with the exception of natural gas since 1970.

In 2004, Sweden imported over 20.5 million tonnes of crude oil, of this amount, about 60% of crude oil imports came from the North Sea, and she net-exported 4.5 million tonnes of refinery products. Concerning the utilization of coal, a total of 3.6 million tonnes of hard coal was used in Sweden in 2004, mainly in the industry.

The use of natural gas in Sweden increased rapidly from the year that it was introduced, 1985 to 1992. The use of natural gas still increases moderately. In 2004, the imports were 9.3 TWh. It was used mostly in the industry for about 45% of total use, with CHP and district heating plants accounting for over 30%. Domestic consumers use almost 20%, and a small amount of natural gas is also used as motor fuel.

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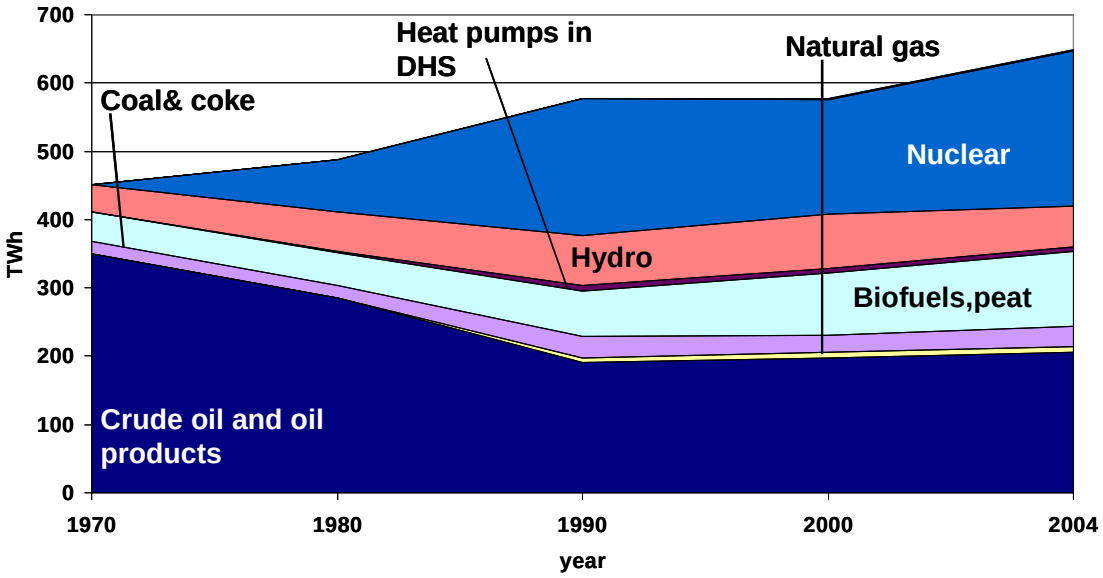
chimneys in the new buildings, which led to an increase for the electricity for the heating purposes (Ljungblom, 2006, interview). Even the district heating companies were using electricity to generate energy (Kåberger, 2006, interview). Not to mention, this development affected the fresh and rapidly rising biomass sector very badly.

[26] According to Kåberger (2006, interview), around these years, there has been an "unholy alliance" among the nuclear power lobbying and the environmentalists for the introduction of the CO2 Tax. Nuclear lobbying pushed for the introduction of the tax thinking that it would further replace oil and increase the demand for electricity.

[27] The statistics are from *Energiläget*, Swedish Energy Agency, 2005b.

Figure 6 Total energy supply in Sweden, 1970-2004



Source: STEM, 2005b

4.1.3.2 Biomass fuels

Forest-based biomass in the form of waste, residues and by-products makes the biggest contribution to bioenergy production in Sweden. As it is seen in the Table 7, the available biomass potential is huge. The Swedish Energy Agency (2005a) identifies five types of biofuels;

- Wood fuels; tops and branches, stem, stump; industrial by-products; wood chips, bark, sawdust and energy plantations. Forests are Sweden's one of the most important natural resources (Swedish Forestry Agency, 2006). They cover 60 % of the land which is equal to 22.7 million hectares compared to the total land area of 41.0 million hectares. Regarding the energy crops, in the first half of the 1990s nearly 1200 Swedish farmers set up plantations of Salix (willow), covering some 15 000 hectares (Helby et al., 2006).

- Black liquors and tall oil pitches; intermediate and secondary products in chemical pulp mills. In 2004, they provided over 39 TWh of energy (excluding electricity production). With the introduction the Tradable Green Certificate System, pulp and paper industry increasingly integrates the utilization of by-products into energy production to generate and sell "green electricity".

- Ethanol; 100% for use in industry.

- Waste

- Peat

Table 7 Bioenergy Potential in Sweden

Fuel source	Supplied 2001 (PJ)	Medium-term potential[1] (PJ/yr)	Gross-potential[2] (PJ/yr)
Black liquor[3]	122	126	126
Forest fuels[4]	190	280	280 (420)
Solid waste	18	58	58
Biogas	3.5	18	43
Straw	0	18	18
Salix	2	40	180
Total biomass	336	540	705 (845)

Source: Nilsson et al, 2004 (based on the statistics in STEM- Energiläget 2002 and 2003).

Notes: (1) Potential that could be realized in 10-20 years, according to, e.g., [SEA, 2003] for biomass. (2) It is assumed that current forestry practices are sustained, and that forestry has access to at least the current amount of stemwood; and that the agricultural systems can produce all food needed to feed the Swedish population with current diet...etc. (3) Potential is given with the assumption that the structure and volume of pulp production are sustained. (4) Number in parenthesis is the gross potential without environmental restrictions.

4.1.3.3 Others

Nuclear power and hydropower

Together with nuclear, hydropower provided more than half of the electricity production in Sweden in 2004 (STEM, 2005a).

Up to late 1960s, there was a focus on hydropower (Uranium Information Centre-UIC, 2006). Hydropower supplied 60 TWh of the total energy supply. According to Karlsson (2006, interview) the potential for large-scale hydropower is very small due to the environmental regulation constraints. He claims that if the permission barriers could be overcome, the potential from the big rivers would be around 20-30 TWh. The contribution of small-scale hydropower is currently 1.8 TWh and the potential is 1 TWh if the closed plants would be opened (Karlsson, interview, 2006).[28]

In 1965, hydropower decided to be supplemented with nuclear power, to avoid the uncertainties of oil prices and increase the security of supply (UIC, 2006). Sweden has ten power reactors (Swedish Nuclear Power Inspectorate, 2006). Nuclear energy contributed 227 TWh to the electricity generation of Sweden in 2004. As stated by the UIC (2006), the government is currently working to expand the capacities of the existing plants to replace 1200 MW_e due to the closure of Barsebäck I&II plants.

[28] The number of small hydropower plants that were closed during the last 30 years was claimed to be 2000-3000 by the respondent.

Wind power

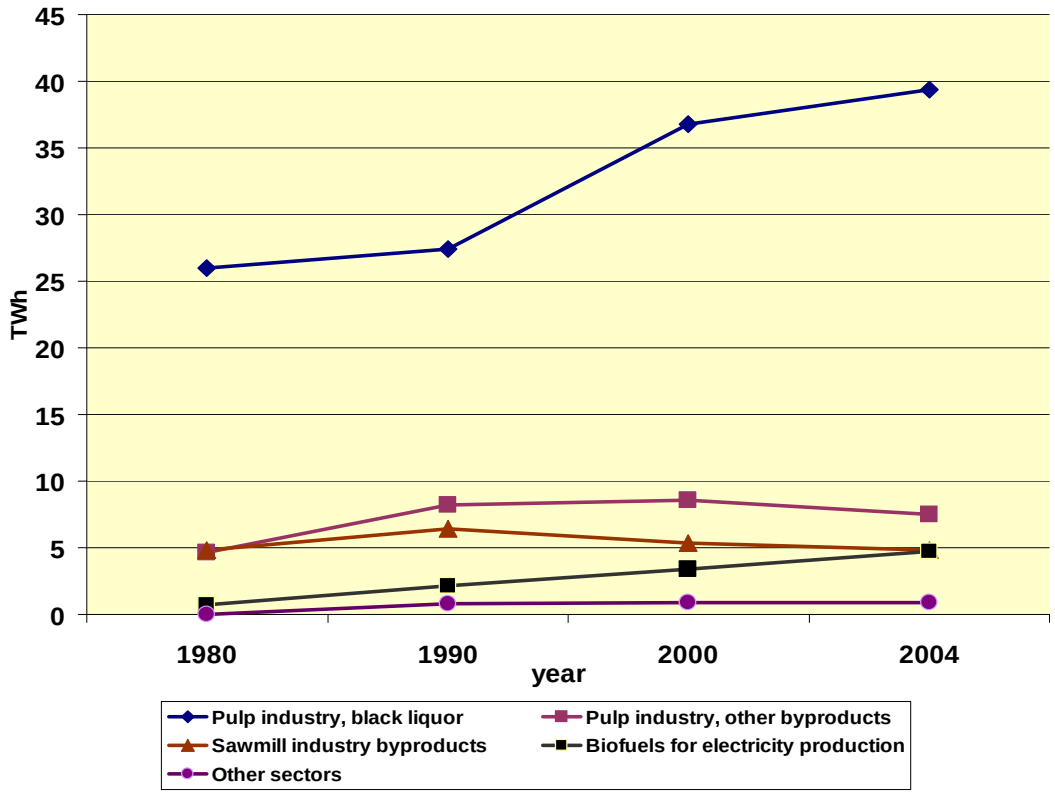
In 2004, wind energy supplied 1 TWh of electricity there are 610 wind power plantations which are included in the green certificate system. According to STEM (2002[29]), the gross potential of wind energy is 100-200 TWh/yr roughly.

4.1.4 Current use of biomass in Sweden

Industrial Use

Industrial consumption of biomass amounted to 56% of the total bioenergy production (Swedish Forestry Agency, 2006). The main consumers of the biomass among the industry are forest products industry; pulp and paper and saw mills. Forest industry increasingly uses the residues and by-products from the wood processing like black liquor and the raw material that is not of high enough quality to use and residues consisting mainly of wood chips, shavings, bark and other waste products are used both in the pulp industry and in sawmills, as shown in the Figure 7 (Swedish Energy Agency, 2005b).

Figure 7 Use of biofuels in industry, including electricity production and peat



Source: Swedish Energy Agency, 2005b

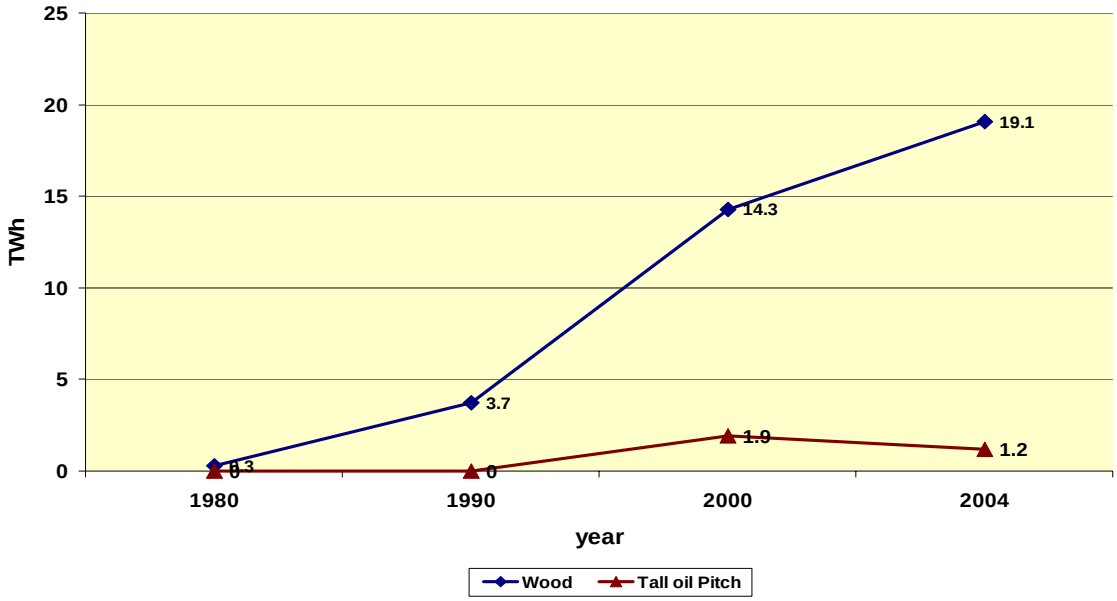
[29] Referred in Nilsson, 2004

According to the Swedish Energy Agency (2005a), the pulp industry used a total of almost 8 TWh of wood fuels in the form of by-products for energy production, while sawmills and other woodworking industries used about 5 TWh of wood fuels. Other industry sectors used almost 1 TWh of biofuels. In total, the forest products industry used about 57 TWh of various types of biofuels in 2004.

District Heating System and Detached Housing Sector

In 2004, the total energy input was 53.5 TWh, of which 32.9 TWh was from biofuels, including peat (STEM, 2005b). Of this amount, wood fuels accounted for over 19 TWh, waste for over 7 TWh, black liquors and tall oil pitch for about 1 TWh, peat for over 3 TWh and other fuels for over 2 TWh. The main form of these fuels is felling residues and by-products from the forest products industry, although processed fuels such as briquettes, pellets and powder have also been increasingly used in recent years (STEM, 2005a). Figure 8 shows the trend of utilization of tall oil pitch and wood for the last 24 years.

Figure 8 Use of wood and tall oil pitch in district heating system



Source: Swedish Energy Agency, 2005b

Almost 13 TWh of biofuels, peat etc., were used in detached houses for heating in 2004, most of which was in the form of logs, but a smaller proportion was provided by wood chips and a growing proportion by pellets and briquettes (STEM, 2005a). Industry figures show that the use of pellets in detached house sector increased by about 12% between 2003 and 2004; and has almost quintupled since 1999, so that about 60.000 houses are today heated by pellets-fired boilers (STEM, 2005a).

Cogenerated Heat and Power

According to Jacobbson (2006), the CO_2 Tax has given large-scale diffusion of biomass in district heating system, but not to biopower production due to the low power prices. However, he also points out the rapid increase in biopower as well during the last years with the introduction of the

Tradable Green Certificates (Jacobsson, 2006, interview). The role of biopower, especially in the form of combined heat and power is expected to increase. The natural potential for bio-fueled CHP in 2010 is estimated by the energy authorities at 60 TWh (Midttun, 2004).

4.1.5 Impacts of forestry and forest industry on the development of bioenergy in Sweden

Sweden has the second largest forests after Russia in Eurasia and historically forestry has always been one of the most important economic activities. Forestry and the forest industries contribute about 4% of the GNP, but represent as much as 15% of the value of exports (Bjorheden, 2006). The forest sector, including its direct support from related industries, represents 25–30% of the total Swedish industry (Bjorheden, 2006).

The long history of forestry and forest industry as the main producers and users of bioenergy has a main role in terms of creation and accumulation of the knowledge and experience related to handling of huge amounts of biomass. Another main user of the bioenergy in the 18th and 19th century was the heavy industries manufacturing native copper, iron and steel with forest biomass (Hector, 2006, interview). These two industry sectors historically demonstrated that bioenergy has been and is still a reliable, secure, efficient and environmentally-friendly energy source establishing the grounds of cognitive and socio-political legitimacy for bioenergy. On the domestic scale forest biomass had been utilized largely as well.

Thanks to the improvements in the infrastructure, logistics and techniques to handle the trees all through the supply chain reduced the market price of the wood fuel (Roos and Hector, 1996) and further research has been going on to increase efficiency in supplying and converting the feedstock and the combustion and gasification technologies. Forestry and the forest industry handle biomass resources (used in forest products or as energy sources) corresponding to an energy content of 150 TWh/y which is equivalent to one fourth of the current Swedish primary energy supply (Johansson, 2004). This has resulted in the technical capacity to handle large biomass flows in an efficient manner and the formations of efficient logistics are essential for competitive bioenergy systems (Johansson, 2004).

4.2 The Swedish Biomass Innovation System at a glance

According to Jacobsson (2006, interview), the Swedish bioenergy business is predominated by SMEs. As elaborated above due to the long history of dealing with forests the resource and knowledge base for bioenergy is rich. Since 1980s (with the exception of the black years), the market has been expanding. New industry, machinery and services has been coming up (Jacobsson, 2006, interview). The whole supply chain for biomass has been well established. Examples to the supply chain of biomass in Sweden are;

- Users and producers of pelletes, briquettes, pulverized fuels, wood fuels, energy crops and recycled wood;
- Equipment manufacturers; boilers, stoves, burners and others, gasifiers, fuel handling equipment, forest machinery, control and monitoring devices, storage and silo, pellets press, briquette press, dryers;
- Transport companies, for pellets, woodchips… etc.

Most of these technologies are commercial. Sweden, together with Finland and Denmark, is world leader for machinery and equipments for forest biomass collection and pre-treatment (ERA, 2004). Wood pellets industry in Sweden has performed a remarkable growth within the last few years with double growth (PIR[30], 2006). In 2004, the Swedish energy system used a total of over 1.25 million tonnes, equivalent to about 6 TWh, of pellets, making up almost 1% of the country's total energy supply (STEM, 2005a). About one-third of this quantity was delivered to the detached house market, which has exhibited strong growth in demand in recent years (STEM, 2005a).

R&D studies continue on these already commercial technologies such as fuel specifications, material technology[31], fuel and equipment efficiency… etc. Sweden also allocates R&D budget for some forefront technologies like "pressurised gasification[32]; environmental consequences of biomass production and utilisation (ash recycling, forest ecology, multifunctional crop systems, etc), ethanol from wood[33]" (ERA, 2004), black-liquor gasification[34]. Sweden has a substantially higher proportion of its institutions engaged with forest related raw materials (including black liquor), than on other raw materials (ERA, 2004).

Everything related to energy falls under the Swedish Energy Agency's (STEM) responsibility (Telenius, 2006, interview), so does bioenergy. STEM is the main body that provides RD&D funding, capital grants and subsidies. Bioenergy RD&D and subsidies collect the most finance from the budget. [35]

Swedish bioenergy innovation system is regarded as highly organized and structured one. All my interviewees mentioned the role of Swedish Bioenergy Association (Svebio) in that sense. Svebio constitutes a meeting platform and provides connectivity for all actors within the whole bioenergy value chain, including research and development bases and academics. Most, if not all, my interviewees indicated that bioenergy- related entrepreneurs are willing to share new information and cooperate. At this point, some also referred to the Swedish culture of cooperation and getting organized.

4.3 Institutions

4.3.1 Policies

In that section, all the policies will not be mentioned or analysed. But rather, they are summarized in Table 8 Policies that effect the development of bioenergy in Sweden. It presents the policy challenges for decision makers (as identified in Jacobsson and Bergek, 2004) to start-off and enhance a new industry, what has been done to overcome this challenges in Sweden and what are

[30] Swedish Association of Pellet Burners. (2006).

[31] There is collaborative R&D among boiler manufacturers and district heating companies on reducing the corrosion on higher temperatures, for example (Jacobsson, June, 2006, interview).

[32] In Vaxjö.

[33] In Umeå, there is a lignocellulose demonstration project.

[34] There is demonstration project of black liquor gasification in Piteå.

[35] STEM receives money from the government under the titles: Based technologies (could be biomass), Introduction of New Technologies (more applied charater) and a specific budget for bioenergy. I could not get specific figures for bioenergy. The exact funding figures for bioenergy in general was tried to be obtained from the STEM, but they could not be provided. However, the RD&D titles they grant are "Fuel-based energy systems, Transport fuels, electricity production, industry, building, system analysis". According to Telenius (2006, interview) of these, bioenergy has the biggest share in "fuel-based energy systems and transport fuels".

the further barriers. (For a summary of the policies affecting the use of bioenergy in Sweden, please see Appendix 6: Policies and measures that affect the use of bioenergy in Sweden.)

However, it is necessary to stress the CO_2 Tax as all the respondents without any exceptions indicated it as two of the milestones of bioenergy development in Sweden, together with the Oil Crises. CO_2 Tax made a central impact on the development of bioenergy and gave it a positive direction overall. This taxation on the fossil fuels also stands as one of the major differences between the UK and Sweden in terms of employing different policy tools to tackle these policy challenges.

In 1991, the introduction of the Carbon Tax made biomass relatively more competitive against the fossil fuels and started important chain effects in terms of market formation both on the demand and supply-side. It furthered the conversion of boilers run by fossil fuels to biomass together with the subsidies given to switch the boilers, with which 25-30% of the initial costs could be covered. Residues and by-products from forestry and forest industry such as logs, barks, saw dust, tops and branches and black- liquor was started to be widely used to generate mainly heat, and also electricity in CHPs. The district heating systems owned by the municipalities became the locomotive of the demand and started to utilize domestic biomass. Today, the tax is 91 öre per kg CO_2. However, the energy intense industry is exempt from the energy taxation and pays only about 25% of the CO_2 Tax in order not to disturb their international competitiveness.

Now, Table 8 will look into major policies in terms of overcoming the policy challenges.

Table 8 Policies that effect the development of bioenergy in Sweden

Policy challenges	Action taken/ The extend that it is fulfilled	Problems/ Barriers
Guidance of research and stimulate market formation	- Political will to reduce fossil fuel dependency since the 1980s, increased research and stimulated the market for bioenergy. - Carbon and energy taxes for fossil fuels make biofuels more cost competitive. - In 1980s, subsidies covering the 25-30% of the costs supported the industry to switch oil boilers to wood-fired ones. - Public and private RD&D contributed to the creation, strengthening and diffusion of the new knowledge. - Investment subsidies give incentives to implement new technologies. - Differentiated taxes give incentives for innovation and testing of more efficient technologies. - Decision to dismantle nuclear power in the 1980s, accelerated the research in bioenergy options. - The Tradable Green Certificates and EU ETS have influenced the direction of research	- According to Jacobsson (2006), the CO_2 tax caused a large-scale diffusion of biomass in DHS, but not in biopower. - Jacobsson (2006) indicates the low electricity prices also discouraged biopower investments. -Some industries that are already covered by the CO_2 are also subject to EU ETS as well. This situation, which disturbs their competitiveness, is not fair to these industries. - Complexity of the taxation system as indicated by some of the respondents (Hakansson, 2006, interview; Tranvik, 2006, interview). - Stringent regulations (e.g. emission constraints for power production) that influence the 'direction of search' and 'knowledge formation' (Olofsson, 2005)[36]. - Recently, gas has started to be seen as the quickest and most cost efficient way of substituting for nuclear power (Thornström, 2005)[37].

[36]Cited in Jacobsson, 2006.

[37] Cited in Jacobsson, 2006.

	towards biopower (Jacobsson, 2006). - Target setting (i.e.; 10TWh electricity to be added to the electricity production by 2010) accelerates the diffusion of bioenergy.	
Specify inducement and blocking mechanisms and devise policies	- Oil Commission is established to identify the blocking mechanisms for achieving the oil dependency. - Swedish Energy Agency, Fuel- based Energy Systems focuses on bioenergy research. - "Competence centres' started in the mid 1990s as a science policy instrument (Jacobsson, 2006). - Subsidies given to universities, institutes and organizations to experiment and to do system analysis.	
Institutional alignment (for bioenergy)	- "Competence centres" are singled out as locations for knowledge formation, as meeting places and mechanisms for technology transfer (Jacobsson, 2006). - RD&D funds to create "knowledge base"[38] on different technologies. - Providing political legitimacy to bioenergy helped reducing the risks and uncertainties. - A number of new comers to the bioenergy business during formation period increased the "advocacy base" for the new technological system. (establishment of Svebio)	- As discussed Jacobsson (2006), the proponents of natural gas; the energy companies and the local authorities lobby for tax reductions and the expansion of the gas pipeline.
Variety of actors to experiment with different design approaches	- Subsidies given to research on black liquor gasification, biomass gasification and fermentation (ethanol) from wood. - Establishment of Centres of Excellence co-funded by the government and the industry with the participation of universities and research centres.	
Sustaining cumulative causation	- Tradable Green Certificates (TGCs) and the EU ETS provided a powerful incentive for firms to both exploit existing capacity better and to invest in new (or modified) biomass fuelled CHP plants, in industry as well as in district heating systems (Jacobsson, 2006). - Increased political support.	- By 2004, CHP production pays no more energy taxes and that the CO_2 tax was reduced by three quarters for fossil fuel CHPs (Jacobsson, 2006). - The expansion of the infrastructure for natural gas might negatively influence bioenergy market (Kåberger, 2006, interview; Jacobsson, 2006, interview). - Jacobsson (2006) argues that the subsidies provided to create liquidty in the early phases of the TGC, creates windfall profits for already invested plants.
Predictable and persistent pricing policies	-/	- Jacobsson indicates that the TGC and EU ETS create price uncertainty.

[38] Term in Jacobsson and Bergek, 2004.

