
The role of Energy Willow in achieving the fossil fuel free goals of Denmark by 2050



Source: farmerenergymedia, 2014

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Abstract



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This thesis investigates the potential role of Danish Energy Willow in helping to reach the Danish 2050 fossil fuel free energy goals. This idea stemmed from two reports by the Danish Energy Agency, investigating the viability of Energy Willow in Denmark. The thesis used exploratory research to further explore Energy Willow's current role in the Danish energy system and to figure out its potential in helping to reach the 2050 goals.

Our research question is: ***What role can Energy Willow play in reaching the Danish 2050 energy goals and is it desirable for society that Energy Willow plays this role?***

Our argument is that that Energy Willow would be highly beneficial for Danish society because of the externalities that are produced, but Energy Willow will not be produced because it is not as profitable as other crops. If we, as a society want Energy Willow to be grown, then subsidies are needed.

In our analysis, we take departure from the theoretical framework on entrepreneurship and the role of ideas, which allows the thesis to look in-depth into how the institutions in a given society and the paradigm in which this society operates, govern the entrepreneurship taking place within that society. This influence was applied to the special case of Energy Willow, where it was shown that this influence was strongly evident. The work of William Baumol on institutions directs our understanding of Energy Willow in Denmark because research showed that institutions are crucial for how farming is done. The work of Mark Blyth helps us to show why people, in particular farmers do what they do, and what it takes to change this way of thinking.

We conducted 10 interviews in order to facilitate this exploratory research. These interviews are embedded in the context of Energy Willow from the perspective of the different stakeholders in the Danish Energy Sector. This allows the thesis to be written through the use of a constructivist method, focusing on the perceptions and experiences of the different stakeholders in order to answer the research question.

The key finding from the empirical material is the confirmation of the Baumol theory on entrepreneurship. The government, in the form of the Danish Energy Agency, plays a large role in how the energy sector operates. In addition to this, the empirical material also shows that, due to the current paradigm of rent seeking behavior in Denmark, Energy Willow's numerous positive externalities cannot be fully compensated despite the large potential of the Willow in helping to reach the Danish 2050 fossil fuel free energy goals. However, it could be possible for Energy Willow to play a much larger role in the Danish energy sector and it would be desirable for Danish society for it do so.

Table of contents

Abstract	2
Table of contents	4
List of tables and figures	6
Tables:	6
Figures:	6
Definitions	8
Biomass	8
Energy	9
1) Introduction	10
2) Context	12
2.1) Basis of the thesis: Summary of the reports	13
2.2) Energy Willow	15
2.2.1) Recent history of Energy Willow in Denmark under the green growth policy	16
2.2.2) Economics of Energy Willow: a non-profit business	19
2.3) Current paradigm of rent seeking behavior	20
3) Stakeholders in the Energy Willow industry	23
3.1) Danish Energy Agency (Energi Styrelsen)	25
3.2) European Union:	28
3.3) Farmers	32
3.4) Landbrug og Fødevarer (Danish Agriculture and Food Council):	34
3.5) Energy producers:	35
3.6) Public:	35
4) Research Question	39
5) Theory and Literature Review	39
5.1) Baumol: Entrepreneurship within institutions	43
5.2) Mark Blyth	45
5.3) Relationship between Baumol and Blyth, the role of ideas	48
6) Methodology	50
6.1) Social constructivism as a pragmatic approach	51
6.2) Ontology & Epistemology	51
6.3) Reliability	54
6.4) Research Design	57
6.4.1) Mixed method	57
6.4.2) Exploratory and Abductive Research	58
6.4.3) Purposive sampling	60
6.4.4) Semi-structured interviews	60
6.4.5) Interview guide	62
7) Operational RQ: No subsidies, no willow	66