4.3.2 Opinion leaders

4.3.2.1 Government

Since the 1970s, Swedish government has always been in support of renewable energy and could embody the political will in solid policies that enhanced the use of bioenergy. Recently, in January 2005, the Prime Minister, Göran Persson declared the ambitious will of "breaking the oil dependency by 2020" and the establishment of the Oil Commission to identify the opportunities and barriers to this target.

According to Jacobsson (2006, interview), this "always-present" and comprehensive political support for bioenergy has shifted to a 100% support. He states that "the statements in the Prime Minister's opening speech during the World Bioenergy Conference (29 May- 2 June, 2006, Jönköping) were the strongest regarding supporting bioenergy back in 20-30 years".

This remark is the evidence of relatively high and growing levels of socio-political legitimacy for bioenergy in Sweden at the political level.

4.3.2.2 NGOs

Bioenergy is on the agenda of the NGOs in Sweden. The Swedish Society for Nature Conservation's (SSNC), the foremost environmental NGO, indicates that the use of energy from forests for electricity and heat should be extended to 30 TWh provided the forest sustainability (Kling, 2006, interview). In terms of forest sustainability, the SSNC lobbies for the "Forest Stewardship Certification". Some of the criteria to get this voluntary certificate are five percent of the forests shall be set aside for biodiversity concerns; broadleaf trees and naturally dead wood should remain on the ground and the use of exotic species is forbidden…etc. They are also concerned about the ash recycling back to forests instead of utilization of artificial fertilizers; and, they stress the need the control of the origin and the sustainability of the imported wood from Russia and Baltic region as well (Kling, 2006, interview).

4.3.2.3 General public

The general public knowledge (cognitive legitimacy) and acceptance (socio-political legitimacy) of bioenergy among the Swedish society are high, also because of the historic familiarity and utilization of forest-biomass. However, even in Sweden, it did not happen straightforward. Ljungblom (2006, interview), mentions when his Professor Olle Lindström[39] was mentioning the opportunities of bioenergy, no one believed in him during 1970s. And, later on, when Svebio was in the process of being established in the 1980s, the society was sceptic to the idea of "being heated with wood". But, as biomass-fired district heating system proved its success, the level of acceptance of society for commercial bioenergy applications turned out to be positive as well.

However, Jacobsson (2006, interview) highlights the distinction between the knowledge on bioheat and biopower saying that biopower is not known by people as bioheat. Kåberger (2006, interview) also says people in the rural areas know more about bioenergy compared to the ones in living in urban areas.

[39] A leading Professor in the field of bioenergy in Sweden.

Despite the general acceptance, "not in my backyard" could always prevail against any kind of plantations in a local area. For example, Tranvik (2006, interview), engineer in Vaxjö Energi AB[40] says that there might be some complaints when the smoke from the stack is black. And, Lars Andrea, from Lomma Cogenerated Heat and Power Plant[41] (CHP) runs on waste wood and wooden boards, indicated that during the commissioning of the plant the local people were worried about the transportation and emission effects, but these complaints have never been so serious also because of the strict emission control mechanisms by the authorities.

4.4 Main actors

The locomotives of the bioenergy system to integrate biomass it into the energy production has been the forestry and forest industry and the district heating system in Sweden as the main users and producers of bioenergy. Still, as it will be presented below, they continue to be important players of the supply chain.

Since the 1980s, the bioenergy market expanded tremendously and there occurred a number of "prime-movers" in number of niche markets on the whole value chain such as pellet producers, pellet burners, transportation and logistics…etc multiplying the benefication of bioenergy. Also with the introduction of Tradable Green Certificate system the pulp and paper industry is increasingly integrating bioenergy into the production process to sell the green electricity.

4.4.1 Forest industry

The forest industry is one of Sweden's most important industrial sectors (Swedish Forest Industries Association, 2005). The forest industry accounts for 10% for employment, and 14% of the added value in Swedish industry, plus, for more than 12% of the country's visible exports (Swedish Forest Industries Association, 2004). Sweden is the world's fourth largest exporter of pulp, the third largest of paper and the second largest exporter of sawn timber. Deliveries from sawmills in Sweden cover about 12% of total consumption of sawn timber in the EU countries (Swedish Forest Industries Association, 2004).

This big sector is the main producer and the user of bioenergy in Sweden. It accounts for about 60% of the energy demand Sweden ….and of that demand 64% is supplied by the internal wood-derived by–products and the rest is electricity which makes the forest industry main biofuel user (Ericsson et al., 2004).

Pulp and paper industry, which is highly energy intensive, has reduced the oil consumption dramatically since the last 30 years, and, has increasingly been using process by-products (STEM, 2005b). However, during the 1980s, pulp and paper industry challenged the utilization of wood as a fuel for energy purposes, which would have increased the prices of raw material due to the competition. Jacobsson (2006, interview) also points out the "dual role" of the pulp and paper industry. They have been in favour of nuclear energy as well with cheap electricity

[40] Sweden's first municipal and the world's third, after London and New York, power station for street lighting and general distribution was opened in Vaxjö in 1887. It is again one of the very first in the country to switch oil-fired heating plant to burn biofuels. 1983, they installed the first CHP. City of Vaxjö is known as the "oil free city" in Sweden. Today, they produce 104 MW of energy in a circulating fluidized-bed boiler, of which more than 98% comes from waste wood, wood chips and peat. (All information from the study trip, (World Bioenergy Conference, June, 2006) and interview with Lotta Tranvik (2006))

[41] Study trip for the preparation of the Sustainable Environmental Development course, Lomma, April, 2006.

price considerations, in that sense, in the early stages of bioenergy development, forest industry had been both the biggest user and challenger of bioenergy.

Opposite of what they had feared the fuel prices went down due to the growing market and efficiency of the woodfuel chain (Roos et. al., 1998). In effect of rising electricity prices and the tradable green certificate system, recently, the pulp and paper industry has started to recognize bioenergy as a business opportunity and integrate it with the production line (Jacobsson, 2006, interview; Kåberger, 2006, interview ; Hektor, 2006, interview).

This is one shift in the role of the forest industry; it has become more commercially involved in bioenergy business with the introduction of EU Emission Trading Scheme and the Swedish Green Certificate system and the rising electricity prices. For example, Stora ENSO, the leading forest products company, has started to integrate bioenergy more and more into business plan. First, they stopped negative propaganda, and then, they started to promote bioenergy themselves (Hektor, 2006, interview).

4.4.2 District Heating Sector

District heating system (DHS) is of strategic importance in Sweden supplying over 40 % of the heating buildings (Ericsson et al., 2004). Today, 77% of the houses are connected to the DHS equivalent to the use of 23 TWh (STEM, 2005a).

According to Johansson (2002), during 1980s, district heating companies have responded very quickly during recent decades to new policy signals such as high taxation of oil by an expansion of coal and electricty heating. And, this trend switched to biomass during the 1990s, due to the Carbon tax.

In 2004, wood fuels accounted for over 19 TWh, black liquors and tall oil pitch for about 1 TWh. The main form of these fuels is felling residues and by-products from the forest products industry, although processed fuels such as briquettes, pellets and powder have also been increasingly used in recent years (STEM, 2005).

The growth of the market, enabled district heating companies to exploit new niche markets as well such as "forest machinery, new technologies for forest combustion and logging residue extraction" (Johansson, 2002). The expansion of biomass in district heating has led to the introduction of flue-gas condensation which has enabled efficiency gains in biomass plants of 10-25% (Johansson, 2002).

Initially, owning the district heating system and most of the apartments, local authorities played a central role around 1980s. They had the say "in the physical planning, choice of heating system and the choice of fuel" (Ericsson et al., 2004). They have been very stable in favour of bioenergy; even, the economics were uncertain, they preferred biofuels for political reasons (Kåberger, 2006, interview). Thus, bioenergy has always had a local political support for the utilization of (local) biomass since the 1980s.

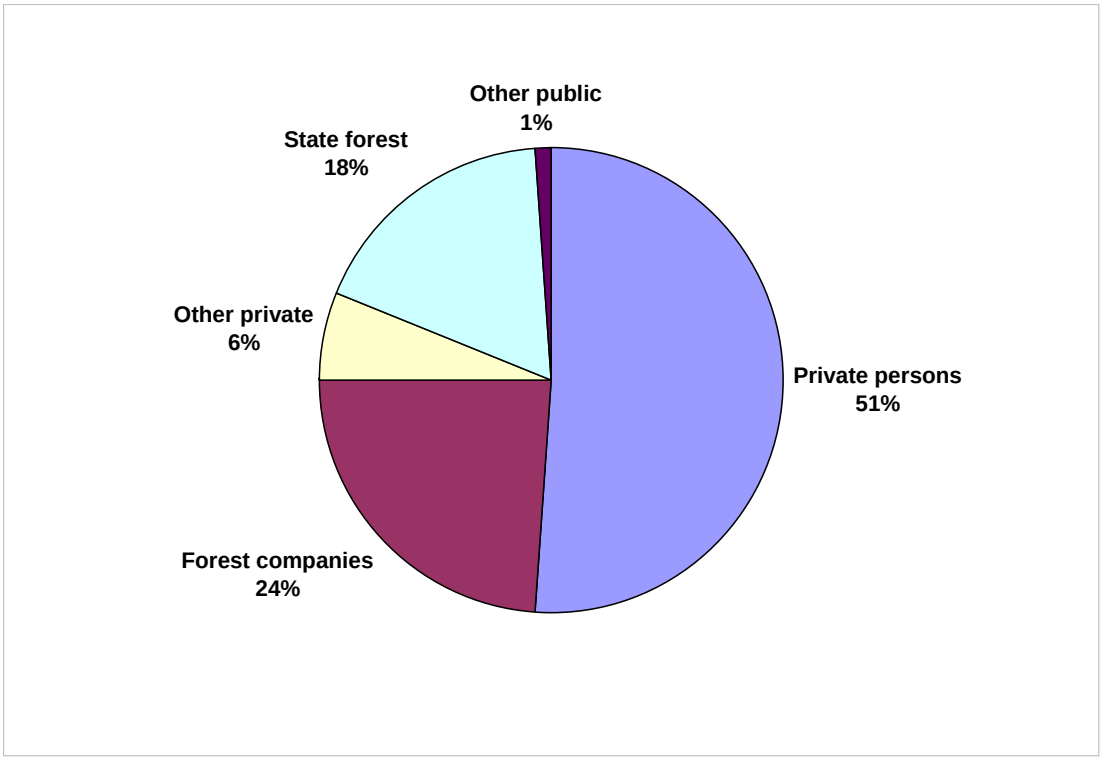
As stated in Section 4.1.4, the detached housing sector has increasingly been using wood fuels, and recently, wood pellets for heating. The Swedish Housing Company, Riksbyggen is a prime-mover in that sense supporting the use of biofuels in the areas where there is no DHS, and switching the burners to woodchip burners.

4.4.3 Forest owners and farmers

In Sweden, private persons (small- scale and/or family forests) hold 51% of the forests as it can be seen in the Figure 9. In total there are about 350 000 private forest owners (Swedish Forestry Agency, 2006). 26% of the forest owners are members of one of the 8 regional forest owners' associations (Elliott and Schlaepfer, 2001) and these associations cooperate nationally under the the Swedish Federation of Forest Owners.

Some of them operate like forest companies owning sawmill and pulp and paper mills. For example, Södra, the forest owners' cooperative in the Region Skåne buys the feedstock from the members produces and sells pulp, timber and other wood products, produces bioenergy and fuel for bioenergy. Then, the members also get shares from the profit of the company.

Figure 9 Ownership of the Swedish forests



Source: Swedish Forestry Agency, 2006

Forest owners have always been a big drive with their interest in benefiting from the forests economically as much as possible. They wanted to utilize it not only for round wood, but also for tops and branches (Kåberger, 2006, interview), for which they could form a market in the energy business.

Having organized forest owners from local to the national level also provided a grassroots mobilization in favour of increasing the market share of forest-based bioenergy, with the support of the local authorities and demand from the DHS and the industry.

4.5 Networks

Swedish bioenergy innovation is of highly connected character. Most of the sub-groups in the user-producer chain have their own organizations such as Regional and National Forest Owners' Association(s), Swedish Federation of Farmers, The Swedish Association of Pellet Producers, Swedish Boilers and Burners Association, Swedish Sawmill Association, Swedish District Heating Association, Swedish Electricity Producers and Distributers Association (Elforsk).

Swedish Bioenergy Association, Svebio, is the overarching political lobby organization and forum in Sweden for the whole bioenergy value chain, being an important contributor to the dynamic of the high connectivity of the actors.

For example, until mid- 1980s, Hector (2006, interview) claims that a network of suppliers and technology producers had not worked since the only way (for the technology developers) to survive was to get grants and provide local support. There had been competition for the funds and the market fragmented among the big companies versus the small ones broken from these big companies. When they saw that Svebio was getting organized and they were supporting the technology developers too, they started to join Svebio as well (Hektor, 2006, interview).

Hence, Svebio deserves a closer look as it stands out as a successful organization that achieved to bring all parties together successfully since 1980 and eased the market formation during the "infant phase" of bioenergy in Sweden. Thus, this section on Networking is focuses on Svebio as it stands out the biggest bioenergy lobby organization in Sweden.

Within the scope of the study, some local networks were tried to be identified as well as the nationwide ones, but not a distinguished one came out. Yet, this point remains as an area of further research. Furthermore, it should be acknowledged that the Swedish Renewable Energy Association (SERO) is not examined into as it has 100 members within the bioenergy group, as opposed to 400 members in Svebio; and is never mentioned during my interviews in any sense related to bioenergy. Yet, still, its formation and relationship with the other renewable energy associations also remain as a future research topic.

4.5.1 Svebio[42]

The focus of this section is on how Svebio was established and its features that contributed to its effectiveness in building up this network.

Here is the story of the formation:

On the eve of 1980 Christmas, some people from the universities, local authorities, woodchippers, forest owners, farmers, equipment manufacturers for wood fuels, district heating companies…etc received a Christmas greeting card from the company Novator, owned by three young entrepreneurs[43]. On the card, they were also welcomed to join the Swedish Bioenergy Club without any membership fee. This invitation created a positive atmosphere and already in February 1980, during the first meeting, the "Club initiative" got

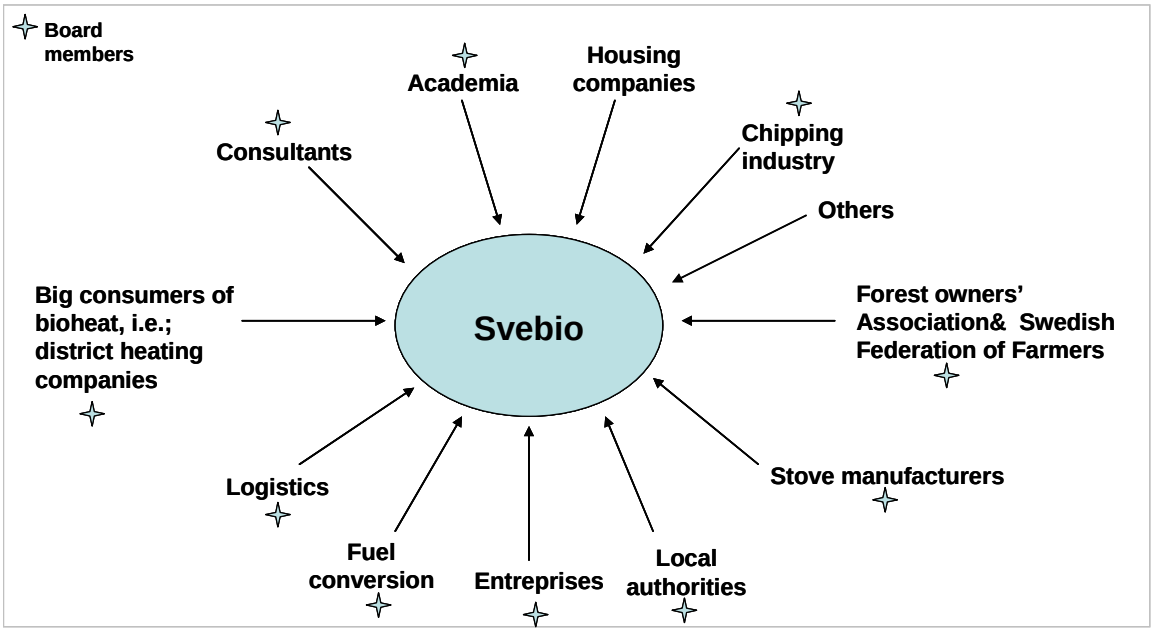
[42] Most of the information on this Section is provided by Ljungblom (2006, interview) and Kåberger (2006, interview).

[43] Lennart Ljungblom, Henrik Lundberg, Karin Segerud.

more serious to form into the Swedish Bioenergy Association, Svebio, with a preliminary board of five people.

Since then, Svebio has been an important meeting point for all the bioenergy actors in Sweden. How? From the first board on, the will was to have all parties represented within the organization to create a holistic learning and market approach. Figure 10 presents the board members and the other supporters during its formation phase.

Figure 10 The structure of the support to Svebio during its establishment period and the board members



Note: The structure of the board is mostly preserved, except a member from the local authorities.

The involvement and backing-up of the whole value chain during the establishment years had been supportive in terms of gaining legitimacy for the organization; as well as reputation, credibility, trust and respect. The engagement of big players such as National Farmers Union, which has always lobbied for bioenergy and big users of bioheat, especially, enabled the parties to come together, get to know each other, and kick-off the market together.

Hence, this structuring of the board was a crucial and very positive decision for Svebio to become a real channel of interaction among the bioenergy actors.

Second important turning point during the establishment of Svebio is the company Novator made an agreement with Svebio to do all the services for the Association and when the association would have some money, they would pay back to Novator. Since Svebio was a non-profit organization and members fee was not enough to realize activities, financing of Novator enabled Svebio to run activities and make itself known and grown.

In 1984, Svebio with the assistance of Novator organized the second world bioenergy conference[44] in the world in Sweden with success that brought to the organization and the sector more reputation. It had grown rapidly until 1985. The organization could survive the

[44] The first one was in the USA.

Black years of 1985-1991, when the electricity prices were so low in Sweden and bioenergy almost went out of business. It sold out the Magazine Bioenergy to another company, which provided some money for the Association. With the introduction of the Carbon Tax in 1991, the market revived again, so did Svebio.

From 1991 on, Svebio started to have its own organization to run its services like organizing conferences, and, now it owns its own company called "Swedish Bioenergy Service Company" and another daughter company to take the economic risks from the Association.

So, two important developments during the early years of the Association helped it to be established on a solid basis, after the initiative by the young spirits to form a Bioenergy Club. The first is the large support from the whole value chain, especially, the powerful organizations like Swedish Farmers Association and district heating companies; and, the structuring of the board. Third, Novator volunteered to finance the costs and run the activities of Svebio and took financial risks of the new organization on its own shoulders.

4.5.2 Svebio as a lobby organization

As mentioned above; in Sweden, the interfirm relations within each sector appear to be strong. This factor might have a positive effect during the emergence years of bioenergy in terms of facilitating the pertinent sectors, such as feedstock suppliers and users, to get mobilized for action and to disseminate information. These organizations also acted as agents of promotion within their outreach which helped the collective action gain legitimacy quicker.

Most of these organizations came together under the umbrella of Svebio. Hence, this section will focus on Svebio's as a lobby organization[45].

How is Svebio effective in lobbying?

This question was a hard one to answer since most of my interviewees defined it as an important actor when it comes to affecting the institutional environment. And, Svebio, successfully, being a meeting point for almost all industry seems to be a strong voice for bioenergy in Sweden.

But, is it strong because bioenergy has always been in line with the government policies due to the fact that the biomass potential of the country is huge, or, is it really because it could rally all the support of these different parties from the industry?

It seems that the answer is both. Svebio was established in a political environment where the support for and interest in bioenergy started to erupt. However, with the problem of oversupply of electricity and cheap prices during the second half of the 1980s, bioenergy was about to go out of business until the introduction of Carbon Tax in 1991 (Kåberger; 2006, interview; Ljungblom, 2006, interview; Håkansson, 2006, interview). During the "Black Years", the government passed a number of laws to increase the demand for electricity to avoid the

[45] This distinction of being a forum and a lobby organization was suggested to Svebio during its accommodation years by Bo Hektor (2006, interview), who at a time was working for a consultancy company that Svebio wanted them to suggest a plan of organizational structuring. Since then, Svebio has these two missions mainly, together with opening up to Europe as well.

nuclear business go bankrupt[46]. On the other hand, Svebio has been active and successful in changing main legislations, which were hampering the development of bioenergy, for example the Building and the Wood Fibre Act together with other organizations.

The current chairman of Svebio, Tomas Kåberger (2006, interview), indicates that the organization could not make the claim of the success of lobbying particularly due to its cleverness or skills; but it has been rather as a result of favourable general attitude towards local biofuels by the politicians and people. He indicates that it was only the Wood fibre law, where there was a deliberate campaign to change, but even during this process, they had dual support of favourable atmosphere for biofuels and very strong global move towards free market competition where wood fibre law was clear example of planned allocation of resources instead of market allocation.

In addition to these, Jacobsson (2006) points out that currently on the issue of power, Svebio is divided and failed to stop attempts to change the CO_2 and energy tax structure. Based on the interview with Kåberger, Jacobsson (2006) highlights two points. "First, with the liberalisation of the power market in the 1990s, larger utilities (some of the utilities favouring nuclear and/or gas are also members of Svebio) have acquired some of the pioneers in bio power and reduce the strength of its advocacy coalition (Kåberger, 2004). Second, the paper and pulp industry is an advocate of biomass but has always been strong proponents of nuclear power. A 'battle over institutions' is, thus, currently underway, the outcome of which is highly uncertain."

These examples demonstrate that measuring the effectiveness of a lobbying organization might be complicated than it looks from outside, as it seems that Svebio has gained legitimacy also in terms of lobbying power and influencing the institutional environment as all my interviewees denoted.

Another issue regarding the effectiveness of a lobby organization that is built around an emerging industry might be the risk of "losing grounds". As the purpose of the organization is fulfilled and the emerging industry is no longer an infant one and certain level of acquisition and trust is constructed among the actors, the organization might not be vital as it used to be. For example, Kåberger (2006, interview) indicates that Svebio used to be a stronger organization during the early years (of bioenergy) when the actors were looking for information and striving for legitimacy. However, the agenda changes always and "fight" on the political grounds never ends.

All in all, since the establishment years of bioenergy, Svebio has been successively a bridging platform for the whole value chain and information dissemination. It also appears to be an organization that has proved itself and gained respect in the eyes of everyone in terms of influencing the institutional environment, although, there has been some weaknesses in lobbying.

[46] In addition to the law introduced in 1985 banning the construction of chimneys in Sweden; at the time, electricity resistant heatings was also tax free (Kåberger, 2006, interview). Plus, the electricity companies were installing electricity resistant heating for free and there was a huge discount on the electricity prices for detachable houses (Kåberger, 2006, interview). All these measures to support nuclear energy business as the time, were close to make bioenergy go out of business.

4.6 Country Analysis: The nature of networking and the level of legitimacy

Chapter review:

√ The current energy situation in Sweden and its implications for the development of bioenergy.

√ Where bioenergy stands within the system and its potential.

√ How the history of energy policy fit into the development of bioenergy.

√ An overview of the structure of the innovation system, main actors and central policies to the deployment of bioenergy, and the perception of "bioenergy" at the public level.

√ The way that the actors interact with each other and the manner in which the collective action is formed around bioenergy in two countries, the advantages and disadvantages of these "networking models".

√ And, finally, the impacts of the structure of the collective action on the cognitive and socio-political legitimacy of the "infant" bioenergy industries in Sweden.

Now it is time to go back to the origin of start, which states that the interaction among actors and the establishment of networks facilitate the diffusion of a new innovation system via providing channels of trust formation, information flow, promotion and representation vis-à-vis other actors.

This chapter will examine into the phenomena of "cognitive and socio-political legitimacy" of a new industry suggested in the beginning and test the propositions on the emergence of bioenergy sector in Sweden, if they occur or not. This compartmentalization of the presented knowledge on the case of Sweden will also enable us to compare it with the UK case through a set of systematically defined items.

4.6.1 Framework Analysis

Box 1 Reminder for the key terms

- **Cognitive legitimacy:** It refers to the degree of the *taken-for-grantedness* of a new venture. When the knowledge spreads and an activity becomes so familiar and well known, the level of cognitive legitimacy of a new industry gets higher. This can be measured by the public knowledge about a new activity.

- **Socio- political legitimacy:** It refers to the process by which key stakeholders, the general public, key opinion leaders, or government officials accept a venture as appropriate and right, given existing norms and laws. It can be measured by assessing public acceptance of an industry, government subsidies to the industry, or the public prestige of its leaders.

4.6.1.1 Intra-industry Strategies

Proposition 3: Industries in which the founders encourage convergence around a dominant product/service design will gain cognitive legitimacy more quickly than others

District heating system has been the predominant use of biomass in Sweden commercially. Having that ready infrastructure for widespread use of biomass had a number of positive macro level implications;

- As depicted above, it reduced the market formation risks. It created a secure and large demand, which motivated the raw material suppliers and gave them trust to the bioenergy market. This overlapping of demand and supply, which facilitated to overcome the "chicken-and-egg" problem for this emerging business.

- This large utilization of biomass also caused economies of scale. As mentioned before, according to Roos et al. (1998), as the market has grown, the fuel prices have fallen too which proves that the whole supply chain has become more cost efficient and there is a good physical supply of wood fuels.

- It accelerated the process of gaining cognitive legitimacy for bioenergy by successfully deploying biomass on an already-existing and widespread infrastructure with a large outreach. It also proved reliability and credentiality.

- Having a dominant type of biomass utilization also made it easier to learn and raise awareness about a complex system like bioenergy among the society.

- There was already a Swedish District Heating Association[47] at the time, which made collective action towards bioenergy easier.

- The web of district heating system enabled a number of new comers to the market in every locality such as feedstock suppliers, logistics, and care takers.

These were the macro level system feature that made a positive impact on the cognitive legitimacy of bioenergy. Besides these, the micro level, product features are important as well. One of the disadvantages of woodfuels, for example, of woodchips, is that they may vary in quality, humid and ash content…etc., which could put its reliability under risk. The Swedish government has adopted the voluntary "pre-standards" defined by the EU (Sjöberg, 2006, interview). Kåberger (2006, interview) indicates that a lot of trade occurs based on, *de facto,* implicit standards and specifications that "increase the shared competences within the (emerging) industry" (Aldrich and Fiol, 1994). "Most important (formal) standards are about the measurements; for example on how to measure humid and ash content (Kåberger, 2006, interview). The level of standardization, whether formal or informal, increases the trust of the bioenergy users regarding the material and machinery they are using.

Another event that helped bioenergy to gain cognitive legitimacy during the formation years was the first World Bioenergy Conference in 1984 organized by Svebio. This conference provided "first" meeting platform for the stakeholders to get to know each other and to exchange information on systems, products and technologies, as well as to discuss the barriers.

[47] Established in 1949.

Proposition 4: Industries in which founders mobilize to take collective action will gain socio-political legitimacy more quickly than others

The consensus-oriented nature of Swedish society had eased to take collective action around bioenergy. The existence of branch organizations for related sectors has been an asset during the commercial emergence of bioenergy system in Sweden during 1970s-1980s. The Swedish Federation of Farmers owning Forest Owners' Association, District Heating Association, Swedish Housing Company-Riksbyggen and the power companies are some of the big ones. When Svebio had been established, the presence and support of these "already-organized" branch organizations to take collective action towards the creation of a market had positive impacts on increasing the degree of acceptance of bioenergy business:

- They provided ready and organized networks for interaction with the outreach to their members, from the farmers to the companies.

- These ready networks eased the flow of information to and from the particular sector to external bodies and other sectors.

- They could provide sector specific education and information to their members on bioenergy; i.e; building design, how to handle the equipment and machinery…etc. Thus, they could better persuade engineers, planners, raw material suppliers…etc switch the boilers.

  Let me give you an example related to this. One of the most common problems in the UK indicated by the interviewees is that the engineers, architects, designers and the care takers were resistant to switch the oil-run boilers to wood-fired ones (see, case study boxes, Box 4 and Box 5), for example, because, they have to deal with the ashes or have to feed the boiler from time to time. They are promoting the existing system and unwilling to switch. That might be due to the lack of an overarching sector-specific organization which gives support to bioenergy applications and educate and inform its members.

  From my interviews, this phenomenon appears to be a "no problem" case for Sweden. Huldberg (2006, interview) from Riksbyggen at the time indicates that the engineers and architects did not challenge the transformation.

- They represented the members voicing their needs and demands in a coherent and organized way, which avoided chaos.

- They brought in sector-specific information and increased the knowledge base of collective action.

- They promoted bioenergy as part of their activities increasing the knowledge and awareness of the public.

- They help to develop a common contracting/calculation language within the sector, which makes communication easier (Hektor, 2006, interview).

Thus, these features not only eased the market formation, but also gave the collective action a coherent, widespread and organized direction, which made it easier to be understood and to gain acceptance in the society and at the governmental and industrial level.

4.6.1.2 Inter-industry Strategies

Proposition 5: Industries in which founding firms promote their activity through third-party actors will gain cognitive legitimacy more quickly than others

When a new industry is emerging, the established industrial system might feel threatened due to the competition for the same scarce resources; i.e; customers, raw material and try to undermine its cognitive legitimacy, for example; through rumours on the efficiency or its compatilibility with the regulations…etc. In Sweden, the challenge to bioenergy was not a strong one from the existing fossil fuel system. They were rather weak since they were not domestic. And, the global energy agenda ignited a relatively rapid deployment of biofuels.

The challenge was mainly from the forest industry, especially the board manufacturers and pulp and paper industry, fearing of competition over raw materials. The pulp and paper industry was undermining the process of *taken-for-grantedness* claiming that "forests cannot be burned for energy, but they should be used in industry" (Ljungblom, 2006, interview) and claiming that "wood could not warm us (Sweden)" (Ljungblom, 2006, interview).

One of the reasons causing this tension was the Wood Fibre Act, which was limiting the use of wood resource for non-forest industry uses. The proponent organizations for bioenergy like Svebio, Forest Owners Association and Swedish Federation of Farmers got engaged in an extensive lobbying and campaign to change this act for the benefit of both energy and forest industries.

As elaborated in the previous proposition, these branch organizations also promoted bioenergy through their activities and inform their members and customers. For example Riksbyggen was introducing the alternative energies and the new warming system through printed material to its outreach.

Another challenge to be able to resist these attacks from the existing industries is to built reputation and respect. The emerging industry has to make itself respected and accepted to realize transactions. For example, to be able to get credits from the banks with reasonable rates, they have to prove that the business involves low risks. Third-party actors, such as Svebio, can help emerging industries to build an environment of respect. As mentioned above, the inclusion of publicly known faces and strong organizations like the Federation of Swedish Farmers during the establishment of Svebio was an asset, providing it a good reputation and trust.

Third-party organizations might also fulfil the role of nursing the new comers, providing them reputation and a higher voice. This strengthens the status of the emerging sub-sector, keep them organized and ease the information flow thus reducing the risks of failures. For example; Svebio also runs the secretary of National Federation of Pellet Industry (Kåberger, 2006, interview) supporting this recently rising industry with its own means.

Proposition 6: Industries in which founding firms negotiate and compromise with other industries will gain socio-political legitimacy more quickly than others

In order to reduce "the severity of attacks from the established industries, new industries need a reliable relationship with the existing industries" (Alrich and Fiol, 1994) and they might need to negotiate and make compromises sometimes. Regarding that proposition some Swedish examples poses an exception to it and some verify it.

The situation where it constitutes an exception arises from the dispute between the forest industry and the bioenergy industry. During the establishment years of bioenergy in Sweden, the severity of attacks from the forest industry was high.

Pulp and paper industry has always been an important and legitimate economic actor; which had been well accommodated within the existing system and the regulatory mechanisms (Wood Fibre Act and the Building Act were favouring their interests) at the time. They were undermining the socio-political legitimacy of the bioenergy by claiming that "burning wood was unlawful". Ljungblom (2006, interview) depicts the situation that they wanted to be the only buyer of wood, so that the forest owners would only be dependent on them, and remain at a relatively weaker position. And, the way that it sort of "settled down" is not through negotiation and compromise between these industries, rather through the engagement of the pulp and paper industry with bioenergy.

Here is one example to this dispute:

Ljungblom (2006, interview) points out the difficult early years of bioenergy business due to the barriers posed by the strong forest industry. He indicates the necessity of proving the "fact" that the bioenergy business would not use the same raw material in those years. For example, the first pellet factory in Mora, in Sweden, had to buy and store large amounts of wood residues before the plant went into operation to demonstrate that they would not cause competition on raw material. He also acknowledges the fact that people from the forest industry came to visit the storage of the pellet factory and approved that they would not use that raw material. In the end, the raw material got rootened and was not appropriate for pellet production. Although, they made this compromise to gain legitimacy in the eyes of the forest industry, due to the low quality of the raw material and some other problems (technology and knowledge/skill related problems) the pellet plant went to bankrupt.

Regarding the evolvement of the discussion between bioenergy and pulp and paper, there are different views. Kåberger (2006, interview) indicates that it was not a "real issue". He states that quite early it was obvious that successful pulp and paper industry would bring more forest harvesting and more forest harvesting, more by product which would increase the amount of raw material for energy sector. Similarly, according to Herland (2006, interview) bioenergy industry made it more feasible to exploit wood resources economically, by creating a value for other parts of a tree. However, according to Ljungblom (2006, interview), the dispute between these industries has never settled down totally in terms of competition. The competition has changed direction when in the late 1980s and the early 1990s, the forest industries started to have their own biofuels companies and get engaged in the bioenergy business themselves.

Currently, more and more the pulp and paper industry is involved in electricity production as the profitability increased with the green certificate and the EU ETS systems. And, they started to promote bioenergy (Lundberg, 2006, interview).

Similary, the discussion between the pellet and the board industry was "solved" when most of the board industry went out of business, or they changed their "industrial structure by changing the technology for board production, or started producing pellets themselves." (Ljungblom, 2006, interview).

Unlike those examples, the district heating companies might pose a matching pattern with the proposition, too. District heating companies, in order to keep the production costs low, they prefer to utilize the parts of the logs and the waste from the industry that has no market value

to anyone, such as stem. Peter Dahl (2006, interview), from the District System Association indicates that if these parts would be started used by others, they would look for other sources of fuels, could be biomass or not.

The first examples from the board and pulp and paper industry, which ended up with engagement or changing of business strategies by the opposing industries might show that a new industry might gain socio-political legitimacy more quickly as there are business opportunities for the existing industry to be involved in as well.

Unlike these examples, the DHS poses an example to verify the proposition. The flexibility of the choice of fuel to employ in the DHS appears to have reduced the eruption of conflicts with other sectors. This pragmatic compromise of change of fuels towards the "unwanted one" facilitated the process of acceptance by the other industries to utilize bioenergy in the district heating system.

4.6.2 Lessons learned from the Swedish case

- Inclusion of the whole value chain into collective action (Svebio) appears to be a facilitating factor in market formation enabling, especially, the demand and supply built trust and reduce transaction costs.

- This feature of the collective action also furthered gaining legitimacy for the newly emerging bioenergy industry by giving it a good reputation and a trustworthy image.

- The existence and the support of strong grassroots organizations like the Forest Owners' Association and Federation of Farmers seems to ease the mobilization of local actors and bridged the national business and industry to the local feedstock supply.

- Similarly, the already-existing intra-industry organizations eased the learning and acceptance process with the diffusion of sector-specific information.

- The support of these intra-industry organizations also provided a widespread outreach to the collective action via promotion of bioenergy to their own outreach.

- The presence of the well established district heating system stands to be an important contributor to the expansion of bioenergy in Sweden; hence, it is legitimacy as well. In the early years, bioenergy could make use of this existing infrastructure rather than having had needed a totally different infrastructure.

- The involvement of the existing industry into the bioenergy market seems to have facilitated the socio-political acceptance of bioenergy as a business.

5 Case study 2: The United Kingdom

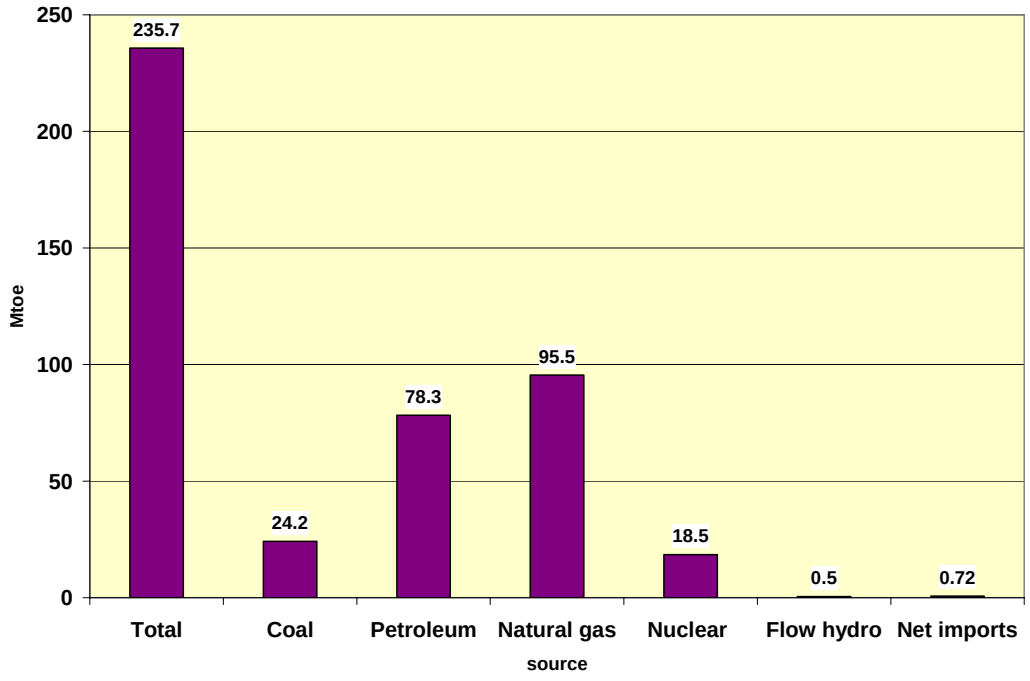
As mentioned above, the UK is one of the EU countries that the level of deploying bioenergy very negligible and is below the EU average level, while it is the third biggest energy consumer within the Union (EC, 2005). This chapter follows the same order with the Swedish case. It will first prepare the grounds for understanding the dynamics behind this fact. It will present the current energy situation and how bioenergy fits into the whole picture. Then, it will provide an overview of the central actors and institutions that have had major impact on the development of bioenergy. And, second, it will look into the core of this thesis and examine into the networking strategies of the founders of the bioenergy industry during its infant years. Finally, it will conclude with the analysis of the impact of these strategies on the legitimacy of the newly emerging bioenergy during its formation years.

5.1 Structures

5.1.1 Current energy situation

In the UK, around 97% of the consumed energy sources are derived from non-renewable resources (RCEP, 2004). In 2005, production of indigenous primary fuels in the UK amounted to 216.1 Mtoe and total inland consumption was 235.7 Mtoe (DTI, 2006a). Of this 235.7 Mtoe, petroleum accounted for 78.3 Mtoe (of which, 99% was used in transport sector); natural gas for 95.5 Mtoe; coal for 42.2 Mtoe and nuclear for 18.53 Mtoe, as shown in Figure 11. The proportion of renewables to TPES occurred as 1.3, in 2004.

Figure 11 Inland energy consumption on fuel basis



Source: DTI, 2006a

5.1.2 Energy history in brief

- During the post-war period, the Labour Party nationalized the coal, electricity and gas industries. The government took the role of market in coordinating demand and supply to facilitate the post-war boom (Helm, 2003). The national coal industry and the electricity sector were vertically integrated. The coal was nationally supplied for electricity production (Helm, 2003).

- In 1955, the White Paper presented "A Programme of Nuclear Power" indicating that nuclear energy was the energy of the future (Helm, 2003). It proposed a ten year programme to provide a capacity of 1.500- 2.000 MW to satisfy 25% of electricity needs.

- Suez Crisis in 1956 accelerated the enthusisasm for nuclear power, during which the UK government became concerned about possible interruptions from the Middle East (Helm, 2003).

- In 1956, the world's first commercial nuclear power plant (Calder Hall) was commissioned in Sellafield. Followed by seventeen other nuclear power plants commissioned starting from late 1950s.

- Between 1958 and 1974, coal remained the main source of energy (Chick, 2006).

- "North Sea oil was discovered in the early 1960s, with the first North Sea oil coming on line in 1971 and being piped ashore at Teeside, England, from 1975."[48]

- By the 1960s, the oil was abundant in supply and cheap; and started to replace coal as the fuel of the heavy industry.

- The Oil Crisis in 1970s, led to more pro-coal, pro-nuclear and more intense North Sea Oil and Gas exploration for domestic self- sufficiency (Helm, 2003). The North Sea fields were not intensively exploited until rising oil prices in the 1980s, which made exploitation economically feasible.[49] Thus, the presence and the further exploitation of the national fossil fuel beds caused a different response to the Oil Crises than that of Sweden and slowed down the reaction to oil dependency. Nonetheless, Bridgwater (2006, interview) acknowledges that since the Crises, the UK government has launched renewable energy projects; this never led to any significant activity in terms of bioenergy.

- 1979, Conservatives came into the power led by Margaret Thatcher, whose aim was to liberalize the market, including the energy market. In 1982 and 1987 oil; in 1986 gas industry; in 1990 the electricity; in 1995 the coal and in 1996 the nuclear industry was privatized. The state monopolies were separated and privatized.

- Within the framework of Kyoto Protocol, the UK government committed itself to reduce GHG emissions by 12.5% below the levels between 2008 and 2012.

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[48] Wikipedia, searched as "North Sea Oil".

[49] Wikipedia, searched as "North Sea Oil".

- In 2003, the White Paper set the target for 60% reduction in the CO_2 level 2050. The Energy Review of July 2006 sets the goal of renewable electricity as 20% by 2015.

5.1.3 Fuel sources and potential

5.1.3.1 Fossil fuels[50]

Historically, Britain has been fortunate in having abundant coal, oil and gas (McKay, 2006). However, this period of good fortune is coming to an end and there is a decline in the domestic production fossil fuels sources. It is argued that much of the UK's economically viable deep mined coal is likely to be exhausted in the next 10 years; it is expected to be a net importer of gas by around 2006 and of oil by 2010; and if present trends in usage continue, the UK could be dependent on imported energy for three quarters of its total primary energy needs by 2020 (McKay, 2006).

The decline in general as reserves deplete pushes the government aims at reducing the dependency on gas (DTI, 2006b). However, coal is planned to continue to have an important share in the future energy mix (DTI, 2006b); while much of the coal is already imported.

5.1.3.2 Biomass fuels

In October 2005, the Carbon Trust published the "Biomass Sector Review", in which four types of indigenous biomass fuels are identified according to their greatest potential for carbon savings at lowest cost (Carbon Trust, 2005).

- Forestry crops; poor quality stemwood, stem tips, branches and arboricultural arisings. The current available yield is around 6 TWh/yr and (almost) none is used for energy at the moment (Carbon Trust, 2005).

- Waste wood; construction and demolition wood, wood packaging, furniture manufacture waste, end-of-life furniture, currently available for 22 TWh/yr and no increase is expected (Carbon Trust, 2005).

- Woody energy crops: short rotation coppice (SRC), willow, miscanthus, eucalyptus, poplar and hemp. Currently, around 0.2 TWh/yr is grown, however, it is expected to grow considerably in future, with a roughly estimated area of 680 000ha with an average potential of 38 TWh/yr (Carbon Trust, 2005).

- Dry agricultural waste; straw, poultry litter, corn stower, oil crop residue, sugar beet tops, oat crop residue and feathers. There is about 73 TWh/yr of dry agricultural residue available, but most of is already used, leaving 13 TWh/yr for use in biomass plant (Carbon Trust, 2005).

The Biomass Task Force (2005) defined 20 million tonnes of material of which could be used for energy, including wet materials like slurry.

[50] The statistics are from the *Energy Review* (DTI, 2006b).

5.1.3.3 Others

Nuclear power and hydropower

Currently, the nuclear power plants supply around 20% of the electricity need of the UK. Many of the nuclear power plants are coming to end of their lives, and the government has decided to commission new generation of nuclear power plants to replace the old ones to avoid a shortfall of energy supply (DTI, 2006b).

The contribution of hydropower to the UK's energy supply has been decreasing. Most suitable land for hydropower was used up between 1940 and 1960. Most of the potential is in small-scale hydropower projects. It is claimed that if all the streams and rivers in the UK could be tapped, it would be possible to produce 10 TWh/yr enough to meet around 3% of the total electricity needs.[51]

Wind power

The UK is one of the eight countries to break 1GW level in wind power (BWEA[52], 2005). Scotland has the best wind potential in the whole Europe.[53] A recent report survey written for the Minister of State for Energy indicated that the capacity factor of wind power in the UK is around 30% higher than the annual average capacity factor (Sinden, on press).[54]

There are currently 130 wind power projects with 1672 turbines, producing 1832.55 MWh/yr (UKWED[55], 2006). There are 20 other projects under construction of 217 turbines with the capacity of 431.25 MWh/yr (UKWED, 2006). And, there are 184 projects with 3 443 turbines, which are under planning (UKWED, 2006).

Landfill gas

There are currently 282 landfill gas power stations in the UK, with a generating capacity of 631.7 MWh, which between them use 12.5 TWh/y of gas, with only 0.16 TWh/y being used directly (Future Energy Solutions, 2005). The market potential for landfill gas is 0.54TWh and 0.29TWh for 2010 and 2015, respectively.

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[51] Ecocentre. (2006).

[52] British Wind Energy Association. (2006a).

[53] Sustainable Development Commission, Scotland. (2006)

[54] Capacity factor (or load factor) expresses the amount of electricity produced by an electricity generator as a percentage of the maximum theoretical production from the generator (Sinden, on press).

[55] British Wind Energy Association. (2006b).

5.1.4 Current uses of biomass

Biomass is far from being fully deployed in the UK and a considerable biomass feedstock resource is not being utilized (Biomass Task Force, 2005).

The burning of biomass, excluding energy from waste, currently makes a small contribution to the UK's energy balance: about 1.5% of electricity (including co-firing, municipal solid waste combustion and sewage sludge digestion) and about 1% of heat (BTF, 2005).

The policies are formed with a focus on electricity-only plants ignoring the heat value of biomass.

Table 9 and Table 10 show the contribution of bioheat to the current energy system and the present biomass plants in the UK, respectively.

Table 9 Contribution of biomass to the UK heat market

Source	Contribution TWh/yr
Wood combustion- residential	2.38
Wood combustion- industrial	3.09
Straw	0.84
Total	6.31

Source: DUKES (FES, 2005)

Table 10 List of current biomass plants as of June 2006

Station name	Capacity (kWh)	Fuel
Elean Business Park	36.85	Straw
Glanford power station	16.70	Poultry litter
Thedford Power station	41.50	Poultry litter
Eye Power Station	14.32	Poultry litter
Fawley Waste to Energy Plant	8.60	Meat and bone meal
PDM Group Widnes	2.10	MBM
Goosey Lodge Power Plant	5.00	Animal waste
SA Cumnock Waste Water Treatment Works	0.177	Sewage
Downhill Farm	0.12	Waste cooking oil
Weston Industrial Estate	0.50	Co-firing
Peabody Trust	0.13	Waste timber slurry and food
Eggborough Power Station	10.62	Palm kernel
The Westfield Biomass Plant	12.5	Chicken litter
Balcas Timber	2.45	Forestry products
Mossborough Hall Farm	0.3	Virgin wood
Total 15 plants	151 867	

Sources: Thornley (2006) and adapted from OFGEM list of accredited generating stations with delivered net electricity more that 50kW by July 2006 (RO, ROS56, NIROC57).

The most widespread use of biomass is co-firing[58] since it is included in the Renewables Obligation (RO) system (see, 5.3.1). If the generators would like to produce Renewables Obligation Certificates (ROCs), 75% of biomass energy content must come from energy crops between April 2006 and March 2011. And, by 1st April 2011 co-firing is no longer eligible to produce ROCs. (The latest Government Strategy on Energy (DTI, 2006b) indicated that the government is planning to prolong it.) The electricity suppliers are allowed to meet only 10% of their ROCs from co-firing between April 2006 and March 2011, and only 5% between April 2011 and March 2016. (DTI (2006b) also stated in the Strategy that the government is also planning to remove these caps as well.) By June 2006, the number of accredited generating stations to OFGEM for co-firing was 34 with the total capacity of 3 391 498 kW (OFGEM, 2006).

5.1.5 The impact of domestic fossil fuels

The existence of a domestic and strong fossil fuel industry and the entire institutional and cultural environment built around it in the society has delayed the process of gaining both cognitive and socio-political legitimacy; in terms of bioenergy. The action towards increasing the energy mix through supporting the marginal renewable energy technologies, as well as the knowledge and understanding was set back due to rooted fossil fuel technology system, as will

[56] Renewables Obligation Scotland

[57] Northern Ireland Renewables Obligation

[58] Co-firing means burning of biomass alongside with the fossil fuels.

be shown throughout this chapter. Only onshore wind and landfill gas are at commercial level due to mature and cheap technology levels.

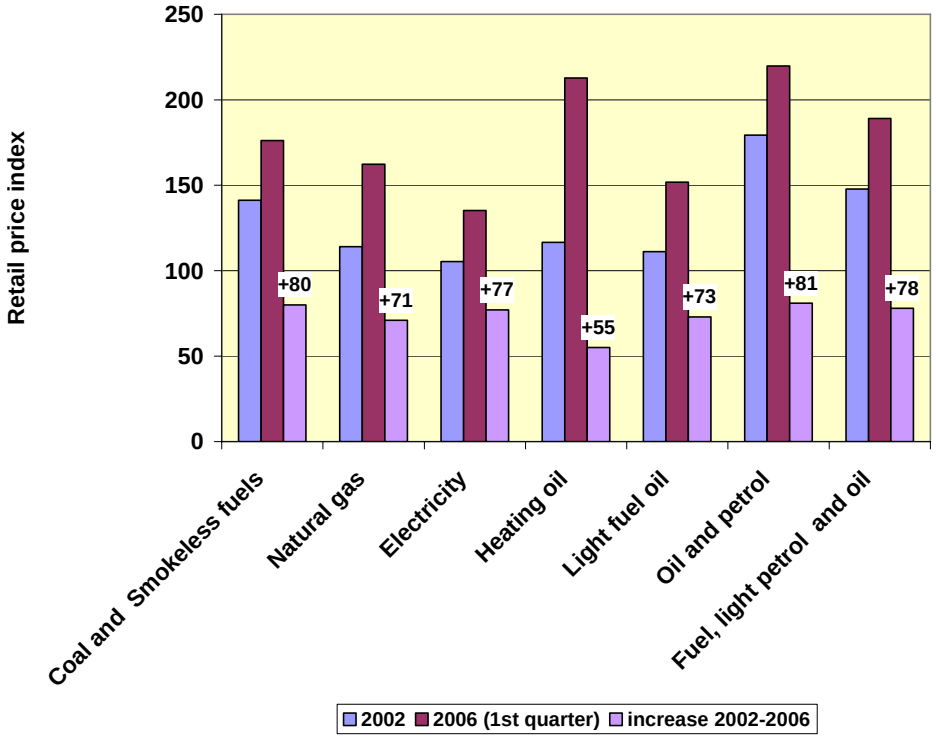
According to Webb (2006, interview) engineers, designers, architects, care takers... etc are all used to the existent technology and have been challenging the introduction of biomass boilers/burners and they do not want to promote the new technology.

Public is not familiar with the concept of bioenergy, the knowledge is low, and until recently they have been resistant to change. Ewan and Webb (2006, interview) indicate that the people are used to utilizing natural gas or oil burners. They are easier to deal with compared to biomass, which needs storage, ash handling…etc.

This has been the scenario until recently that Britain used to enjoy cheap and domestic oil and gas. However, with the rising oil and gas prices biomass also has started to become to be competitive.

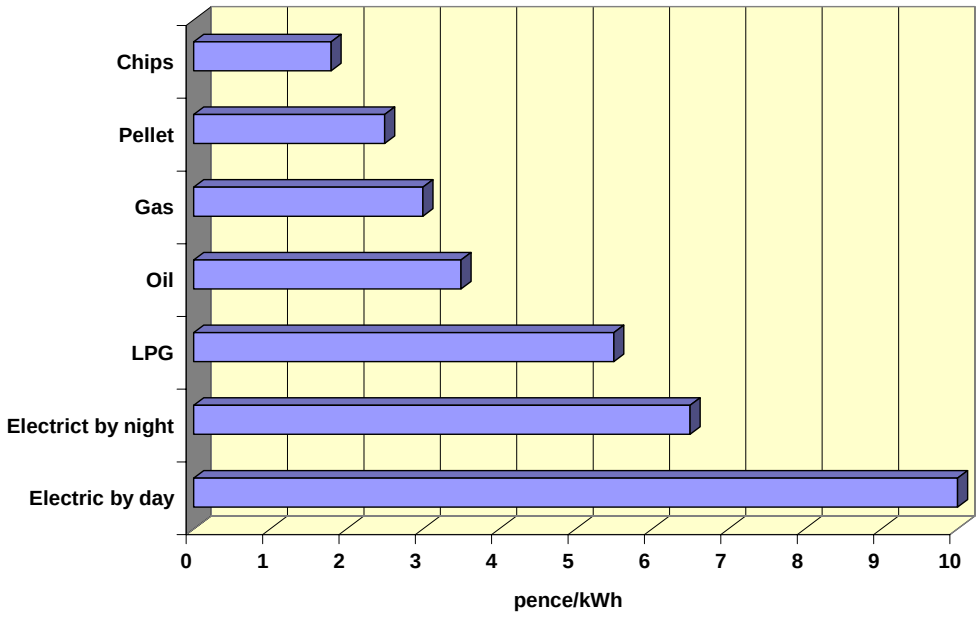
Figure 12 and Figure 13 show the increase in the retail prices of the fossil fuels and the relative cost of fuels, respectively.

Figure 12 The increase in Retail Price Index according to fossil fuel component



Source: DTI, 2006b.

Figure 13 Relative cost of fuels in the UK, pence kWh



Source: Marches Wood Energy Network (Webb, 2006)

5.2 Biomass Innovation System in the UK at a glance

The common bioenergy applications in the UK concentrate around electricity production mostly in the form of co-firing and landfill gas. As indicated above, there are fifteen dedicated biomass-fired electricity generation plants (accredited to OFGEM by July 2006) from waste wood, chicken litter and BMB. The main fuels for co-firing in the UK are straw, energy crops and waste wood. Bioheat does not have a specific target and it lags behind. According to European Research Area (ERA, 2004), in the woodworking and furniture industries there is a well established heating sector. The small-scale wood burners start to become applied at the local level, mostly in the public buildings with the support of capital grants given by DTI and DEFRA.

The UK, together with Sweden has a lead position in exploiting genetic techniques for breeding short rotation coppice… (and) in terms of R&D UK agricultural raw materials engaged a higher number of institutions than forest related materials did (ERA, 2004). UK R&D also engages with pyrolysis and gasification of biomass.

The UK has a very fragmented structure of division of responsibilities in the field of bioenergy at the governmental level. Mainly, DTI and DEFRA are responsible from different segments of bioenergy (i.e.; DTI, technology and industry; DEFRA, crop plantation), but there are other government agencies (i.e.; Forestry Commission) and companies (such as Carbon Trust, established by the government) giving funding to bioenergy projects as well. All these different agencies and different support schemes (seventeen support schemes as of September 2005) create confusion and make the information harder to find. It also appears to make the potential international collaborations harder since it is hard to find the main responsible department for a specific bioenergy area.[59]

The bioenergy actors are not united and are unorganized. Bridgwater (2006, interview) points out the "complexity of structures" in the UK in the field of bioenergy; having so many independent organizations or groups, overlapping to a limited extend without any overarching body; a body that ensures the dialogue between them.

Flow of information is weak and mostly one way (Foxon, 2005). There are 33 public and private R&D institutions as of 2004 (ERA, 2004). Some are government-university-industry collaborations like SUPERGEN. However, according to Brammer and Longden (interview, 2006) in most of the university-industry collaborations, the information seems to flow from the industry to the universities mostly as industry is more experienced. The information flow from and to the government is also problematic because of fragmented structuring of the responsibilities.

5.3 Institutions

5.3.1 Policies

So far, the policies towards employing renewable energy technologies mainly benefited only the technologies, which are already mature and close to the market price; and, only, in the area of electricity. Renewable heat seems to continue to be neglected by the government in terms of

[59] Telenius (2006, interview), works in the Swedish Energy Agency, pointed out the difficultness of establishing cooperation with the UK, and finding the "most corresponding" department among all these different departments engaged with bioenergy.

concerted policy framework like the creation of a renewables heat obligation as it exists for the electricity. Currently last years, there has been lobbying by bioenergy proponents for bio-heat to the government emphasising the economic efficiency and the carbon reduction effectiveness of the bioheat or biomass CHP compared to electricity-only plants run on biomass (Carbon Trust, 2005; BTF, 2005; RCEP, 2005; FES, 2005). Although, there are grants given to bioenergy projects, without clear and long-term policies that makes the bioenergy market clear, the investments do not seem to be likely to take-off, as they face "short-term policy" risks and uncertainties. National Audit Office (NAO, 2005) indicates that of the seven larger electricity and CHP projects, only two made significant progress and the rest might not go ahead.

Under this section, mainly the Renewables Obligation System (RO) will be presented and analysed as it is the government's central policy to increase the renewable electricity and all my interviewees (except the government officers) acknowledged its deficiencies regarding reaching the targets. Some other common policy-related problems will also be touched upon, which are the most commonly mentioned during my interviews.

Table 11 shows other main policies in place within the framework of the policy challenges to introduce and maintain a new industry, the actions taken by the British government and the problems related to these policies. For the summary of all bioenergy related policies and grants in the UK, please see, Appendix 7: Grant schemes and policies related to bioenergy in the UK.

Renewables Obligation (RO)

Renewables Obligation is the Britain's central, at the same time the most controversial, renewable energy policy tool aiming at increasing the renewable electricity at the lowest cost.

It was introduced in April 2002 (DTI, 2002) succeeding the former Non-fossil Fuels Obligation (NFFO). RO superseded NFFO, expecting that it would compensate the defects of NFFO (Mitchell, 2004) since it was (Mitchell et al., 2006):

- a market-based mechanism was more desirable on the grounds that it would increase deployment while at the same time maintaining a competitive incentive to keep prices down;
- it would enable renewable energy generators to become more integrated into the electricity market;
- it was non-technology specific so would not attempt to pick winners.

RO obliges the licensed suppliers of electricity to buy a particular percentage[60] of their electricity from generators that produce green electricity from eligible renewable resources (OFGEM, 2002). The obligation on suppliers increases each year. It started with 3% in 2002-2003, it will rise to 10.4% for 2010- 2011 and to 15.4% by 2015- 2016, where initially it was to remain at the same level until 2027 (DTI, 2002). However, in the last Energy Review (DTI, 2006b) the obligation of 15.4% is raised to 20% and it will remain at this level until 2027. Suppliers have to prove Office of Gas and Electricity Markets (OFGEM) that they met the obligation by showing the renewable obligation certificates (ROCs). During the RO round

[60] 6.7% for 2006/07

covering the period for April 2005- March 2006, one ROC was around around £ 40.65 per MWh today. There is no must-take contract for renewable electricity and no price or contract length is stipulated with in RO (Mitchell, 2004). Developers have to negotiate with a supplier for all agreements (Mitchell, 2004).

If the suppliers choose not to meet the obligation, then, they can "buy-out" ROCs, currently at a price of £33.24/MWh for the period 2006/07. These "buy-outs" then collected in a pool and returned to the suppliers in proportion to the percentage of RO that they met. This is called "recycled green premium".

So, a RO generator has, de facto, four revenue streams (Mitchell et al., 2006):

- payment for energy;
- payment for ROC;
- payment for Levy Exemption Certificates[61] (LEC) if the final customer is eligible for LEC;
- the recycled buy- out payment.

However, in practice, from a risk reduction point of view for supporting the infant technologies and new comers, according to Mitchell et al. (2006), RO does not remove the risks, and mainly benefits the big utilities. Since the risks are not brought down and the promising technologies are not differentiated from the cheap and incumbent technologies, Smith and Watson (2002) indicate that the system is also short of giving incentive to the innovation and new technologies. Moreover, according to Mitchell (2006, interview) it gives disincentives to not to meet the obligation via the green recycled premium system.

How is that? Before looking at RO within the framework of our policy challenges, I would like to highlight some points;

1) RO aims to reach the targets from the cheapest way (Shanahan, 2006, interview). Thus, it benefits already mature and commercial technologies, and do not promote or reduce risks for new technologies.

2) The price of ROCs change according to supply and demand (Smith and Watson, 2002[62]) There is no fixed, guaranteed, long- term prices. All terms are subject to negotiation between the contractors.

3) According to Mitchell (2006, interview) the vertically integrated big electricity utilities, which also have their own generators, turn the RO market into a illiquid one. They meet their obligations from their own generators. And, the independent generators face the risk of not being able to sell their green electricity, or have to sell it from a lower price with a short-term contract. Then, these independent generators have the risk of not being able to cover the production costs. And, they leave the system.

[61] See, Appendix 7: Grant schemes and policies related to bioenergy in the UK

[62] Mitchell et al. (2006).

4) Mitchell (2006, interview) also indicates that RO gives disincentives to meet the renewable electricity targets. The "green recycled premium" approaches to zero, as the suppliers get close to meet the targets (because no one will be buying-out"). Thus, it is in the interest of the big utilities to keep the shortfall between the target and what is achieved to be able to benefit from the "green recycled premiums" and make the value of ROCs cheaper.[63]

Most of my interviewees, with the exception of two, emphasised the need for a long-term and stable policies, which are able to reduce the risks for the "next generation technologies" (Smith and Watson, 2002). Furthermore, all in all, it appears from the literature and my interviews that the trust to government policies in terms of supporting the infant renewables such as bioenergy is very low. Table 11 summarizes the other main policies within the framework of policy challenges, barriers and problems with these policies.

Table 11 Policies that affect the development of bioenergy in the UK

Policy challenges	Action taken/ The extend that it is fulfilled	Problems/ Barriers
Guidance of research and stimulate market formation	- Renewables Obligation introduced in 2002 to increase the share of renewable electricity. - Several different capital grants are given to develop bioenergy projects (see, Appendix 7: Grant schemes and policies related to bioenergy in the UK.)	- RO benefits already commercial technologies such as wind power, and does not promote the new ones, such as biomass- fired power plants. - Big utilities control the ROC market and the technology direction; do not let new comers, or new technologies. - RO gives incentives not to meet the green electricity target. - It does not reduce risks for next generation technologies. - Independent generators are in a disadvantaged position vis-à-vis the big suppliers in the RO system. - It is not traded separately (Mitchell et al., 2006). A ROC value is calculated with green recycle premium and a LEC value. - The length of contracts for independent generators might not be enough to finance a project (Mitchell, 2006). - The recent Energy Review (DTI, 2006b) put another market risk declaring that there will be "technology banding" meaning that not ROCs will be given in different amounts depending on the fuel source by 2010. That creates uncertainties regarding already made long-term contracts. - The capital grants appear to kick-off bioenergy projects, but in order to provide long-term financial sustainability, these technologies and projects should be supported with targeted and firm policies to reduce the market risks. - The highly divisioned nature of the grants programme under different government agencies is a challenge to find the information and makes the process of application even more complicated.

[63] Mitchell (2006, interview) points out that they suspect if the big utilities communicate with each other not to meet some portion of the obligation all together. And, based on some subtle long-term calculations, they prefer to buy-out some of the obligation, while meeting some to get revenues from the green recycled premium. By doing this, they might pay less than paying for all the ROCs.

Specify inducement and blocking mechanisms and devise policies	-To specify the barriers regarding bioenergy Biomass Task Force (2005) was established. - Biomass Sector Review (2005) was prepared for the Carbon Trust. - Several other reports were demanded by the government such as from RCEP and FES. - Carbon Trust was established to assist low carbon projects.	- The policies try to reach targets in the cheapest way and do not "nurse" the marginal ones.
Institutional alignment	- The government departments try to increase coordination by publishing common reports and government responses in collaboration with related government agencies.	- Bioenergy falls between DTI and DEFRA, also DFT, OFGEM…etc. All have different agendas. - According to most of my interviewees, there is not enough communication among these departments. - Confusing information from different departments. - Some waste that could be used as feedstock cannot be benefited because they fall under waste laws. - There are still problems with planning permissions for plants. - Risks and uncertainties do not give incentives to new comers regarding bioenergy. - No significant lobbying for bioenergy as a whole.
Variety of actors to experiment with different design approaches	- Capital grants scheme - Research councils are established - Research fund to pyrolsis and gasification.	- There are 14 different schemes for bioenergy (RCEP, 2005) which makes the information hard to find and rather complicated. - According to Bridgwater, there is no coordination between the Research Councils. They are unorganized.
Sustaining cumulative causation	-	Short- term policies do not reduce risks to create market for bioenergy. Moreover, the existing projects face risks to maintain themselves.
Predictable and persistent pricing policies	-	- RO system is found to be very problematic in that sense. It does not reduce "price risks" (Mitchell et al., 2006). The value of ROC is dependent on many other factors and market actors, which makes the prices unpredictable.

Sources: Mitchell et al., 2006; Mitchell, 2004; Mitchell, 2006, interview; Foxon et al., 2005; NAO, 2005; BTF, 2005; Carbon Trust, 2005.

5.3.2 Opinion Leaders

5.3.2.1 The government

At the governmental level the level of cognitive and the socio-political legitimacy regarding bioenergy has been relatively low. Some of my interviewees stated from their experiences (Bridgwater, 2006, interview; Miles, 2006, interview) that even the public officers are confused and do not know where to start from and what bioenergy is and how it works. In addition, bioenergy has never had a strong political support to carry it to a commercial stage.

1990s

The first policy kick-off for the renewables came as a side- effect of support to nuclear power. The first renewables deployment policy in the UK was NFFO, which stayed in operation between 1990 and 1998. In fact, it aimed at enhancing nuclear capacity. When the UK government was required to ask the European Commission for permission to support nuclear power, they preferred to ask formally to support for "non-fossil fuel" (Mitchell, 2004). In a way, renewables sneaked in the corridors of the Whitehall, but, during the NFFO era, it never got clear targets and broad political support. Rather, the government used NFFO as a "natural selection" process which would bring the cheapest and the quickest technologies[64].

According to Mitchell (2006, interview), bioenergy projects were crushed under low bids and could not show a consistent and competitive appearance under NFFO rounds.

2000s

The Blair government came into the power in 1997 and announced two more NFFO rounds[65] (NFFO 4 and 5) and 10% renewable electricity target by 2010 (Mitchell, 2004). Between 1997 and 2006, Blair government expressed their support for renewable energy, published several policy papers and reports. They declared 60% renewable energy by 2050 (Energy White Paper, DTI, 2003), employed renewables obligation system in 2002 and created several capital grants scheme. But, most of these policies are technology blind and still benefiting the cheap ones. And, yet alone wind power and landfill gas fail to meet the targets. The support for bioenergy has been in the form of capital grants, which is essential to bear the initial costs, but most of them are short- term in nature and unstable economical environment creates long term risks. Most of the bioenergy projects are in the form of electricity- only, which is neither carbon nor cost effective as shown by the Biomass Task Force Report (BTF, 2005). Bioheat still continues to be neglected by the government as seen in the Energy Review (DTI, 2006b), though, there are capital grants given for community district heating run on biomass.

Mitchell (2006, interview) expresses the government's lack of understanding about the innovation technology policies by leaving infant technologies into the hands of the market. Recently, it is the rising oil, gas and electricity prices that have given the incentive to the industry and business to consider biomass as an alternative fuel source since biomass prices start to become relatively more cost competitive.

To conclude, the political support for bioenergy has never been broad, targeted and strong in the UK

5.3.2.2 NGOs

It appears that bioenergy does not receive the same attention from the NGOs yet, as the wind, wave and solar energy does. Two of the major NGOs (Friends of the Earth and Greenpeace)

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[64] This approached has crippled the development of renewables as you will read under "public opinion" and "the delivery of NFFO remained very poor and most of the NFFO bioenergy projects are not still realized (Mitchell, 2006, interview).

[65] Most of the projects from these rounds still are not realized because of low bids and planning permission difficulties (Mitchell, 2004).

that were got in touch with had no policy statements on bioenergy at present. However, Friend of the Earth acknowledged that they were working on it and is expected to be published in December. Furthermore, Greenpeace stated that they focus more on wind, wave and solar energy, but not in bioenergy.

5.3.2.3 Public opinion

The lack of knowledge and understanding (cognitive legitimacy) of biomass and bioenergy is a serious barrier to the enhancement of bioenergy indicated as all my interviewees in Britain. The definition and scope of biomass is complex by nature. This aspect of bioenergy coupled with inadequate communication on it makes it more problematic in terms of public awareness. The main reasons for "the lack of everything related to biomass" (Longden, 2006, interview) in the society can be summed up;

- the lack of cognitive legitimacy about what bioenergy is and about its benefits, combined with;
- the failure of initial biomass policies to consult the local inhabitants prior to the commissioning of plants;
- and, the history of bad examples, like ARBRE plant reduced the trust of the public towards biomass.

Lack of understanding and knowledge (cognitive legitimacy) on bioenergy

All the respondents highlighted this point as one of the main barriers to bioenergy. One of the reasons raised as a reason for this problem was the fossil fuels' system being well-spread around the country and relatively cheap prices. The natural gas grid reaches almost all houses, or oil-fired boilers are utilized, even at the individual level. No storing or no pre-treatment is needed (as it is the case with biomass) and it has been regarded as secure and efficient resource. Paterson (2006, interview) indicates that people even did not even used to think about energy because it was cheap.

Another reason for the lack of cognitive legitimacy on bioenergy stems from the misconception of biomass. Due to examples of plants run on animal waste (slurry) and manure (chicken litter) and widespread application of landfill gas, it seems that bioenergy is intertwined with waste. Public relates biomass with odour pollution and harmful emissions.

Policies that discarded the public opinion

Public opposition (lack of socio-political legitimacy) has been a serious barrier to bioenergy plants. The policy drives have been initially unsuccessful in communicating the bioenergy and the projects, especially with the inhabitants of the locality of a project. This lack of consultation and education, in fact, led to the delay or determination of some of the projects such as wood gasification plant development in North Wiltshire. The literature (van der Horst, 2005; Upreti and Van der Horst, 2004) gives examples of the projects that had to be stopped due to the public opposition.

Furthermore, the first renewables deployment policy NFFO was a failure in addressing local consultation.[66] NFFO was very competitive and secretive since the cheapest projects would win the bid. The project developers had to specify and tie the project to a location to enter to the bid, which put the project developers in a difficult position. If a developer would start sitting discussions publicly to winning the bid, other competitors could claim the same site and propose a similar plant for lower per kWh price and win the bid (Upreti and van der Horst, 2004). Second, the result of the bidding is not known, so it was costly for the project developer to engage with local stakeholders (Upreti and van der Horst, 2004).

Thus, the cheap and quick way of reaching the targets crippled the image and viability of the biomass in the long- term and undermined its socio-political legitimacy.

Bad examples

Another issue that undermined both cognitive and socio-political legitimacy of bioenergy is the history of bad examples such as unrealized and failed projects due to policy failures. Regarding public opinion and trust towards bioenergy projects, the failed project ARBRE was always mentioned without any exception during the interviews on the bad psychological effects on the development of bioenergy in the UK; destroying the reputation and trust for the realization of the biomass projects in the eyes of the public, but especially in the eyes of the farmers.

Box 2 presents the case of ARBRE and the reasons to its failure as an important example to affect the image of bioenergy negatively in the UK.

Box 2 Case of Project ARBRE: A failed dedicated biomass plant leaving a deep impact in the bioenergy history of the UK

Information on this case is mostly provided by Paterson, Lundberg and Mitchell via interviews, 2006.

ARBRE

1) Big project, big failure and the different views

Project ARBRE was a joint venture between Yorkshire Water Projects (UK), Royal Schelde (the Netherlands) and Termiska Processer AB (TPS, Sweden). It was a pilot Biomass Integrated Gasification Combined Cycle (BIGCC) fueld with waste wood from forest and short rotation coppice. This electricity generation plant constructed at Eggborough, North Yorkshire to produce 8 MW of electricity. It won the contract under NFFO in 1993 and got financial support of approximately £30 million from the European Commission's THERMIE programme as a targeted BIGCC project. It was expected to be the one of its first kinds in Europe and open up the potential biomass market development in the UK (Pitcher et al., 1998).

However, it was closed after 8 days of operation in year 2002 because of technical problems (Paterson, technology manager of the project, 2006, interview). According to Lundberg (sales manager of the project through TPS, 2006, interview), another problem at the time was the governments forcing the board of Yorkshire Water to resign and made the company go back their core business water and sewage due to the drought occurred at that year.

[66] This paragraph is based on, Upreti and van der Horst (2004).

However, the other face of the coin reveals a policy failure of the government regarding renewables. Mitchell (2006, interview) highlights the fact that after NFFO finished in 1998, and the RO was expected to come in in the year 2000 or 2001 the latest. In the year 1996, the SCR started to be planted for the ARBRE project, already making the yearly payments to the farmers, based on the calculation that RO would come in 2001. However, RO came in in the 2002. That one year without the income from the expected electricity generation under RO by 2001, caused a financial bottleneck. The government, instead of giving subsidies to the real developers of the project, made the plant go bankrupt. It was sold to DAS, an American Company, at a very low cost without any debt. The problem "solved" in the cheapest way for the government. But, the real owners of the project were harmed because of the uncertain and unstable policy sight of the government itself.

The American Company DAS approached TallOil- TPS again to resurrect the project and the local authority is of Yorkshire is also interested in ARBRE, but the future is rather vague concerning the fact that the plant has just been sitting there since the last three years and the costs are high.

2) In the aftermath of ARBRE

Linking the story back to the public reputation of biomass projects; ARBRE needed 43 000 dry tonnes of wood fuel per year. To meet this demand, around 1 500 ha. of land within the radius of the plant was planted with willow coppice in total with 50 sub-contractors. When the project failed, they remained with the crops on the field without any markets for sometime, shaking deeply the trust of the farmers in bioenergy projects.

Although, the trust to biomass projects was shaken at the time, ARBRE had a good side-effect in the bioenergy development in the UK as well. It helped the supply- chain to be established (Brammer, 2006, interview). Luckily enough, the farmers then formed Renewable Energy Growers Ltd. and sell the feedstock to the biggest coal firing installation in Europe (please see, Box 3).

Nonetheless, the psychological effects of ARBRE on the trust to the technology and the bioenergy in general are still felt, especially, on the farmers' side.

3) An important remark

ARBRE is also an example to the limited information flow and the experience sharing among the stakeholders. Mitchell (2004) states that the people involved in the project were made to sign contracts by the government in order not to publicize what really caused to the failure of the project. Apart from the technical problems that crippled the project, other factors still remain uncovered.

5.4 Main Actors

This section mainly focuses on the actors which are central to the main renewable energy mechanism in the UK, the Renewables Obligation System as elaborated above.

5.4.1 Electricity Utilities[67]

It is important to understand the structure of the UK electricity market to in order to be able understand the central renewable energy policy, RO. According to Mitchell (2006, interview), the UK electricity market is a very good example of the policy failures in terms of giving incentives for new comers and technologies to the system. The UK is the nineth biggest electricity market in the world (EIA, 2005). They are the drivers of the economy and hence have a big say in the how the energy policies are shaped and function. Hence, it looks that without their participation, the deployment of biomass is likely to remain low.

The electricity market was liberalized during the Margaret Thatcher government in 1990. Before that, Central Electricity Generating Board (CEGB) was the monopoly of the power generator and transmitter, in the country. With the transition to the full market economy in electricity, CEGB was separated into three generator utilities (National Power, PowerGen and Nuclear Electric), one transmission utility (National Grid Company) (Oliveira and Tomalsquim, 2004). And, the "Area Boards" were turned into Regional Electricity Companies (RECs). In the beginning of the 2000s, the two utilities and the regional companies were overtaken by companies such as the German companies, RWE and E.ON and the French company EDF and the Scottish and Southern Electricity and the Scottish Power. Currently, two regions of Scotland (which counted as a part of a British market) and 14 retail regions of Britain are now in the hands of five companies (Thomas, 2006), which are vertically integrated. Table 12 shows the companies and their capacities in the electricity market in 1990 and 2005.

Table 12 Ownership of generating capacity: 1990 and 2005

1990	(Capacity GW)	2005	(Capacity GW)
National Power	30.0	British Energy (Nuclear)	11.6
PowerGen	20.0	Scottish Soouthern*	8.6
Nuclear Electric	8.0	PowerGen (E.ON) *	8.0
Scottish Nuclear	2.3	Innogy (RWE) *	8.0
Other Scottish	7.7	Scottish Power *	5.9
Total	68.0	EDF *	4.8
		International Power	3.7
		Centrica *	2.9
		BNFL	2.7
		Plant for sale	9.4
		Other	6.3
		Total	71.9

Companies marked with (*) are both generators and suppliers.

Source: Thomas, 2006.

5.4.1.1 Implications of the RO System

According to Mitchell (2006, interview) and Collins (2006, interview) will never serve meeting the targets as these big five companies are in a position to control most of the transactions in the RO market. They indicate that:

[67] Most of the information on this section is provided by Barry Paterson and Catherine Mitchell via interviews, 2006.

- First, since the vertically-integrated "big-five" have their own generators, they are able to meet the obligations by buying ROCs from these generators with relatively good price and a long term contract. As a result, the individual generators remain in a position not to be able to find customers to sell their green electricity. Mitchell (2006, interview) adds that the big-five, then, offers them short-term contracts with relatively lower prices, with which these independent generators cannot cover costs and have to withdraw from the system. Hence, the big-five avoids independent generators to come into the market. Santokie (2006, interview) highlights that at the present most of generators (that used to generate ROCs from co-firing) have stopped employing co-firing as the vertically integrated electricity companies are able to meet their obligations already from their own generators.

- Second, "the big-five" will always be interested in not meeting the RO targets and keep some shortfall between the demand and the supply because of the recycled green premium revenues. The value of the green recycled premium approach to zero as the RO targets are met. Thus, they do a very subtle calculation on "meeting the target and how much paying for the ROCs" versus "how much obligation to meet, how much fine to pay and how much to get from the recycled premium". Mitchell (2006, interview) acknowledges that they suspect that these suppliers talk to each other and decide on to meet just the 60-70% of the obligation and recycle the rest. Hence, the individual generators face the risk of not being able to sell their green electricity again.

As an example to the system failure, Box 3 brings in the case of Drax Ltd. This example is significant to mention; (1) to demonstrate how the vertically- integrated big-five can negatively affect even such a well-established utility; (2) also, as an example of how big utilities could be drivers of bioenergy given the right economical conditions (carrots); (3) to give an example to the lack of policy integrity in the UK regarding meeting the targets and achieving policy integrity.

Box 3 Case of Drax Ltd.: An example on the role of big fossil fuel users in biomass deployment and a demonstration of system failures

The information about this case is provided from mostly Paterson via interview, 2006.

Drax

1. As a case to demonstrate that big fossil fuel users can also be a driver for bioenergy:

Drax is the biggest coal-firing utility in Europe (4000 MW) supplying 8% of the UK's electricity. With the introduction of RO, Drax started to deploy co-firing to make revenues with the ROCs. First of all, Drax bought the energy crops that were planted to fuel the project ARBRE (please see, Box 2). By buying this feedstock from the cooperative of these farmers, Renewable Energy Growers Ltd, Drax avoided a further mistrust to the bioenergy business and facilitated the establishment of supply-chain. Secondly, they replaced the heavy fuel for the ignition phase of the operation with talloil (a by –product of wood pulp manufacture). Talloil is exported to the UK by the Swedish company TallOil AB, which entered the UK market four months after the introduction of RO in 2002. TallOil AB sells this by-product to Drax and Ferry Bridge (daughter company of Scottish and Southern Energy) in the UK.

Fight on political grounds: However, before Drax and Ferrybridge started to import talloil to the UK, there were two legislative barriers to be overcome, "otherwise, the financial risks and costs would be too high" (Paterson, 2006, interview). To tackle these, Ferry Bridge and Drax hired lawyers. The first battle was with the Environment Agency (EA) on the category of talloil. The EA initially considered talloil as waste and wanted it to be under "waste incineration" terms, which is objected to special process requirements, operation conditions, emission and control measures based on the definition of waste; "any substance or object……which the holder discards or intends or is required to discard." However, talloil is processed to produce a fuel, hence cannot be considered as discarded as a waste (Paterson, 2006, interview). The second battle was with the UK Customs and Excise. Talloil was exposed to the same conditions with imported heavy fuels, which pay higher duties. And, talloil is not a heavy fuel.

In the end, the companies could change the classification of talloil, but, the process had financial and time cost. This is an example reflecting the situation in the UK regarding the lack of communication between the departments and the lack of political integrity. On one hand, there is the government putting an ambitious target of 60% reduction of CO_2 by 2050, and on the other, there are agencies delaying the change. Nevertheless, the companies won the "institutional battle" and gained political legitimacy for deploying talloil.

As a result, they could produce more ROCs. But, this did not last long neither.

2. As a case to point the Renewables Obligation System failure

Even Drax was negatively influenced by the big-five controlling the ROC market and supply from their own generators. Drax could not find customers to sell its ROCs and it stopped co-firing in April 2006. Also, because the cap on the ROC claims from cofiring went down to 10% from 25% (From the interview transcripts with Drax conducted by Perry Miles). Paterson indicates that the withdrawal of Drax from the RO System and its complaints to the government played a role in the recent planned policy changes regarding the co-firing rules mentioned in the Energy Review. The last Energy Review gives the signals of prolonging the eligibility of co-firing and removal of the 10% caps under the RO.

5.4.2 Feedstock Suppliers

The failure of ARBRE biomass gasification project has shaken the trust of the feedstock suppliers in the UK regarding bioenergy projects, although, they are interested in realizing the economic benefits. They are still sceptic towards, for example, switching from food crops plantation to energy crops plantation until the plant would start to be commissioned. This causes the "chicken-and-egg" problem; without securing the demand, the farmers are hesitant to start planting energy crops, as the project developers are hesitant to invest without securing the supply. In that sense, there are capital grants given by the government to farmers and forest owners seem to help overcome this problem and create feedstock infrastructure.

5.5 Networks

This section will introduce and analyse the structure of lobby networking at the local and national level around bioenergy; including the differences and the relationship between them (see also, Figure 15). The national networking case evolves around networking for all renewable energy technologies due to the character of the collective action itself. The

nationwide lobby networking in the UK has a broad scope and includes all renewables under one organization. The part on the local networking focuses only on bioenergy and presents a case study as an example of how the local networks are established.

5.5.1 Nationwide networks

Collective action around the renewables is still under the process of being constructed in the UK. There is action towards merging under one organization for the whole renewables, which has been strived to be accomplished since the late 1990s.

The discussion around renewable energy networking concentrates around two organizations the Renewable Energy Association- REA, (formerly, Renewable Power Association- RPA), and the British Wind Energy Association (BWEA). REA is the overarching organization that lobbies around all renewable energy technologies and merges with the other renewables trade associations. Regarding bioenergy, it looks like REA would be the representative organization for bioenergy in the future along with the other renewables.

Now, let's look at the formation of these networks, the relationship between them and their seeming levels of legitimacy.

5.5.1.1 Towards an overarching renewable energy lobbying organization- REA

In 1997, when the Blair government came into the power, one of their primary concerns was to make changes in the field of energy; i.e.; replacing the NFFO with another mechanism, consultation on the RO and setting targets for renewable electricity (Hartnell, 2006, interview). At the same time, the government was giving signals to the contemporary renewable trade associations of its desire for the creation of one renewable trade association. With the motivation given by the government, all renewable energy trade associations[68] and companies came together under the Confederation of Renewable Energy Associations (CREA). The Confederation appointed a Committee to come up with solutions regarding the unification of all trade associations; i.e.; the organizational structure of a possible merger and how the chairmanship would be structured. When the Committee suggested that all trade associations would merge with a chairmanship system that shifts among the trade associations, companies liked the idea. But, not the trade associations, fearing that "some people" will lose their positions (Mitchell, 2006, interview). So, initially Renewable Power Association (RPA) was established with the £45.000 from the volunteering companies. Later on, RPA started to approach the trade associations and suggested to merge with them. Initially, only the Biogas Association decided to merge with RPA. Then, Biogen (former association solely for bioenergy), Solar Power Trade Association and the PV UK joined to RPA. And, lastly, it is likely that it will also merge with the British Wind Energy Association into British Renewable Energy Association.

5.5.1.2 How REA works?

[68] British Biogen, British Wind Association, British Hydro-power Association, Solar Power Trade Association, PV UK, Biogas Association.

RPA changed the name to REA in October 2005. Currently, REA lobbies around all the renewable energy sources. Its personnel are composed of nine people. And, it has a range of members, around than 400 now, from large companies to individual members.

It manages the whole renewables by organizing them into what is called "Resource Groups". There currently seven groups; Primary Biomass Group[69], Bioenergy Group[70], Solar Group, Ocean Group, Renewable Transport Fuels Group, Renewable Power Markets Group and the Generator Group. The chairman of each group is mostly also a board member.

Primary Biomass Group, which deals with the bioenergy issues other than biomass from waste, has 150 numbers. They meet three times a year. It has two chairmen, who are also board members, one from the REA (Peter Billins) and one from the business (Graham Stowell, from Bronzeoak).

The REA board has 15 members. It is mainly composed of companies doing business in the fields of; wind, biomass, solar, biodiesel, waste water, cogeneration, energy from waste, electricity supplying, wave and tidal, consultancies and also an academic.

However, the organizational structure of the organization is expected to change if the merger with the BWEA is realized.

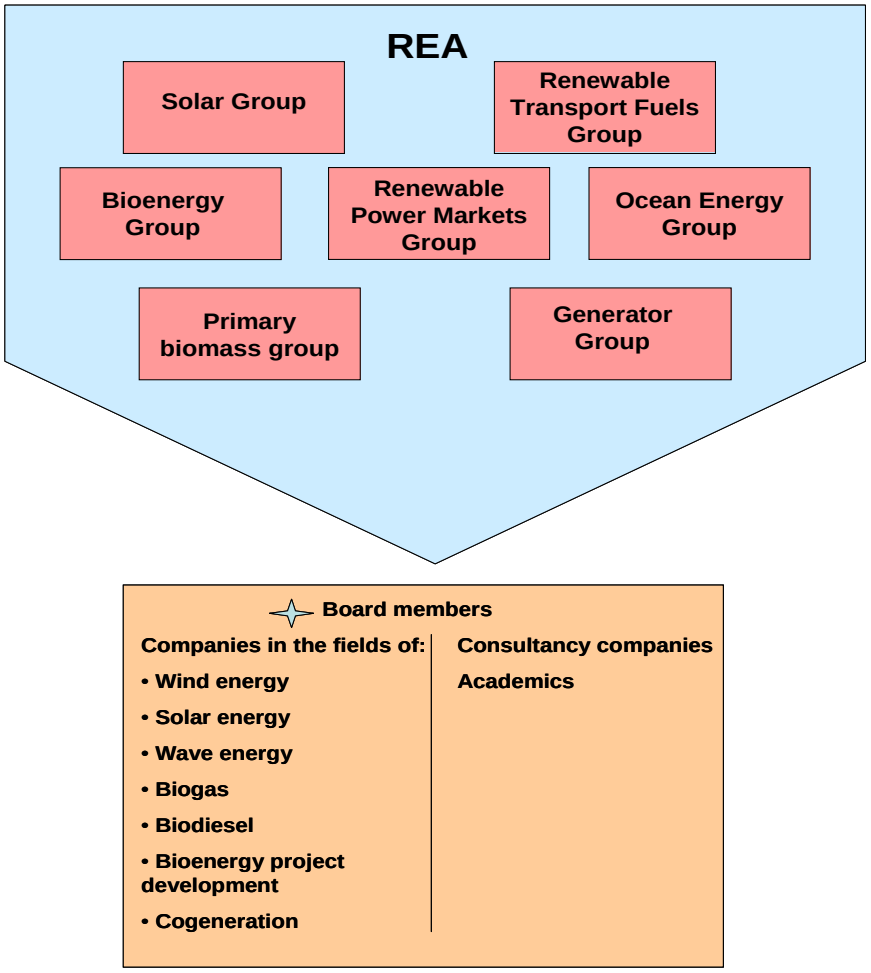
Being different than Svebio, REA manages its own finance rather than dealing with it through a daughter company.

Please see Figure 14 for the general structure of the REA.

[69] The group works on supply side issues from the growing, collecting and processing of fuels, through to end-use applications, including domestic and industrial heat production, electricity generation and combined heat and power (REA, 2006).

[70] The group works on landfill gas, sewage gas, anaerobic digestion, and thermal energy recovery techniques from fuels covered by the Waste Incineration Directive (REA, 2006).

Figure 14 The general structure of the Renewables Energy Association



5.5.1.3 The relation between BWEA and REA

When I was having interviews in England, the discussions on merging with the BWEA was still going on, and some of the respondents indicated that the merger was not likely to happen. However, by the 28th of July, the REA and BWEA declared that they agreed on most terms regarding representation and their objective is to create a sole representative to the government for the whole renewables (REA, 2006).

The BWEA is a trade association established in 1978. It lobbies around onshore and offshore wind power, and recently wave and tidal energy as well. It has around 300 members ranging from big utilities to individuals. The votes are allocated according to the money that the members pay. This undemocratic structure of BWEA results in more say within the organization by the big utilities such as E.ON, Scottish and Southern, Southern, EDF and RWE, the subsidiaries of the ex-monopolies mentioned in the Section 5.4.1.[71]

[71] E.ON, Scottish and Southern and Npower (EDF) are also on board.

Mitchell (2006, interview) indicates that a merger among the BWEA and REA is desirable since the government tends to pick up between them and BWEA is considered as a relatively powerful organization and has more legitimacy regarding lobbying to the government.

The indication that Mitchell (2006, interview) highlights on the lobbying power of the BWEA shows a parallel argument with the question on the effectiveness of Svebio (please see, Section 4.5.2). Mitchell states that BWEA stands out as more powerful in lobbying because it has always supported the wind and the conventional power, which has suited the government's will and the policies. Shanahan (2006, interview), from the Department of Trade and Industry (DTI), comments on the lobbying effectiveness of BWEA to the government as the government might have a firmer relationship with BWEA in terms of increasing the deployment of wind farms, which predominate the renewables agenda of the government.

As a result, it is believed that the merger between the two would increase the lobbying power of the REA, as well.

5.5.1.4 REA as a biomass lobbying and promotion network

It appears that this manner of the REA merging all the renewable energy trade associations into one organization might be problematic in terms of effectiveness in lobbying and promotion platform for bioenergy. Hence, it might be problematic in terms of increasing the legitimacy of the bioenergy as well.

By shouldering the responsibility of lobbying for the whole renewables through mergers, the REA takes upon the whole responsibility of fulfilling the role of a dedicated bioenergy organization with a larger dedicated staff working on bioenergy such as Svebio. These problems might be:

- REA might encounter the risk of being too general. In terms of bioenergy, which has a more complex character than the other renewables, having a general Primary Biomass Group might be too all-purpose and too much to deal with for one person to follow the agenda, write policy recommendations, raise public awareness…etc.

- Raising the public awareness on bioenergy in the UK stands out as a crucial necessity considering the fact that lack of cognitive legitimacy and public oppositions occasionally as were indicated as some of the most important problems coupled with the confusion about many types of biomass. Hartnell (interview, 2006), from the REA, states that they could not put much effort on promoting bioenergy at present.

- Furthermore, by the creation of general Resource Groups, the intra-industry connectivity might get weaker among the sub-sectors or the sector as a whole. As elaborated under the Section 4.5, a high connectivity among the members of the same industry (i.e.; bioenergy industry, equipment manufacturing industry, pellets producers…etc.) is vital in terms of (1) providing a platform for the development of inter-firm relations and for information and experience sharing, developing a common language; (2) providing better sector-specific information flow; (3) outreaching more members; (4) industrial harmony; (5) and, promotion.

Oppositely, there also seems to be advantages of this type of formation such as better stand and more respect, especially towards the government by having a sole spokesman. And, the money is gathered together under one organization, which might increase the finance of the

collective action base as well. To be able to see the advantages and disadvantages of REA-type of networking, please see Figure 14.

Most of the potential problematic areas seem to be possible to overcome by structural adjustment, as they are touched upon under the Section 7, General conclusions and networking propositions for the actors of emerging bioenergy . If the REA could deal with these problems and be able to act as a dedicated bioenergy organization, it would be more effective in lobbying and promotion of bioenergy industry.

5.5.1.5 National Farmers' Union (NFU)

NFU is the biggest lobbying group for farmers in England and Wales. They firmly support the development of bioenergy market for energy crops, agricultural and animal waste to open up new income areas for the farmers. They claim to be effective in the process of Renewables Obligation for Transport Biofuels with the help of REA (Proudley, 2006, interview). NFU seems to have a good potential to bring the grassroots level into the collective action and to ease market formation in terms of promoting bioenergy at the grassroots level and bridging the feedstock producers and the users. However, they collaborate with the REA on the basis of policy reviews, not within a formal organizational structure.

5.5.1.6 Remarks on the legitimacy of these networks from my interviews

All these organizations say they participate in the government consultation, write policy recommendations and they are effective. However, all my interviewees had to think for a while to be able to name a main and effective lobby group or network of any kind for bioenergy. Most, if not all, indicated that all the actors in the bioenergy innovation system are disjoint and disorganized as one of the main barriers to the development of bioenergy. Out of twelve interviews five could not name any names at all. Three (somewhat) mentioned REA, but indicated that they are big but not effective in bioenergy lobbying. Three (two were from the government departments) considered them as REA as effective. The ones that (somewhat) could name REA are mostly the people in London. The interviewees working at the local level did not even mention the name. And, the NFU was mentioned only twice as a network around bioenergy.

While national representativeness cannot be claimed, the author considers that the following hypotheses regarding the legitimacy and the status of these networks seem reasonable:

- None of the lobby organizations appears to gain attention, respect and trust in the eyes of everyone regarding bioenergy in the UK. Remember, Svebio was either the first to be mentioned as an important actor, or second after the government, regardless of the location and the occupation of the person.

- It looks like the connectivity between the national and local networks is low. Much lobbying and promotion by the REA seems to be the "Westminster Village"[72] focused, but not outreaching to the public in general or to the local champions, for example, through grassroots organizations such as the NFU.

[72] Westminster is the quarter where all the state departments and the parliament are located in London. The expression goes "Whoever is in the Westminster Village is within the government." (Paterson, 2006, interview).

5.5.2 Networks at the Local Level

Although, the scope of this study was limited to the political networks representing a large base of the actors, there are three reasons that made it necessary to cover the local aspect of networking. The first is the low connectivity between the national and local bioenergy initiatives, which would cause a knowledge gap on the bioenergy activities carried out at the local level, which seem to be effective in terms of market formation and promotion of bioenergy. The third reason is the different characteristics of the network formation, which might have different impacts on the legitimacy of bioenergy.

Box 4 and Box 5 present the two local project-driven networks, which the author visited in England. They help to fill the knowledge gap about what is going on at the local level, how the local bioenergy networks are established and what the barriers to the development of bioenergy at the local level. From other examples that are found in the literature (Carbon Trust, 2005; Biomass Task Force, 2005), these two examples appear to be representative.

From the case studies, it appears that when the local development needs are addressed better and the inhabitants are consulted; and the projects are small-scale, the socio-political legitimacy (acceptance) for biomass projects is likely to be higher. They also stand out as effective means to promote bioenergy at the local level influencing the process of cognitive legitimacy positively through "show-how".

Box 4 Case of Marches Wood Energy Network as an example of local network formation

The information on this network is provided from Bent and Webb via interviews, 2006 July

Marches Wood Energy Network, Shropshire, Westmidlands

1) Formation

Marches Wood Energy Network (MWEN, 2006), a non-profit organization established by Ewan Bent in 2001. He became interested in wood energy throughout his career and saw "biomass heating as the most viable and cost-effective for the future" (2006, interview). He started identifying local people in Shropshire, who might be interested in supplying fuel and storage such as timer owners, sawmills and farmers; and local authorities… etc. He organized meetings in order to initiate a local biomass heating project and to identify the barriers to this, together with the 30-40 interested people from potential local supply chain (private forest owners, farmers, sawmill owners, Forestry Commission, Shropshire County Council, environmentally aware people and Timber Research and Development Association- TRADA).

2) Identified Barriers

The first barriers they identified during these meetings were:

- High cost of boilers.

- The lack of understanding of what biomass is and how the technology works. One challenge was to persuade the engineers, architects, designers and caretakers to switch the boilers. Webb (2006, interview) indicates that they were resistant to change and believed that by doing what they have been doing already, they would do it faster. Hence, they saw the new technology as a loss of money and time (Webb, 2006, interview).

- The lack of good examples to see that it really could work. Ewan points out the effectiveness of the "show-how" trips they organized to observe the functioning wood-boilers and to persuade potential producers and users.

- The lack of trust to the market, which leads to difficulties in market formation as the fuel supply and the demand cannot

3) Success

Finally, the willingness of the local authority to heat the swimming pool with biomass, created an initial demand and the incentive for the raw material suppliers to supply the fuel. In that process Marches Wood Network acted as the mediator between the supply chain and the energy demands, by filling the gap inbetween. Finally, they raised £100 000 from the National Lottery and the Forestry Commission for three years to promote wood heating, organizing events, training courses, publicity and technical advice on boiler installation and feasibility studies. They also offered capital grants to farmers and forest owners through Advantage West Midlands (the Regional Development Agency for the West Midlands Region). Throughout three years, MWEN installed ten biomass boilers doing everything in between the supply and the demand; converting raw material into fuel, handling and transporting it, importing the boilers (from Austria) and installing and maintaining them throughout the lifespan. At the end of the third year, although, there was a demand for the boilers, the supply of fuels went under risk because one of the fuel suppliers, a waste company providing waste wood went out of business. Thus, they decided to set up a trade company with the existing network, Midlands Woodfuel Ltd., to trade technology, wood chips and pellets. They initially supplied 450- 500 tonnes of wood chips per year, and now this volume amounted to 3000 tonnes/ year. Bent (2006, interview) highlights the increasing number of inquiries and demand for the boilers and the increasing capacity of the boilers.

4) What changed and what stayed the same?

- High cost of boilers went down thanks to the capital grants.

- The supply-chain has been established with the creation of demand.

- The increasing oil and gas prices give people the incentive to change their boilers.

- However, the lack of understanding still exists, as people are accustomed to using oil- boilers, where they just burn fuel and do not have to deal with the ash and loading the fuel (Bent, 2006, interview). But, Bent says that this is improving as well.

The communication with the universities or research institutes or industries seems to be low. Further, he believes that the market and the policies are driven by the large business and the government ignores local, small- scale initiatives.

The next case study will present that the availability of good practices and pioneers to follow facilitates to create a momentum to take collective action.

Box 5 Case of "Biomass Support Group" as an example of spreading of a good local network formation

The information on this network is provided from Lawrence via interview, 2006 July

A snowballing effect from MWEN- Biomass Support Group

1) Formation

The second example is the Biomass Support Group initiative around the Warwickshire City Council.

Energy West Midlands wanted to roll out a good practice like MWEN in the region with the DTI funding to deliver regional energy strategy. They gave funds to MWEN to carry out 10 feasibility studies mainly on the public buildings in Warwickshire. Lawrence, who is heading the Climate Change Strategy in the Warwickshire County Council took the lead on networking and mobilized the actors. They organized meetings on the results of the feasibility studies, to share information and experience where the local support for biomass heating embodied into Biomass Support Group "to work together to make feasibility studies happen".

The feasibility studies identified 5 MW heating need as requiring 5000 tonnes of wood waste per year. Some stakeholders volunteered to provide space for storing the wood. To increase multiplying effects of the project and increase local business, they decided to engage the farmers to the project as well. As Lawrence indicated, the Forum for Farmers will issue a report this autumn about the survey they carried out among 850 land-based industries in the region to understand the potential woodlands, space to grow wood or energy crops.

2) Barriers

Lawrence identifies the barriers during the process as:

- The unwillingness of the engineers, planners, architectures and care takers to switch the boilers simply because they are used to oil boilers and they do not believe that it would work.

- Little finance.

- The lack of political support to expand the budget.

- The difficultness of identifying suitable buildings with appropriate storage space. Even though, people might be interested in since the infrastructure does not exist, the projects cannot be realized.

3) Success

By end of mid-October 2006, they will be installed their first wood-fuelled biomass in Oakley Wood Crematorium, which will require 50 tonnes of biomass per annum and save 70 tonnes of CO_2/yr. In 2007, another one in Warwick Collage will start operation, which has a capacity four times bigger than the first one and it is expected to save 165 tonnes of CO_2/yr.

In relation with the last point, the Warwickshire County Council also creates a Design Guide to answer the questions about bioenergy, biomass boilers, storage, design…etc with the financial support of Energy West Midlands.

4) What changed and what stayed the same?

- Local support and awareness have improved regarding bioenergy. Partnerships improved.

- The political support still is not enough.

- Finance is still a problem.

Again, this initiative has limited connections to the national networks or the academics and researchers.

5.5.3 The relationship between the national and local networks

Longden (2006, interview) points out the low connectivity between the local and the national networks and the communication to be almost at the zero level. Although, there might be overlapping platforms in between, the information flow still seems to be limited. For example, MWEN is a member of Forest Contracting Association, which is a member of the REA. However, during my interview with the MWEN, the REA was never mentioned as a lobby organization or a meeting platform. The reason for the unfunctioning information flow:

- As stated above, it might be the "Westminster Village" focused activities of the national network and it does not consider establishing links with the local networks.

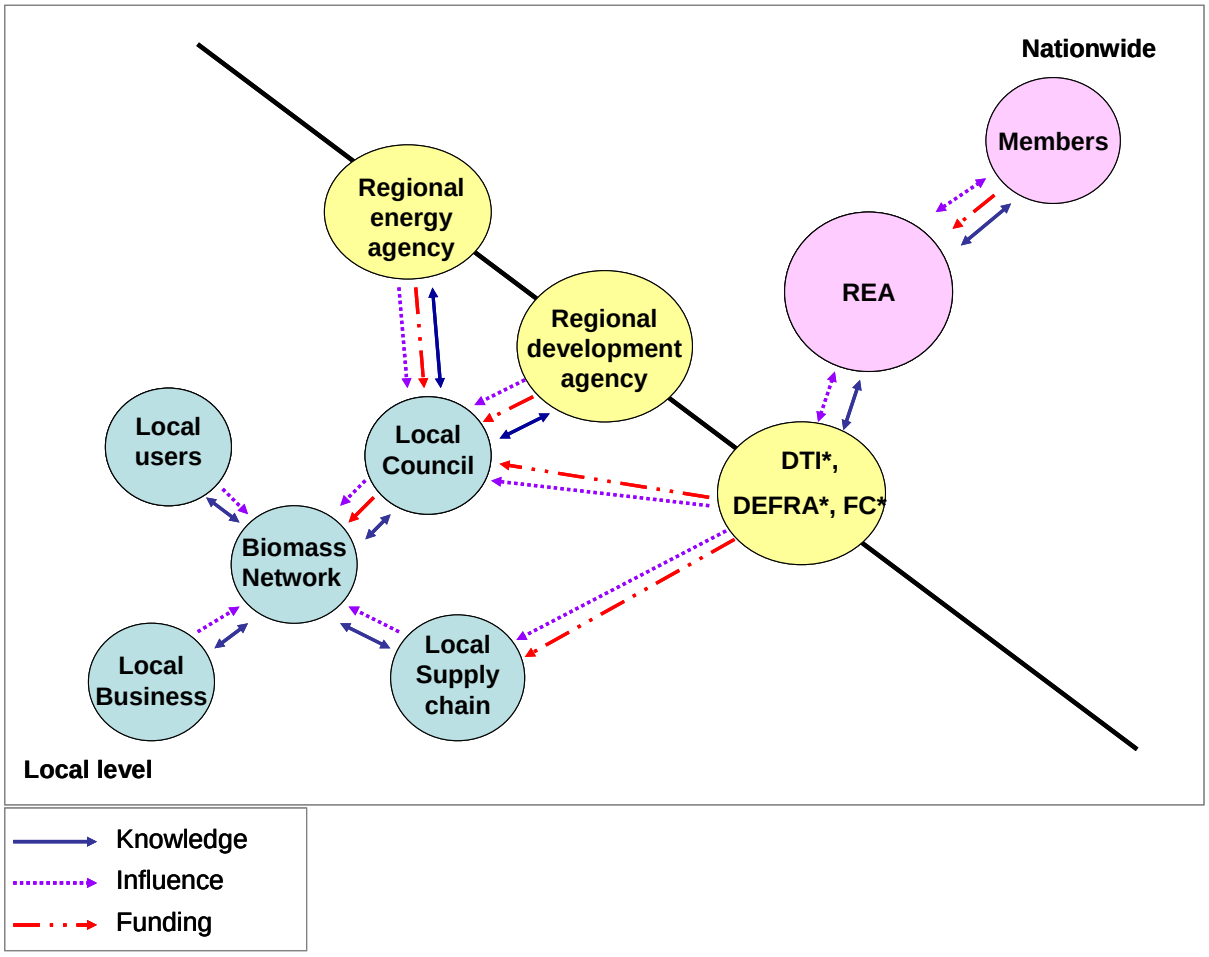
- The intra-industry organizations (Forest Contracting Association) might be ineffective in carrying information to their members.

- The local networks might not consider participating in or forming relations with the national forums actively, because they do not think that there is no returns.

Indeed, the evidence found in this study, during the interviews with both sides, shows that there is unwillingness to cooperate between these two levels of initiatives; and in fact, they perceive each other as competitors for the scarce resources such as respect, attention and finance from the actors like the government and the society.

Figure 15 depicts the relationship between these networks.

Figure 15 The "general state of affairs" between the national and local networks according to "knowledge, influence and finance flows"



Notes: 1. (*) Department of Trade and Industry, Department for Environment, Food and Rural Affairs, respectively. 2. The knowledge, influence and funding flow between the authorities are not reflected. 3. The "knowledge, influence and funding framework" is adopted from Foxon, 2003.

5.6 Country Analysis: The nature of networking and the level of legitimacy

Chapter review:

√ The current energy situation in the UK and its implications for the development of bioenergy.

√ Where bioenergy stands within the system and its potential.

√ How the history of energy policy fit into the development of bioenergy.

√ An overview of the structure of the innovation system, main actors and central policies to the deployment of bioenergy, and the perception of "bioenergy" at the public level.

√ The way that the actors interact with each other and the manner in which the collective action is formed around bioenergy in two countries, the advantages and disadvantages of these "networking models".

√ And, finally, the impacts of the structure of the collective action on the cognitive and socio-political legitimacy of the "infant" bioenergy industries in the UK.

After covering these issues, now it is time to go back to the origin of start again.

Before starting examining into the phenomena suggested in the beginning and test them if they occur or not in the UK bioenergy sector, it is important to note that as the bioenergy market is in its early phases, as well as the collective action around it in the UK, work examining the relevance and validity of these propositions needs more time to see the results of these initiatives better. Nonetheless, there are clear patterns of network formation and interaction among actors, which provide us general indications of the current situation.

5.6.1 Framework analysis

Box 6 Reminder for the key terms

- **Cognitive legitimacy:** It refers to the degree of the *taken-for-grantedness* of a new venture. When the knowledge spreads and an activity becomes so familiar and well known, the level of cognitive legitimacy of a new industry gets higher. This can be measured by the public knowledge about a new activity.

- **Socio-political legitimacy:** It refers to the process by which key stakeholders, the general public, key opinion leaders, or government officials accept a venture as appropriate and right, given existing norms and laws. It can be measured by assessing public acceptance of an industry, government subsidies to the industry, or the public prestige of its leaders.

5.6.1.1 Intra-industry Strategies

Proposition 3: Industries in which the founders encourage convergence around a dominant product/service design will gain cognitive legitimacy more quickly than others.

Bioenergy in the UK is growing or try to grow on many diverse raw materials. The UK has neither abundant wood supply nor a widespread web of district heating as Sweden has, which made it possible wood-fired heating at a large scale. As mentioned under the Public opinion section, the public is confused about what bioenergy is.

The evidence shows that prime movers in the emerging bioenergy industry in the UK follow different paths. The diversity of bioenergy applications coupled with inadequate promotion jeopardize the cognitive legitimacy of what bioenergy is. Currently the dominant bioenergy product is electricity from landfill gas. This appears to make bioenergy mostly intertwined with waste in people's minds and might create dislike. The electricity production from other sources is very negligible. As mentioned above, there are electricity-only plants run on chicken litter, meat and bone meal, straw, waste wood, co-firing, energy crops and most are small scale.

Thus, it looks like the initial diversity of bioenergy applications coupled with the lack of familiarity with its utilizations as a society slow down the learning process of the society regarding what bioenergy is. The low level of cognitive legitimacy on bioenergy makes it vital for newly emerging bioenergy industry to communicate and promote it to the public effectively in order to facilitate the market formation and to be able to gain trust.

Proposition 4: Industries in which founders mobilize to take collective action will gain socio-political legitimacy more quickly than others.

In the UK, the intra-industry organizations that might contribute to the development of bioenergy are either weak, or do not exist. The connectivity within the bioenergy-related industries seems to be loose, which gives the collective action a more individualistic character (rather than the support and the rallying of the pre-existing industry organizations for the collective action, as it was the case in Sweden).

However, the mergers under the REA seem to have relatively increased the socio-political legitimacy of the former bioenergy association, British Biogen, as it was indicated to be ineffective, unable to meet members' satisfaction and unable to attract new members. Hence, the merger between the British Biogen and the REA is expected and seems to be giving bioenergy a better voice, than the British Biogen used to do. Similarly, the merger of British Pellet Club with the REA seems to give this network relatively better position as well.

Hence, on one hand, in terms of giving smaller organizations a rather better position, the REA seems to provide them a relatively higher socio-political legitimacy. But, on the other hand, over all in absolute terms, socio-political legitimacy of bioenergy vis-à-vis the society, the government and the other industries seem to lag behind. The acceptance for bioenergy by these important stakeholders lies behind the promotion and increasing the cognitive legitimacy of bioenergy. And, by being an all-encompassing lobbying organization for all the renewables, the collective action faces the problem of not being able to promote and spread the knowledge enough around the society. Hence, this situation appears to undermine both the cognitive and the socio-political legitimacy of the bioenergy in the UK.

5.6.1.2 Inter-industry Strategies

Proposition 5: Industries in which founding firms promote their activity through third-party actors will gain cognitive legitimacy more quickly than others.

Following from Aldrich and Fiol's (1994) indication for this proposition, in the UK, within the framework of the study, obvious evidence showing the existing industries that were trying to undermine the cognitive legitimacy of bioenergy through spreading rumours or inaccurate information was not found. This does not indicate that they do not or will not exist; rather, it might be due to fact that currently bioenergy industry in the UK is very small and the potential is not considered as a significant competitor to the existing energy systems, or the industries (i.e.; using the same raw material), so the tension is not distinct. Only the evidence revealing discomfort within the board and furniture industry towards the pellet production was found and this discomfort does not seem to turn into a process of "attacks to damage the cognitive legitimacy" of the bioenergy yet.

However, at a more micro level, as seen in the Box 4 and Box 5 one of the biggest challengers of the bioenergy utilization is the resistance by the engineers, architects and care takers to switch the boilers. As indicated by the respondents, they are not willing to promote them and

they question their efficiency and practicalness regarding the ash handling and loading the fuel. In that sense, promotion of the working examples (show-how) by the MWEN and the BSG helps these actors to understand the technology and facilitate the process of cognitive legitimacy.

Another the indication by Aldrich and Fiol (1994) states that in the case of discomfort and attacks to the cognitive legitimacy of an emerging actor, by an existing actor, third-party organizations might help to strengthen this sector and increase the level of knowledge and understanding via promotion and building respect for it.

At the national level, currently, the REA seems to take the responsibility for this; however, it appears that as an organization itself has not yet gained respect fully in the eyes of everyone. Moreover, in terms of building reputation for bioenergy through raising awareness and spreading knowledge does not seem to take place, especially vis-à-vis the society and other industries. However, as elaborated in the Section 5.5.1, in relative terms the REA seems to have a relatively positive impact on the cognitive legitimacy of bioenergy vis-à-vis the former bioenergy association.

Yet, at the local level, as observed in the snowballing effect from the MWEN cases the small-scale practices seem to help bioenergy to built a reputation and trust in an effective way.

On the other hand, the case of introduction of talloil in the UK might pose an exception to this proposition. As mentioned in the Box 3, when Drax and Ferrybridge wanted to change the waste and duty terms applied to talloil in order to be able to utilize it, they employed their own means and could attain the political legitimacy. Not to mention, these two companies from the fossil fuel industry are powerful enough to rally their sources for this end. At this point, it is important to note that in a newly emerging industry, there might not be any champions with enough resources to pursue a legal fight; and even if they do so, they might be reluctant to take individual action since the results would benefit everyone.

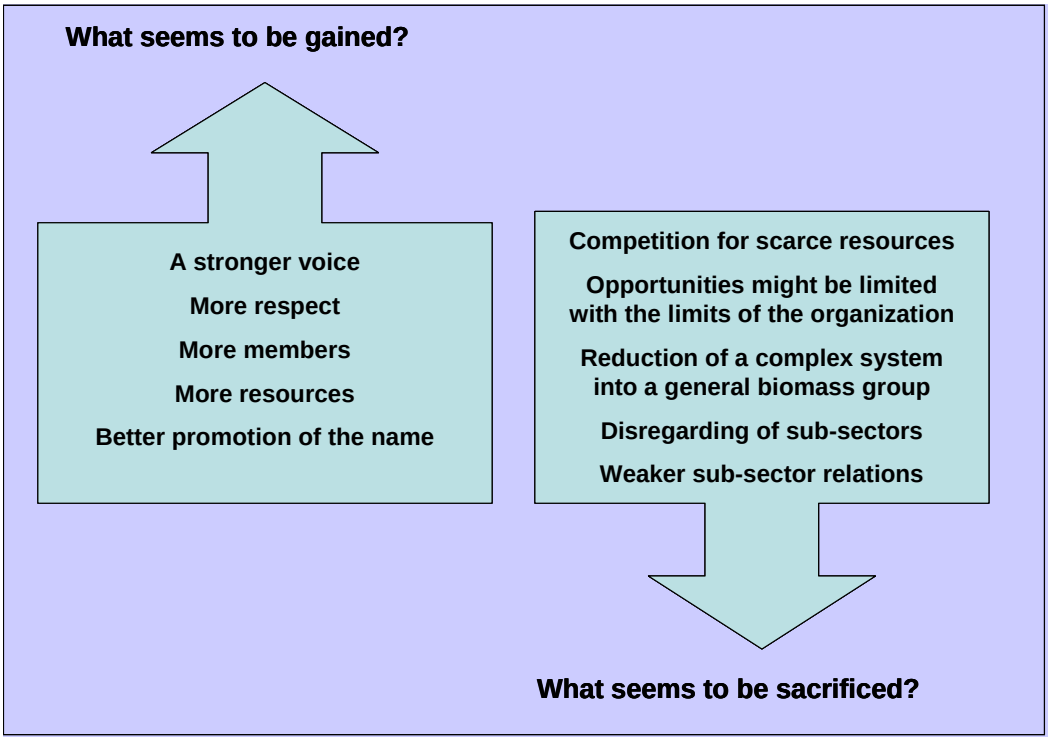
All in all, in the UK, it seems that the process of creating cognitive legitimacy via third-party actors have been more effective at the local level. However, considering the need for bigger scale effects to gain respect and legitimacy, the spread knowledge and understanding to the society and industries appear to be lagging behind, which undermines the cognitive legitimacy of bioenergy in general.

Proposition 6: Industries in which founding firms negotiate and compromise with other industries, will gain socio-political legitimacy more quickly than others.

Aldrich and Fiol (1994) states that the existing industries might strongly oppose to the rise of new venture by questioning the knowledge base of it, and by inducing legal and regulatory barriers. Hence, emerging industry necessitates reliable relations with the existing industry, and might need to do negotiation and compromises during the formation years. Again, under the light of this study, in the UK, much evidence, which shows that bioenergy industry was powerful enough to negotiate with other industries, was not found. For instance; in the example of tension between the pellet producers and the furniture and board industry, the worries by the forest industry has not evolved into a case of negotiation. Yet once more, this does not indicate that cases of negotiation and compromise do not or will not exist, rather the reason why they might not be so obvious is that all in all the policies already favour the existing technologies, but not infant technological systems like bioenergy; and the scale of bioenergy is small.

Rather than negotiations and compromises on a "business basis" with the existing industry, there is a rather obvious compromise that the bioenergy industry makes together with all other renewable energy sectors on a "collective action" basis. As mentioned above, the merger with the REA seems to give these industries a more respected position, especially in respect of the government. In specific for bioenergy, the compromise that the bioenergy group does with the merger is shown in the Figure 16. To be able gain a stronger voice, more respect and resources, it looks like the bioenergy industry encounters the potential risk of being just a small piece of a bigger picture, where the competition for scarce resources (such as money, time, staff) within the same organization would be tough; the opportunities and activities for bioenergy might be limited with the limits of the organization; the complex structure of bioenergy and the all sub-sectors are reduced to a general biomass group.

Figure 16 The compromise made by the bioenergy industry by merging with REA



Overall, it appears that the business-oriented compromises made by the bioenergy industry with the existing industries are not very visible. Rather, the negotiation and compromise is carried out among the all renewables in the UK by uniting under the REA. For bioenergy sector, the compromise made by this action along with the other renewable energy sectors seems to increase its socio-political legitimacy, while sacrificing other benefits of being an independent, dedicated bioenergy organization.

5.6.2 Lessons learned

- The evidence shows in the cases of MWEN and BSG (see, Box 4 and Box 5) that the inclusion of local producers and users in the bioenergy projects increase the pace of both cognitive and socio-political legitimacy, as opposed to the public opposition to commissioning of plants due to the lack of understanding and knowledge (see, 5.3.2.3).

- Similarly, from the same local cases studies, it seems that the inclusion of local producers and users in the bioenergy networks facilitates the pace of trust building process, hence the market formation. However, in that respect, at the national level, it appears that there is the lack of concerted grassroots support (such as NFU) to the collective action (the REA) in general.

- The local cases might also indicate that the transformation from small-scale applications to big- scale applications (incremental versus radical technologies) might perform better in attaining socio-political legitimacy.

- From the case of co-firing with energy crops or talloil (see, Box 3), it seems that the integration with the existing technologies provide both cognitive and socio-political legitimacy to emerging industry more easily.

- Given the diverse nature of bioenergy, spreading knowledge and promotion is the bottom-line to gain socio-political legitimacy in the eyes of the society, government and the industries.

6 Summary of the case analysis and cross-country comparison

What is introduced so far?

√ The current energy situations of two countries and its implications for the development of bioenergy.

√ Where bioenergy stands within the system and its potential.

√ How the history of energy policies fit into the development of bioenergy.

√ An overview of the structure of the innovation system, main actors and central policies to the deployment of bioenergy, and the perception of "bioenergy" at the public level.

√ The way that the actors interact with each other and the manner in which the collective action is formed around bioenergy in two countries, the advantages and disadvantages of these "networking models".

√ And, finally, the impacts of the structure of the collective action on the cognitive and socio-political legitimacy of the "infant" bioenergy industries in two countries.

This chapter will now seek to compare and summarise the networking strategies of the bioenergy system founders in two countries and encapsulate their effects on the issue of cognitive and socio-political legitimacy of the "emerging" bioenergy industries.

This study has found the evidence that there are clear differences at the early levels of legitimacy for bioenergy between the two countries. In Sweden, there has been a higher general support for bioenergy and a degree of collective activity; whereas in the UK, the support seems to be evolving in a slower and disunited way.

One of the factors affecting the pace of deployment of new industries and their legitimacy is the policies. In Sweden, the high oil prices, government subsidies and taxation policy made it so profitable to switch to bioenergy during the early 1980s, whereas the policies in the UK are still fall short of reducing the risks and barriers for new bioenergy technologies, thus hampering the growth of the industry and new comers. Just recently, with the rising oil and gas prices biomass has started to become relatively more cost competitive against the fossil fuels in the UK.

However, as presented throughout the thesis, there are many dynamics, other than the policies, that makes an impact of the legitimacy and the deployment of bioenergy. Under this section, first, the differences in dynamics in two countries will be summarized; and second, the analysis on the differences in networking strategies and their impact on the legitimacy of the bioenergy will be reviewed. And, finally, under the third section, Table 13 will conclude this chapter by presenting a comparative picture of the framework analysis

6.1 Differences in Dynamics in two countries

6.1.1 Dynamics in Sweden

Conclusion: The availability of resources and infrastructure, coupled with the existing knowledge and skills on how to handle biomass and the availability of essential actors that were fuelled with the right policies to further reduce the risks and uncertainties have been the main dynamics in Sweden towards carrying the "infant" bioenergy system to its growth and expansion phase.

The Swedish industry and the society in general are historically familiar to the idea of utilizing wood fuel thanks to the wide forest resource base of the country. This familiarity has had a positive impact on the cognitive (understanding and knowledge) and the socio-political (acceptance) legitimacy at the societal, governmental and the industrial levels regarding utilizing bioenergy.

Traditionally being the prime producers and users of biomass, the successful deployment of this resource at large scale by the industry prepared the grounds for the trust towards the commercial utilization of bioenergy. Moreover, the existence of a strong forest industry, which has always been using biomass as fuel up to a certain degree, also avoided the supply-chain come to an end totally during the times of cheap oil and electricity prices. Thanks to the skills and experience of dealing with large volumes of feedstock, the suppliers of wood, meaning mainly the forest owners, could relatively easily responded the increased demand with the spread of the commercial applications during the 1970s and early 1980s.

Besides, the already-available and wide-spread district heating system had been the locomotive of the commercial bioenergy system in Sweden. This ready infrastructure not only reduced the necessary investment costs, but also provided a secure and large amount of demand for biomass, which facilitated the initial market formation.

During these initial formation years, the policy support by the government mainly in the form of subsidies and Carbon Tax, gave a vital impulse to these actors to mobilize sources towards realizing the potential and the skills. Still, the government believes in and supports bioenergy fully.

6.1.2 Dynamics in the UK

Conclusion: The lack of understanding and familiarity of bioenergy in the society associated with the culturally and technologically predominant fossil fuel system; lack of coherent and "technology-differentiated" political support; ignorance of biomass potential lead up to several fundamental problems regarding reducing the risks and uncertainties necessary for bioenergy sector to develop as a whole in the UK.

Currently, fossil fuels are the predominant sources of heat and electricity in all sectors in the UK. The existence of domestic fossil fuel resources and well established technological and cultural system around it appears to be one of the factors to retard the initiatives to bring about alternative renewable energy technologies to a commercial level. The only commercial renewable energy applications are power from wind and landfill gas.

There is lack of understanding of bioenergy in the society. Different applications of bioenergy seem to complicate the process of learning even more. Furthermore, there seems to be a

dominating misconception of bioenergy mostly linked to waste, which even sometimes leads to opposition. Recently, co-firing of biomass with the fossil fuels, such as coal, is the main form for the utilization of bioenergy (excluding landfill gas).

There are a number of general barriers to the development of bioenergy as indicated by several reports to the government (Biomass Task Force, 2005; Carbon Trust, 2005; FES, 2005) and as found out by this study as well, such as (1) the ignorance of biomass potential; (2) ignorance of bioheat; (3) the fragmented structure of government departments and support schemes dealing with bioenergy; (4) issue of planning permission of the plants; (5) the mistrust of the producers to the market and the issue of secure supply chain (the chicken and egg problem); (6) the chaotic and segmented character of the actors, including the government and the networks; (7) lack of acquaintance and knowledge of the society on bioenergy; (8) technology-blind policies, which benefits the cheapest technologies. These problems undermine the progression of bioenergy, as well its legitimacy and makes the collective action even more necessary.

6.2 Differences in political networking in two countries

6.2.1 Political networking around bioenergy in Sweden and the impact on the legitimacy of bioenergy

Conclusion: This study shows that, in Sweden, the inclusive, joint and organized nature of the collective action, which has been supported and created by the whole value chain, has had positive impacts:

• On the process of initial market formation; by facilitating the process of trust building, hence by reducing the risks and transaction costs.

• On the process of cognitive and socio-political legitimacy for bioenergy; by creating and spreading the knowledge and understanding on bioenergy systematically to the all levels of the society; by giving it a widespread but organized structure; hence, by being able to influence the institutions.

Bioenergy emerging as a new industry sector would not be an exception to the highly organized and consensus-based nature of the Swedish society. In 1980, the Swedish Bioenergy Association, Svebio, was established with the joint support of the strong organizations, which helped both the Association and the bioenergy sector gain legitimacy more easily.

Since the beginning, the principle of Svebio has been to include and represent the whole bioenergy value chain (see, Figure 10). The creation of such a forum for the actors to get to know each other, build trust, and share information and experience, increased the connectivity among them and contributed to the reduction of risks, hence to the reduction of transaction costs. The first board of Svebio was composed of representatives from (1) local authorities, (2) fuels production, (3) transportation, (4) enterprises, (5) Forest Owner's Association (the Federation of Swedish Farmers), (6) big consumers of heat (district heating companies), (7) equipment manufacturing (stoves), (8) chipping industry, (9) academia, and (10) consultants. This all-encompassing structure of the board is generally maintained up to now. In addition to these organizations, one of the biggest housing companies, Riksbyggen, also rallied its resources, engineers and architects to switch the boilers to wood-fired ones, where the DHS was not available. The inclusion of the publicly known and respected faces to the collective

action accelerated the trust-building and its socio-political legitimacy in the eyes of the other stakeholders.

One of the most important assets during the initial market formation years of bioenergy and Svebio has been the existence of the leading sectoral organizations and the high connectivity among the intra-industry firms. The form of collective action rallied around by intra-sectoral organizations to guide the institutional environment and to collaborate, had several positive impacts on the legitimacy of the new innovation system. (1) These organizations acted as agents of general and the sector-specific information flow to and from their members. (2) They also contributed in the new industry as the producers of information, collecting and assembling sectoral data and statistics, thus, increasing the knowledge base of the collective action. (3) These intra-industry organizations also assisted the creation of common, codified language among the firms, which eased both the external and internal communication. (4) They also brought in the grassroots links with their own outreach to forest owners, farmers, architects, engineers…etc. (5) They helped Svebio promoting bioenergy through their own activities to their customers and members, thus making it known further.

Today, Svebio seems to be an association that gained respect, trust and legitimacy in the eyes of all stakeholders. It has always been mentioned as an important and strong actor during my interviews without any exceptions regarding its success in making the stakeholders meet and influencing the institutional environment.

6.2.2 Political networking around bioenergy in the UK and the impact on the legitimacy of bioenergy

Conclusion: All in all, in the UK, this study elucidates that the structure of bioenergy networking in the UK, which is either of a too broad character at the national level to grasp the complexity and problems of the bioenergy system, or, of a too narrow character at the local level to multiply the beneficial impacts, does not effectively facilitate neither increasing the cognitive and socio-political legitimacy of bioenergy nor the market formation in a broad manner.

The network formation around the renewables in the UK is still under the process of being established and it is formed very differently than the Swedish one.

The connectivity among the bioenergy related actors appears to be low in the UK. Most of my interviewees indicated that the actors and networks were unorganized, disunited and do not communicate well. Currently, there seems to be no organizations, which has gained full respect, trust and legitimacy in the eyes of everyone at the local and the national levels, as it is the case in Sweden.

After the merger with the British Biogen (the former bioenergy trade association in the UK), the Renewables Energy Association (REA) has become the organization at the national level, which seeks to be the spokesman for bioenergy. Hence, it constitutes the centre of the British bioenergy networking formation in comparison with the Swedish case, Svebio.

REA is a broad organization aiming to represent and lobby for all the renewable energy sources (RES) (see, Figure 14). It has merged with the (formerly existing) renewable trade associations other than the British Biogen such as PV UK, Solar Power Trade Association, Biogas Association, and lastly it is likely that it will merge with the strong lobby organization British Wind Energy Association as well. It manages all the renewables through what is called

"Resource Groups". There are seven Resource Groups at present; Primary Biomass Group (biomass excluding waste), Bioenergy Group (for biogas and thermal waste applications), Solar Group, Ocean Energy Group, Renewable Transport Fuels Group, Renewable Power Markets Group and Generator Group. Mostly, the chairman of a group is also a member of the REA board as well.

It has nine personnel dealing with different RES. And, the board is composed of 15 people; the representatives from companies working in different source area, in addition to an academic, two persons from a law firm and consultancy.

It appears that there might be some problems with the REA- type of networking:

- The physical and capital (staff, time, money, space…etc.) limits of REA might be a limiting factor for the development of activities and tasks related to all renewables. By mergers REA shoulders the responsibility of all activities that are supposed to be carried out by these trade associations with dedicated personnel for them. It looks like the responsibility of promotion, communication, education and lobbying for each and every renewable energy source might be a big task for the current REA staff.

- This very broad scope coupled with limitations might result in an organization, which tries to do everything but cannot do it all effectively.

- Besides, the current structuring of the Resource Groups seems to give them a very general character. At this point, in specific for bioenergy, which has many different items and has a more complicated system than the other RES, this general scope might give the bioenergy collective action a "reductionist" nature. It might lead to the disregard or the missing of different bioenergy sub-groups such as pellets, woodchips, energy crops…etc., which have different characters and problems.

- Moreover, by mergers into one organization, these industries might face the risk of breaking or weakening of the intra-industry relations, which are important (1) to increase the source and knowledge base of the collective action, (2) to carry general and sector- specific information to and from the industry, (3) to collect and create sector-specific data and statistics, (4) to assist the REA as agents of promotion of bioenergy through their activities to their members and customers, (5) thus, to increase public awareness and the legitimacy of the emerging industry.

- At a more micro-level, the RES technologies, which are already commercial and have relatively stronger proponents, might be influential in decisions or the allocation of the finance.

However, it also seems that there might be some advantages of the REA-type of networking:

- Merging with the REA seems to give these groups a better stand and more respect vis-à-vis the government by having a sole spokesman with a large member base and this might provide a stronger lobbying to the government.

- The financial resources of the collective action increases (but, at the same time, the beneficiaries increase as well).

Besides this nation-wide lobbying network, at the local level, there are also networks towards promoting and realizing small-scale bioenergy applications, which have narrow activity area such as a county. In general, these networks are formed around small-scale district heating or heat-only projects with the contribution of regional authorities, local users and suppliers and local business like the Marches Wood Energy Network (please see, Box 4).

The links between local networks and national networks are very weak and the information flow is very low and seems to be crippled (see, Figure 15). On top of all, there is unwillingness to cooperate from both sides; in fact, these networks perceive each other as competitors for scarce resources such as attention, respect and finance. (Please see, Section 5.5.3 on The relationship between the national and local networks)

Moreover, unlike in Sweden, the UK lacks strong intra-sectoral organizations that would support the collective action, spread information to and from its members and would enrich the knowledge base of the collective action. Currently, the Forestry Contracting Association and Confederation of Forest Product Industries are members of REA, but they are not considered to be strong organizations. Only, NFU seems to be relatively strong organization, but it lobbies for bioenergy individually, besides its core areas of activity.

6.3 Cross-country comparison of countries according to the analysis propositions

With the information provided on the structure of the bioenergy networks in both countries, it is time to see the impact of these formations on the pace of the cognitive and socio-political legitimacy of the emerging bioenergy sector on a comparative basis in Table 13.

Table 13 Cross-country comparison of countries according to the analysis propositions

Propositions	Sweden	United Kingdom
Proposition 3: Industries in which the founders encourage convergence around a dominant product/service design will gain cognitive legitimacy more quickly than others.	- The existence of district heating system as a dominant service design seems to have eased process of learning. - Informal and formal standards contribute to the trust towards the product and the technology and ease the process of learning.	- The variety of bioenergy applications seems to confuse public on what bioenergy is.
Proposition 4: Industries in which founders mobilize to take collective action efforts will gain socio-political legitimacy more quickly than others.	Character of the collective action is also vital to gain socio-political legitimacy: - Organized and concerted support from the whole value chain. - The existence and support of leading intra-industry organizations was an asset. - Widespread outreach of the action also facilitated the promotion of bioenergy to the society, government and other industries, as well as the spread of knowledge and information. - The collective action was embodied into Svebio as a political network organization dedicated to bioenergy. * This nature of collective action seems to	Character of the collective action is also vital to gain socio-political legitimacy: - The structure of interaction among the actors appears to have had both a fragmented and individualistic character. - There seems to be competition among the actors for scarce resources such as capital grants, respect and attention from actors like the government and the public. - The knowledge and experience flow among the stakeholders is low. - Bioenergy political networking is integrated into Renewable Energy

	ease the process of gaining socio-political legitimacy for the newly emerging bioenergy system.	Association (REA) with all other renewable energy sectors. - The connection between the nation-wide networks and local network seem to be very low. * This nature of collective action seems to slow down the process of gaining socio-political legitimacy for the newly emerging bioenergy system.
Proposition 5: Industries in which founding firms promote their activity through third-party actors will gain cognitive legitimacy more quickly than others.	The Swedish case seem to verify this proposition: - The existence of strong sectoral organizations and a political network seems to have helped bioenergy to overcome the negative rumours about commercial bioenergy use through information dissemination and promotion to the society, government and other industries.	The UK case, while verifying it, also shows that there might be exceptions to this proposition: - REA seems to provide bioenergy sector relatively better image and relatively more strength in terms of lobbying to the government. - The case of introduction of talloil in the UK shows that an industry champion might also rally their own resources to gain cognitive legitimacy and obtain it.
Proposition 6: Industries in which founding firms negotiate and compromise with other industries will gain socio-political legitimacy more quickly than others.	The Swedish case shows that there might be exceptions to this proposition: - The example of the bankrupt Mora Pellet Plant, in spite of a negotiation and compromise made with the forest industry, shows that negotiation might not always lead to a better gain. - Or, the dispute between bioenergy industry and the pulp and paper industry on raw material was "settled" when the pulp and paper industry has started to gain economic benefit from the bioenergy business	The UK case, while verifying it, also shows that there might be exceptions to this proposition: - The merging under one organization as a compromise for becoming stronger made by all the renewable energy industries seem to provide them a better image and a higher voice all together. - However, the employment of co-firing with the introduction of the Renewables Obligation System to generate extra earnings from selling the green electricity shows, negotiation and compromise might not be always a prerequisite to establish good relations with existing industry.
	Both cases show that: - When there are economic benefits from the emerging industry for the existing industry, the process of gaining socio-political legitimacy might be easier. - Bonding onto existing infrastructure and technological system provide quicker legitimacy to the new technological system.	

7 General conclusions and networking propositions for the actors of emerging bioenergy industries

7.1 General Conclusions

This work manifests that there is a substantial link between "the pace of legitimacy obtaining of a new industry" and "the structure of collective action" which seeks to increase the level of understanding and acceptance for an infant bioenergy industry.

One of the two purposes that guided this study was to understand how the strategy of prime movers' and the manner in which they interact affect the pace of legitimacy of the "newly emerging" bioenergy system. As it has been stressed out in this work, the concept of legitimacy for an infant industry provides a comprehensive framework to compare and analyse the emergence of bioenergy industries in the UK and Sweden beyond the policy frameworks.

In order to cast light upon the phenomena of legitimacy and industry emergence, the main research question and complementary questions discussed below were posed.

Research Question 1: How have the founders of the bioenergy system acted so as to form a market and create legitimacy (knowledge, understanding and acceptance) for the new industry in the two countries?

Sweden

1. During the initial market formation years, the system founders' interaction in Sweden had a distinctly collaborative character. There was an organized and concerted support from the whole value chain towards the establishment of a market and an overarching lobby organization.

2. The presence and support of leading organizations in the collective action, and known faces to society such as local authorities accelerated the process of gaining respect, credibility and a more "taken for granted" status for the industry's offerings.

3. These organized actors with a widespread outreach also facilitated the promotion of bioenergy to the society, government and other industries, as well as the spread of knowledge and information.

4. This joint collective action was embodied into Svebio as a lobbying and forum organization dedicated to bioenergy.

The UK

1. The structure of interaction among the actors in the UK appears to have had both a fragmented and individualistic character. There are a number of networks (i.e.; the RD&D networks between government, industry and universities, National Framers Union, farmer cooperatives for energy crops, or local networks around small-scale bioheat projects), but the interaction among these is minimal, and insufficient to lead to a level of "taken for grantedness".

2. Indeed, there is notable competition among the actors, including companies, universities and networks, for scarce resources such as capital grants, respect and attention from actors like the government and the public.

3. The knowledge and experience flow among the networks, universities and companies is limited, and might be one way and poorly coordinated. The information flow to the society is not adequate to create a knowledge and understanding; and to clarify the confusion about what bioenergy is.

4. Bioenergy political networking is integrated into Renewable Energy Association (REA) with all other renewable energy sectors. Also, in terms of bioenergy, the connection between the nation-wide networks and local network seem to be very low.

Sub- question 1. How do the founders of the bioenergy system interact among each other, with other industries and the decision-makers?

Sweden

1. **Connectivity:** The connectivity of the actors within/between the related-sectors (district heating companies, municipalities) and the bioenergy as a sector in general (such as the feedstock suppliers, logistics and equipment manufacturers) has been high. This feature of the actors appears to have provided a rich resource base to the collective action and facilitated spreading the information and experience.

2. **Collective action/collaboration:** Thanks to the high connectivity, the founders of the bioenergy system in Sweden, they could successively mobilized collective action covering the whole bioenergy value chain. The interaction among the forest owners, farmers, district heating companies, municipalities, equipment manufacturers, housing companies, as well as logistics providers, woodchippers, academics and consultants was embodied into Svebio to represent and coordinate the collaboration.

   The broad and organized support and high degree of collaboration has clearly helped the organization to gain trust and credibility in the eyes of the society, government and other industries.

3. **Meeting place/Information hub:** Svebio, which currently has around 400 members, provided a meeting platform for the whole bioenergy value-chain from local level to national level. This meeting place has become the platform, where the actors have met, get to know each other and built trust. The process of building trust seems to have helped the market actors to reduce risks and uncertainties; hence the transaction costs as well. The high connectivity among the actors and the presence of strong, established organizations provided the meeting place to be an effective information and knowledge exchange platform as well.

4. **Central focus actor and resource provider:** The Swedish Energy Agency (STEM) is responsible from all energy issues, hence bioenergy as well. All the bioenergy grants, subsidies and funding to the regional or national projects are given by the STEM. The existence of a central entity makes the functioning of the system more smooth and the flow of information to and from the government easier. The central character of the resource provider also makes the information easier to find, access, understand and process that information.

The UK

1. **Connectivity:** The connectivity among the bioenergy actors in the UK appears to be low. The level of coordination and organization within the related sub-sectors (i.e.; forest owners, energy crop growers, R&D centres) seem to be limited as well. It seems that the actors operate more individually, and networks more independently from each other. This nature of the actors and networks also reflects on the nature and resource base of the collective action as well.

2. **Collective action/collaboration:** In the UK, it seems that due to the lack of leading intra-industry organizations, the collective action has more an individualistic character. This feature of the collective action looks like constricting its outreach and the dissemination of knowledge. Moreover, under the light of this study, there seems to be a distinction between collaboration around bioenergy at the national and local level. At the national level, all the renewable energy trade associations have been merging under one broad organization, the Renewables Energy Association. At the local level, the collaboration has a narrow geography and mostly is composed a group of local feedstock suppliers and users, local authorities and local business. The collaboration among these initiatives is minimal and they seem to be competing for resources rather than collaborating. This weak connection between the local and national networks seems to be one of the retarding factors for the market formation slowing down the meeting process of the local producers and big users.

3. **Meeting place/information hub:** The REA, which has 150 members in the Biomass Group, constitutes the biggest meeting place for the bioenergy actors in the UK. However, the "too broad" character of the collective action might hinder enriching the knowledge base of bioenergy by simply reducing it to a large "biomass group" and by missing its intricacy. Furthermore, the information sharing among the national and local networks seem to be very low as well. It also that even among the members of the same collective action, the flow and sharing of information is not working well. In terms of information and experience sharing and spreading the knowledge, the local networks seem to be working effectively.

4. **Central focus actor and resource provider:** The information flow to and from the government is also highly segregated. The main responsible government departments from bioenergy are the Department of Trade and Industry (DTI) and the Department of Environment, Food and Agriculture (DEFRA). However, there are other also government bodies that coordinate grants and support schemes like Carbon Trust (company founded by the Government) and the Forestry Commission. This division of responsibilities make the process of communication and getting, understanding and handling information more confusing and harder.

Sub- question 2. What is the structure of networking around bioenergy for promoting and lobbying?

Sweden

1. Svebio has been the central lobby and forum organization only for bioenergy.

2. Especially, during the emergence years, it appears that the support of the strong intra-industry organizations in promoting and lobbying for bioenergy, have facilitated the

creation of knowledge and understanding related to it, as well as the acceptance in the eyes of the society, government and the other industries.

3. Moreover, the support of the grassroots organizations like the Forest Owners Association into the networking seems to facilitate bridging the local actors and national actors.

4. The board has been composed of the representatives from each component of the bioenergy supply chain; producers of biofuels to users. During the establishment years, the board consisted of representatives from local authorities, fuel production, feedstock suppliers, logistics, equipment manufacturers, big users of energy, chipping industry, consultants and academia

The UK

1. REA seeks to be sole speaker for the whole renewable energy sources, including the bioenergy sector. Thus, the networking for renewables in the UK has a very broad character and bioenergy is just one part of it.

2. The REA is still at the process of being established. It was established with support of 44 companies. Then, it merged with the British Biogen (former association for bioenergy), PV UK (former association for solar energy), Solar Trade Association and British Biogas Association. It is also likely to merge with the British Wind Energy Association.

3. It manages all the renewable energy sources by separating them into "Resource Groups". They are Primary Biomass Group, Bioenergy Group (for biogas and thermal waste applications), Solar Group, Ocean Energy Group, Renewable Transport Fuels Group, Renewable Power Markets Group and Generator Group. Currently, the Primary Biomass Group has 150 members.

4. The REA board is composed of companies in the fields of energy from wind, gas, biomass, solar and wave, plus a law firm and an academic.

5. Besides, the REA, there are also small-scale networks at the local level, which lobby for and promote bioenergy at the county level. However, the weak link between the national and the local networks coupled with the effective networking made it necessary to cover these networks as well.

6. These local networks consist of mainly the local supply-chain such as the local feedstock suppliers and local users (public buildings), local authorities and local business.

Sub- question 3. How effective are they?

Sweden

1. Svebio is considered as an effective forum since the market formation years. It facilitated the market formation during the early years by creating a platform for trust building eased the process of demand meeting with the supply.

2. In terms of lobbying effectiveness, Svebio seems to have been more effective during the initial years. Yet, it also seems that the political support for bioenergy by the Swedish government might contribute to lobbying effectiveness of Svebio.

3. Nevertheless, today, it stands as an organization which has gained respect, trust and legitimacy in the eyes of industry and the government as a political network for bioenergy. It is considered to be one of the most important actors in the development of bioenergy in Sweden.

The UK

1. It seems that the REA needs more time to be evaluated to see the real advantages and disadvantages of this type of networking, plus, it is more likely that it would go under changes by the merger with the British Wind Energy Association. Yet, it does not seem to be able to achieve the same level of legitimacy compared to the initial years of Svebio.

2. It seems that the REA is relatively better contributing to the creation of a meeting platform for bioenergy compared to the former bioenergy trade association. However, it still it looks like lacking some important actors in an organized manner such as the local players and grassroots organizations like the NFU. This feature of the collective action slows down the trust building among the supply and demand.

3. Under the light of the findings, in specific for bioenergy in the eyes of all the stakeholders the REA seems to have not gained trust and legitimacy in terms lobbying.

7.2 Propositions for the emerging bioenergy networking and market formation

The second purpose of this thesis is to see if it is possible to provide some lessons and good examples of networking strategies for a "prenatal or infant" bioenergy market like the United Kingdom from a more "mature" bioenergy market like Sweden in order to facilitate the process of being able to overcome the embedded risks and uncertainties.

Aldrich and Fiol (1994) provided an analytical framework, which enabled us to analyse the impacts of interaction strategies of bioenergy prime-movers on the cognitive and socio-political legitimacy of bioenergy in the UK and Sweden. Under this section, whether or not these propositions were valid for our case studies; and whether or not they could be recommended will be summed up. In addition to these general recommendations, some other recommendations revealed from the findings of this study will also be stated. Some of these additional suggestions are supplementary to Aldrich and Fiol's four propositions, thus will be indicated under each relevant proposition named as "supplementary propositions"; and some are "additional propositions" indicating there might be other dynamics to be analysed further on the issue of legitimacy for a new industry.

Research Question 2: What could be the ways for the founders/prime movers of a newly emerging bioenergy industry to ease the process of overcoming the embedded risks and uncertainties?

This thesis has shown that in general the manner, in which the bioenergy networking for lobbying and meeting platform, was established in Sweden can serve as a good example in terms of increasing the cognitive and socio-political legitimacy for a newly emerging bioenergy industry. As such, in the context of the Swedish example, some recommendations are presented below that might be helpful for not only for the UK case, but also for the countries, where bioenergy starts to sprout as a new business.

Furthermore, some UK-specific recommendations are also provided, which might constitute possible pathways to counter the potential weaknesses of the poorly coordinated structure of the collective action.

7.2.1 Propositions for the founders of an emerging industry on the networking for lobbying and forum creation:

In order to prompt the propositions that are used for analysing the case studies and to integrate the "supplementary" and the "additional" propositions derived form the findings into the picture; Table 14 is prepared as a guide to the next section on propositions.

Table 14 Guiding table to the propositions and the framework analysis

	Cognitive legitimacy	Socio- political legitimacy
Intra-industry strategies	**Proposition 3:** Industries in which the founders encourage convergence around a dominant product/ service design will gain cognitive legitimacy more quickly than others. **Supplementary proposition 3.1:** If there is diversity of product or service design for the new innovation system, public awareness and promotion seems to be important to gain grounds for cognitive legitimacy. **Additional proposition 1:** The incremental deployment of a new technological system, rather than radical, helps the new technological system gain cognitive legitimacy more easily.	**Proposition 4:** Industries in which founders mobilize to take collective action will gain socio-political legitimacy more quickly than others. **Supplementary proposition 4.1:** Including the whole value chain in the collective action is important if legitimacy for the emerging industry is to be achieved effectively. **Supplementary proposition 4.2:** Obtaining the support of strong intra-industry organizations, including the grassroots organizations in the collective action accelerates the cognitive legitimacy of the emerging industry. **Additional proposition 2:** Stipulation of the local (economic) benefits allows the new innovation system to gain socio-political legitimacy more easily.
Inter-industry strategies	**Proposition 5:** Industries in which founding firms promote their activity through third-party actors will gain cognitive legitimacy more quickly than others.	**Proposition 6:** Industries in which founding firms negotiate and compromise with other industries will gain socio-political legitimacy more quickly than others. **Supplementary proposition 6.1:** Bonding onto existing infrastructure and technological system provide quicker legitimacy to the new technological system.

7.2.1.1 On the framework propositions

1. **On the Proposition 3:** Industries in which the founders encourage convergence around a dominant product/ service design will gain cognitive legitimacy more quickly than others.

The examples of district heating system and standardization of fuel measurement in Sweden versus the variety of bioenergy applications in the UK show that industries in which the founders encourage convergence around a dominant product/service design will gain cognitive legitimacy more quickly than others.

- **Supplementary proposition 1.1.** As it is observed in the UK case, if there is diversity of product or service design for the new innovation system, public awareness and promotion seems to be important to gain grounds for cognitive legitimacy.

2. On the proposition 4: Industries in which founders mobilize to take collective action will gain socio-political legitimacy more quickly than others.

The different structures and the characters of the collective action from both countries prove that the manner in which the collective action is formed have a great value on its effectiveness for providing socio-political legitimacy of the new industry; and not only the existence of the collective action solely as suggested in the proposition. Below are some propositions on the formation of the collective action from the case study findings:

- **Supplementary proposition 2.1**: Obtaining the support of strong intra-industry organizations in the collective action eases the information flow and mobilization of actors, and hence accelerates the legitimacy of the emerging industry.

- **Supplementary proposition 2.2:** Including the grassroots actors or organizations such as forest owners and farmers in the collective action facilitates the trust-building between the supply and the demand, reduces the risks and transaction costs, and hence accelerates the legitimacy of the emerging industry.

3. On the Proposition 5: Industries in which founding firms promote their activity through third-party actors will gain cognitive legitimacy more quickly than others.

In general, the findings from the two countries verify that the existence of a third party actor might facilitate the process of gaining the cognitive legitimacy through defending the emerging industry against the rumours from the existing industries; nursing the weaker industry organizations and building "external" respect for it. However, as it is seen in the case of introduction of talloil in the UK, industry champions might also rally their own resources to gain cognitive legitimacy and obtain it.

4. On the Proposition 6: Industries in which founding firms negotiate and compromise with other industries will gain socio-political legitimacy more quickly than others.

This study showed that there might be exceptions to this proposition; hence two supplementary propositions are suggested to address these situations:

- **Supplementary proposition 4.1**: When there are economic benefits from the emerging industry for the existing industry, the process of gaining socio-political legitimacy might be easier.

- **Supplementary proposition 4.2:** Bonding onto existing infrastructure and technological system provide quicker legitimacy to the new technological system.

7.2.1.2 Additional propositions

1. Stipulation of the local (economic) benefits seems to allow the new innovation system to gain legitimacy more easily. They also raise better public awareness and as such, the system is less likely to face opposition:

In the UK case, the projects, which also benefit local business such as forest owners, farmers and sawmills seem to face less opposition as it is seen in the cases of Warwickshire Biomass Support Group.

2. The incremental deployment of a new technological system, rather than radical, helps the new technological system gain both cognitive and socio-political legitimacy:

As, stated by some of the respondents in the UK, the introduction of big-scale and high-technology biopower applications are more likely to face opposition from the public. However, as it is shown in the Marches Wood Network Energy case, it appears that the small-scale and local needs-oriented bioheat projects are more likely to gain support.

7.2.1.3 Specific propositions to the bioenergy networking in the UK

1. In order to avoid further fragmentation and competition with the local networks, it appears that there would be a value in attempting to appeal to, and include them in the nation-wide networks.

2. The information flow between the national and local networks should be improved by further interaction, as well as the information flow among the members of the networks.

3. The increased intensivity of interaction with the National Farmers Union might assist the REA in, i.e; promoting bioenergy, outreaching the network of local producers more easily.

4. It might be necessary for the REA to strengthen the structure of the Resource Groups in order to increase their effectiveness as meeting forums and information creation places for the sectors.

5. In order to be able to grasp the whole complexity of bioenergy, it might be necessary for the REA to increase the number of dedicated staff under each resource category.

6. From the Swedish case, it seems that it is important to preserve the sub-sector links. Hence, some effort might be required by the REA, may be in the form of cross-sector working groups, to be able to make these sub-sectors come together and share knowledge and experience.

7.3 A concluding remark on the relationship between the cognitive and socio-political legitimacy

The prior creation of an environment for cognitive legitimacy seems to facilitate the process of obtaining socio-political legitimacy for a newly emerging industry.

The findings of this study indicate that there might be a "conditional relationship" between the cognitive and socio-political legitimacy. The making of a "society" (or, all stakeholders), which knows and understands the new technology seems to be a catalyzer to ease process of

comprehending, trusting, accepting and using it. It appears that socio-technical barriers could be overcome more easily by spreading the knowledge, sharing information and experiences, showing good practices ("show-how") and building trust, which would lead to gaining socio-political legitimacy more easily.

7.4 Final remark

This thesis has shown that the manner in which the political networks are established and function has a major impact on their effectiveness in supporting a new industry through serving the network functions of creation of an environment for cognitive and socio-political legitimacy.

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Abbreviations

BWEA- British Wind Energy Association

DHS- District heating system

EA- Environmental Agency

EC- European Commission

EIA- Energy Information Administration

EP- European Parliament

ERA- European Research Area

IEA- International Energy Agency

Mtoe- million tonnes of oil equivalent

NFFO- Non-fossil Fuels Obligation

NFU- National Farmers' Union

OECD- Organization for Economic Cooperation and Development

OFGEM- Office of Gas and Electricity Markets

PIR- Swedish Association of Pellet Burners

RCEP- Royal Commission for Environmental Pollution

REA- Renewable Energy Association

RES- Renewable energy source

RO- Renewable Obligation

ROC(s)- Renewable Obligation Certificate(s)

RPA- Reneawable Power Association

SCR- Short Rotation Crops

STEM- Swesdish Energy Agency

TPES- Total Primary Energy Supply

TRADA- Timber Research and Development Association

UN- United Nations

UNDP- United Nations Development Programme

Appendix 1: Summary of the interviews- Sweden

Questions	General answers and comments
What is your personal motivation for engaging in bioenergy?	- Interest from the high education years - Interest stemmed from energy projects - Awareness about the need to transform the energy system after the Oil Crises - Contribution to reduce the greenhouse gases; climate change issue
What was the motivation to start utilizing and/or supplying biomass?	- The Oil Crises and high oil prices in the 1980s, plus, government subsidies to switch boilers - During 1990s, the CO_2 tax combined with the subsidies * Generally, also the benefits of utilizing bioenergy are mentioned too, such as contributing to the CO_2 reduction.
What is the major factor in Sweden's success regarding being able integrate bioenergy into its modern energy system? What are the milestones?	The Oil Crises and the CO_2 tax
Who are the important actors that made an important impact on the development of bioenergy in Sweden?	- The government to introduce the CO_2 tax and support bioenergy - Svebio to create a meeting platform for all the actors in the value chain and carrying out good lobbying
What is the level of connectivity among the actors? What is the attitude towards information and experience sharing and collaboration?	-High connectivity and good information flow among the actors - Open attitude to work together and share information * Almost all interviewees mentioned Svebio, as the major contributor to the high connectivity and information flow. * Most of the interviewees emphasized that "getting organized and work together" is embedded in the Swedish culture
Which networks are important in the field of bioenergy in Sweden?	* Without thinking, all my interviewees named Svebio as an important and effective network. * The Federation of Swedish Farmers, Association of Forest Owners and the District Heating Association are mostly mentioned as important networks during the establishment years of bioenergy. * 2 interviewees also mentioned other networks such as Elforsk and Värmeforsk.
What is the role of these networks?	- To make the actors meet and get to know each other - To exchange experience and knowledge - To lobby to the government and affect the institutional environment
Are there any obvious shifts since the 1980s (shift in roles, policies, technologies…etc.)?	- The government support for bioenergy is even more - The forest industries also started to employ and support bioenergy with the introduction of the Green Certificate System and the EU ETS.
How *taken for granted* is bioenergy in Sweden?	- The public generally knows and understands what

	bioenergy is and supports it.

Appendix 2: Summary of the interviews – the United Kingdom

Questions	General answers and comments
What is your personal motivation for engaging in bioenergy?	In general, through educational or business links
What was the motivation to start utilizing and/ or supplying biomass?	- National and regional targets of CO_2 reduction and renewable electricity set by the government - The capital grants and support schemes by the government
What are the barriers to the development of bioenergy in the UK?	- Lack of knowledge and understanding about what bioenergy is at the public level, governmental and industrial levels. - Short- term government policies; uncertainty about the continuation of the present regulations and measures, and uncertainty about the upcoming regulations. - The highly fragmented structure the responsibilities and grants at the governmental level - This point also makes the process of accessing, handling and using the data from the government even more confusing and harder, as well as communicating the information to the government. - So many independent, unorganized and disjoint organizations or groups working in the field of bioenergy. - Low connectivity among the actors - Limited and low flow of information among the actors - The lack of trust to the bioenergy projects; bad examples from the past
Who are the important actors in the field of bioenergy in the UK?	- Department of Trade and Industry (DTI) and Department of Environment, Food and Rural Affairs (DEFRA)
What is the level of connectivity among the actors? What is the attitude towards information and experience sharing and collaboration?	- (Very) low level of connectivity among the actors - Unwillingness to collabotare * Most of the interviewees emphasized the opportunistic and competition- driven nature of the relations among the actors such as the business, industry, universities and research centers.
Are there any effective (lobbying) networks around bioenergy in the UK?	* All my interviewees had to think for a while to answer this question. * Most, if not all, could not name any networks. * The Renewable Energy Association the National Farmers Union were mentioned few times.
Are there any obvious (shift in roles, policies, technologies…etc.)?	- Bioenergy has stared to be seen as an option by the farmers to generate income.
How *taken for granted* is bioenergy in the UK?	- There is lack of knowledge and understanding of bioenergy in general and low level of acceptance at the societal level.

Appendix 3: Remarks from the interviews

1. I found interviewing a very effective means to get deeper insight on policies, the stories of firms and networks as they very well reflect the political atmosphere at their times, most of which is not easy to find in the literature. Especially, the British case was very pleasant and exciting to discover for me, but hard to read and understand from the literature as a pure outsider to the system as well.

2. Given the different levels of maturity and problems, I found it challenging to address all of the pre-defined questions. For example, for the UK interviews, the questions related to my analytical framework sometimes remained unasked since the innovation system is very complicated, full of problems and barriers and there are lots of policy changes, reviews, consultations going on and each person telling different parts of the stories.

3. Another remark from my interviews is that, in the UK case, it was easier to spot the biomass plants; and companies or utilities that are active in bioenergy business. Most of my interviewees were naming the same companies, same plants and persons. However, for the Swedish case, a company (except TallOil AB) or a plant were not mentioned repeatedly. This might be due to the fact that bioenergy is commercial in Sweden and it is everywhere. And, in the UK, the implementation is few and easy to keep track of on project basis. In Sweden, the emphasis was on the lobby organization, Svebio, whereas in the UK, the emphasis was on the business actors most of the time.

Appendix 4: Propositions on increasing the social and cognitive legitimacy of a new industry, Aldrich and Fiol (1994)

Table 15 All propositions on the legitimacy of a new venture by Aldrich and Fiol (1994)

	Type of Legitimacy	
Level of analysis	Cognitive	Socio- political
Organizational Strategies	Proposition 1: Founders who utilize encompassing symbolic language and behaviours will gain cognitive legitimacy more quickly than others.	Proposition 2: Founders who communicate internally consitent stories regarding their activity will gain socio-political approval more quickly than others.
Intra-industry Strategies	Proposition 3: Industries in which founders encourage convergence around a dominant product/services design will gain cognitive legitimacy more quickly than others.	Proposition 4: Industries in which founders mobilize to take collective action will gain socio-political approval more quickly than others.
Inter-industry Strategies	Proposition 5: Industries in which founding firms promote their activity through third-party actors will gain cognitive legitimacy more quickly than others.	Proposition 6: Industries in which founding firms negotiate and compromise with other industries will gain socio-political approval more quickly than others.
Institutional Strategies	Proposition 7: Industries that create linkages with established educational curricula will gain cognitive legitimacy more quickly than others.	Proposition 8: Industries that organize collective marketing and lobbying efforts will gain socio-political approval more quickly than others.

Appendix 5: European Union Technical Specifications on Solid Biofuels

Table 16 EU Technical Specifications on solid biofuels

Standard reference	Title	Standard reference	Title
CEN/TS 14588:2003	Solid biofuels - Terminology, definitions and descriptions	CEN/TS 15105:2005	Solid biofuels - Methods for determination of the water soluble content of chloride, sodium and potassium
CEN/TS 14774-1:2004	Solid biofuels - Methods for determination of moisture content - Oven dry method - Part 1: Total moisture - Reference method	CEN/TS 15148:2005	Solid biofuels - Method for the determination of the content of volatile matter
CEN/TS 14774-2:2004	Solid biofuels - Methods for the determination of moisture content - Oven dry method - Part 2: Total moisture - Simplified method	CEN/TS 15149-1:2006	Solid biofuels - Methods for the determination of particle size distribution - Part 1: Oscillating screen method using sieve apertures of 3.15 mm and above
CEN/TS 14774-3:2004	Solid biofuels - Methods for the determination of moisture content - Oven dry method - Part 3: Moisture in general analysis sample	CEN/TS 15149-2:2006	Solid biofuels - Methods for the determination of particle size distribution - Part 2: Vibrating screen method using sieve apertures of 3,15 mm and below
CEN/TS 14775:2004	Solid biofuels - Method for the determination of ash content	CEN/TS 15149-3:2006	Solid biofuels - Methods for the determination of particle size distribution - Part 3: Rotary screen method
CEN/TS 14778-1:2005	Solid biofuels - Sampling - Part 1: Methods for sampling	CEN/TS 15150:2005	Solid biofuels - Methods for the determination of particle density
CEN/TS 14778-2:2005	Solid biofuels - Sampling - Part 2: Methods for sampling particulate material transported in lorries	CEN/TS 15210-1:2005	Solid biofuels - Methods for the determination of mechanical durability of pellets and briquettes - Part 1: Pellets
CEN/TS 14779:2005	Solid biofuels - Sampling - Methods for preparing sampling plans and sampling certificates	CEN/TS 15210-2:2005	Solid biofuels - Methods for the determination of mechanical durability of pellets and briquettes - Part 2: Briquettes
CEN/TS 14780:2005	Solid biofuels - Methods for sample preparation	CEN/TS 15234:2006	Solid biofuels - Fuel quality assurance
CEN/TS 14918:2005	Solid Biofuels - Method for the determination of calorific value	CEN/TS 15289:2006	Solid Biofuels - Determination of total content of sulphur and chlorine
CEN/TS 14961:2005	Solid biofuels - Fuel specifications and classes	CEN/TS 15290:2006	Solid Biofuels - Determination of major elements
Standard reference	Title	Standard reference	Title
CEN/TS 15103:2005	Solid biofuels - Methods for the determination of bulk density	CEN/TS 15296:2006	Solid Biofuels - Calculation of analyses to different bases

CEN/TS 15104:2005	Solid biofuels - Determination of total content of carbon, hydrogen and nitrogen - Instrumental methods	CEN/TS 15297:2006	Solid Biofuels - Determination of minor elements

Source: European Committee for Standardization, 2005

Appendix 6: Policies and measures that affect the use of bioenergy in Sweden

The content of the table is exclusively from STEM (2005), unless otherwise stated.

Table 17 Renewable energy policies and measures in Sweden

Policies	When? Objective	Implementation
Energy taxation	Introduced in 1991. Fiscal and environmental objectives.	- Fuels used for electricity production are exempt from energy tax. However, the use of electricity is taxed, at rates that vary depending on in which part of the country the electricity is used, and on what it is used for. - Fuels for heat production are taxed. Heat use is not taxed. - From 1st January 2004 on, cogeneration plants are taxed on the fuels used for heat production at the same rate as on these fuels when used in industry, which is lower. However, that portion of the fuel which is used for electricity production receives a full rebate of energy tax, although that part of the fuel which is regarded as producing electricity for internal use is subject to full taxation. - Nuclear power plants were previously taxed on the basis of their electricity production, but since 1st July 2000 the tax has been based on the maximum thermal power rating of their reactors. - Manufacturing industry, horticulture, farming, forestry and fisheries pay no energy tax on fossil fuels.
CO_2 taxation	Introduced in 1991. Fiscal and environmental objectives.	- 91 öre/kg of CO_2 in 2005. Levied on the amount of CO_2 emissions from all fuels except biofuels and peat. - Fuels used for electricity production are exempt from CO_2 tax. - Fuels for heat production pay. - The electricity production at the cogeneration for internal use is subject to CO_2 tax. - Biofuels and peat is exempt from this taxation. - Manufacturing industry, horticulture, farming, forestry and fisheries pay only 21% of the carbon dioxide tax.
SO_x taxation	Introduced in 1991. Fiscal and environmental objectives.	- SEK 30 per kg of sulphur emission from coal and peat, and at SEK 27/m^{3s} for each tenth of a percent of sulphur by weight in oil. - Fuels for heat production pay. - Oils containing less than 0.05% of sulphur by weight are exempted from the tax.
NO_x levy	- Introduced in 1992. Fiscal and environmental objectives.	- Levied on niotrogen emissions from boilers, gas turbines and stationary combustion plants at least 25GWh per annum. - SEK 40/ kg of NO_x. It is intended to be fiscally neutral, and is repaid to plant operators in proportion to their energy production and in inverse proportion to their NO_x emissions,

		so that only those with the highest emissions are net payers.
EU ETS	Introduced in May 2005 with the EU ETS system. To reduce the CO_2 emissions and to meet Kyoto Protocol targets.	- The emission trading system is based on each member state setting a ceiling for its emissions prior to each trading period. - Each member state has a total number of emission allowances that each country intends to distribute. - Each emission allowance represents one tonne of carbon dioxide. The trading system creates a market price for carbon dioxide emissions, with the actual price level being determined by availability of, and demand for, certificates. - For the 2005–2007 trading period, the Swedish state has issued27 emission allowances equivalent to about 67.3 MtCO2. For 2005, allowances representing about 22.2 MtCO2 were allocated to about 530 plants. In addition, there is a reserve of emission allowances equivalent to about 2.1 MtCO2, available for allocation to new members of the scheme and to existing plants that have increased their capacity.
Electricity Certificate System	Introduced in May 2003. The system is to contribute the aim of increasing the amount of renewable electricity by 10TWh between 2002 and 2010.	- All electricity users, with the exception of manufacturing processes in energy-intensive industries, are required to buy certificates corresponding to a certain percentage of their electricity use. - Quali-fying renewables are electricity from wind power, solar energy, geothermal energy, certain biofuels, wave energy and small-scale hydro power. With effect from 1st April 2004, electricity from peat has also qualified for certificates.
Investments grants and support for RD&D	Intensively since 1980s. To support the new and renewable technologies and innovations and get them on the ground.	The main funding agency is the STEM. From the RD&D funding bioenergy gets the biggest share mainly under the "Fuel- based energy systems and the Transport" research themes (Telenius, August, 2006, interview).
Climate investment programme (KLIMP)	It started in 2003. Partially a continuation of Local Investment Programme (LIP). To support renewable energy investments.	- Klimp provides grants for local authorities and other parties to make investments in measures intended to reduce the emission of greenhouse gases, provide energy savings or represent interesting new technology that can contribute to these objectives. These grants are also available to companies, although they must relate to measures undertaken in more than one Swedish county. - A total of SEK 1040 million has been assigned for Klimp for the period 2002–2006. - During the first two tranches of grants in 2003 and 2004/05, SEK 810 million were assigned to 47 programmes, comprising 389 individual projects, mainly in connection with the transport and energy sectors. - These projects are expected to result in a reduction in greenhouse gas emissions of about 365 000 tonnes of carbon dioxide-equivalents per year. In addition, they should reduce energy consumption by 570 GWh/year.

Technology procurement	The objective is to encourage and accelerate the development of new technology.	- The first phase is a feasibility study, to investigate the potential for efficiency improvement and the feasibility of, or opportunities for, carrying out the procurement, followed by the formation of a purchaser group, production of a performance specification, sending out requests to tender, evaluation of received tenders and dissemination and further development. - Technology procurement is a complete tendering process, with the aim of encouraging and accelerating the development of new technology. As it involves a tendering procedure, it can be seen as a form of competition between manufacturers.
Information activities	To diffuse to and collect information from the whole stakeholders.	Policy, the Swedish Energy Agency is a central provider of information, using many different channels and working with a large number of different parties in order to ensure that information reaches its target groups.

Source: STEM, 2005

Appendix 7: Grant schemes and policies related to bioenergy in the UK

Table 18 Grant schemes and policies related to bioenergy in the UK

Policies	When? Objective	Implementation
Climate Change Levy	Introduced in 2001. To achieve carbon and energy saving targets.	- Energy tax applied to UK industry, commerce and public sector. - It does not apply to fuels used by the domestic or transport sector, or fuels for the production of other forms of energy (such as electricity production) or for non-energy purposes. - Energy used by small firms is also excluded. - It adds approximately 15% to a business typical energy costs. - It was introduced with a cut in employers' national insurance contributions (NICs), which has led to a net reduction in tax liability for business. - Electricity generated by renewable energy sources is exempt. - Fuels used by good quality CHP; fuels used as feed stocks, and electricity for electrolysis are exempt from the tax. - Horticulture sector was given a five year period of 50% discount which ended in March 2006. - Current rates of levy are 0.15 p/kWh for gas; 0.15 p/kWh for coal; 0.07 p/kWh for LPG; 0.43 p/kWh for electricity.
Climate Change Agreements (CCA)	Introduced in 2001 to encourage business to improve energy efficiency or to commit carbon saving targets and be eligible for Levy Exemption Certificates.	- Implemented between DEFRA and the business. - At present around 10 00 facilities have agreements. - The business, which engages in CCA obtain a reduction of up to 80% in the Climate Change Levy if the targets are met.
Levy Exemption Certificates (LECs)	.	LECs exempt business from being subject to a proportion of the Climate Change Levy when business has entered into a CCA
Emission Trading Schemes (UK & EU ETS)	Introduced in the EU in 2003. To achieve cost effective emission reductions.	- Companies set annual targets for greenhouse gas emissions. They may meet these targets either by achieving it by themselves or buying "allowances" from other companies. - Since 1 January 2005 the operators of installations have to monitor their emissions and to ensure that they surrender

		allowances equivalent to their emissions in any calendar year. - The UK scheme covers 1000 installations, responsible for approximately 50% of the CO_2 emissions, including electricity generators, oil refineries, offshore platforms and industrial plants in the iron, steel, cement and chemicals sectors. - The installations in the UK can buy allowances from other installations in the EU and from other Kyoto Protocol mechanisms. - So far, it has delivered to reduce over 1.6 MtC, ahead of the planned reductions.
Carbon Trust RD&D Programme	Independent company established in 2001 by the government to help business and public sector save energy, reduce CO_2 emissions and integrate low carbon technologies.	- It provides independent information and impartial advice on energy saving and carbon management through site visits, events and case studies. - £460k on biomass to- date. - 6 of the 30 projects funded to-date relate to biomass
DTI Technology Programme	Programme available to businesses as grants via DTI business support products: 'Collaborative Research & Development' and 'Knowledge Transfer Network'.	- £320 million over 2005-2008 - 17 projects in 'New and Renewable Energy Technologies' with £9m funding.
Grants	Programme Desription	Implementation
Energy Crops Scheme	To support the establishment of energy crops. Support includes: -establishment grants -set-up and operating costs for SRC will producer groups.	- Total value of the Scheme is £17.9m over 6 years is available - Currently, there are 157 propjets in place of: 668 ha of Miscanthus and 660 ha of SRC. - 3 projects initiated under Producer Groups
Farm Woodland Scheme (FWS)	Trial scheme preceding FWPS (from 1988-1992). Long-term agreements in place.	- Succeeded by Farm Woodland Premium Scheme. - Total money available was £2m in 2004-05. - Projects that were realized take up approximately 9 400 ha.
Farm Woodland Premium Scheme (FWPS)	Part of England Rural Development Programme (ERDP), only available in conjunction with Wood Grant Scheme. Annual payment compensates farmers for agricultural income foregone. Scheme closed.	- The money available was £77m over 7 years to 2006; about £42m was taken. - 43 068 ha approved of planting between start of scheme in 1992 to end 2004-05.
English Woodland	Funds stewardship of	- Balance of uncommitted funds from

Grant Scheme	existing woodland and creation of new woodland where there is public benefit, particularly in terms of improved biodiversity or public access.	WGS. (c. £10m for new applications from 01/04/06) - Funding available for new applications from 01.04.06
Bio-Energy Infrastructure Scheme	To help develop supply chain & market infrastructure for wood fuel (forestry materials & energy crops) and straw for energy.	- The money available is £3.5 m and it is all allocated. - Projects address supply chain issues and include CHP, heat only, gasification and other technologies.
Clear Skies	Supports installation of renewable technologies, including biomass heat.	- Money available is £12.5m for 2003-2006. - The money taken so far by 59 domestic wood-fuelled projects is £53.850.(c. 2% of total domestic spend). - 61 community projects using biomass, with funding of; 1 347 550 (c. 25%of total community spend).
The Community Energy Programme	Supports public sector district heating schemes through capital grants.	- Monet available is £60m (includes £10m extension to the programme, covering the years 05/06-07/08) - 12 grants for biomass out of 75 grants approved (16%)
Community Renewables Initiative	Countryside Agency, Forestry Commission and DTI-funded; provides information and facilitation for community-based partnerships to promote small-scale renewable energy.	- The money available is around £2m. - 89 fully completed projects; 256 advanced projects, 3000 phone calls or email.
Bio-Energy Capital Grant Scheme	Introduce to develop markets for biomass in heat. CHP and power generation. Also, demonstration projects focused on new, high efficiency technologies.	- The money available is £66m. - Money delivered to £4.2m for biomass heating boilers; £22m for small-medium sized biomass power plants; £28m for large city electricity projects.
Woodland Grant Scheme (WGS)	For managing existing woodland and planting woodland. Scheme now closed.	- The Scheme has been succeeded by English Woodland Grant Scheme. - The projects realized is 224 037 ha for management; 25 952 ha for new planting;

Source: BTF, 2005 and DTI, 2006a.