8)	Literature review: externalities – How does Energy Willow benefit society and how can we encourage growth in the industry?.....	67
8.1)	Indirect Land Use Change (ILUC).....	73
8.2)	Conclusion to externalities.....	74
9)	Analysis.....	74
9.1)	Stakeholder views on the paradigm of Danish 2050 biomass scenarios and how this influence their relationship with the institutions of Denmark	74
9.1.1)	Academics	75
9.1.2)	The Danish Energy Agency	77
9.1.3)	The EU.....	77
9.1.4)	Farmers.....	79
9.1.5)	L&F	81
9.1.6)	Energy Companies	82
9.1.7)	The public	83
9.2)	Optimal extent of institutional interference in the energy production sector from a stakeholder perspective	83
9.3)	The benefits and drawbacks of Energy Willow for Danish society	90
9.4)	Local vs imported biomass	95
9.5)	Dissemination of knowledge to new growers of Energy Willow/ Considerations to new entrepreneurs/farmers.....	98
10)	Discussion.....	100
10.1)	The importance of an institutional framework.....	100
10.2)	Ideas shaping the institutional environment	101
10.3)	The natural environment as a priority for society	104
11)	Conclusion.....	106
12)	Acknowledgements	110
	Bibliography.....	111
	Appendix:.....	117
	Email Correspondence:	117
	Recorded Interviews:	117

List of tables and figures

Tables:

Table 1 - Potential of different kinds of biomass	8
Table 2 - Danish 2050 energy scenarios.....	9
Table 3 - Sources on the economics of Energy Willow.	19
Table 4 - List of interviews.....	63
Table 5 - Impact calculation measured in kr./ha/year on externalities	71
Table 6 - Externality comparison of biomass crops.....	72
Table 7 - Reduction costs with the use of Energy Willow in power plants, kr/t CO2 equiv. ..	73
Table 8 - Stakeholders opinion towards subsidies for Energy Willow based on interview data	87

Figures:

Figure 1 - (image) Front cover - Commercial Energy Willow Crop.....	Error! Bookmark not defined.
Figure 2 - Danish energy sources 1990-2015	14
Figure 3 – (Image) Energy Willow grower (Henrik Bach) examining his Energy Willow crop	16
Figure 4 - Development of area with Willow and Polar on agricultural land in Denmark 2005-2013	18
Figure 5 - Two year dry matter yield with differing levels of fertilizer *on poor sandy soil and first harvest cycle which tends to yield 20-30% less than subsequent harvests	20
Figure 6 - Stakeholder map of the Energy Willow sector in Denmark.....	24
Figure 7 - Number of re-investments before 2050	26
Figure 8 - Share of energy from renewable sources, 2004 and 2015	30
Figure 9 - The nine steps of making Danish law	37
Figure 10 - Graph showing the relationship between environmental concern in selected countries and GDP per capita (PPP), 2010	38

Figure 11 - Energy Willow Externalities.....	67
Figure 12 - External costs per technology for electricity technologies, EU 28 weighted averages (in Euros 2012/MWh)	70
Figure 13 - chart illustrating pay-out for Energy Willow in Denmark with and without subsidies compared to other crops.	93

Definitions

This chapter will be dedicated towards clarifying some of the terms used throughout the thesis. The aim is to define these terms and ensure a common understanding.

Biomass

The term biomass encompasses many different terms. In the case of this thesis; the term biomass is used to describe all types of organic matter derived from living or recently living organisms (Ege, Bøndergaard, Normander et al. 2013). In this context, the definition is organic matter that can be used in energy production. In the scenario report by the Danish Energy Agency, they outline a number of different categories used in their biomass calculation as seen below in Table 1 (Danish Energy Agency 2013). Table 1 shows that compared to the consumption in 2011, Denmark has the potential to use almost twice as much biomass in the power supply, and that biomass can reach a potential of up to a third of the future Danish energy consumption. This table does not include blue biomass such as seaweed since it is still in the experimental phase (Danish Energy Agency 2013).

Numbers in Peta Joule (PJ)	Consumption 2011	Of this Imports	Potential
Straw and other one year crops	20	0	148
Woodchips and other wood biomass	17	6	40
Firewood	24	3	0
Wood Pellets	30	28	0
Wood Waste	8	0	0
Biogas	4	0	42
Bio oil	9	6	0
Waste	39	0	42
Total	151	43	272

Table 1 - Potential of different kinds of biomass

As opposed to the category of total biomass, the term dry matter biomass will be used as the subcategory to define Energy Willow and also to present the group of substitute products. Dry matter biomass is represented in Table 1 above as straw, wood chips, firewood, wood pellets and wood waste.

Energy

Energy is an all-encompassing concept that is used when planning for the future. This includes electricity, heating, transportation etc. In 2011 the total energy consumption was 807 Peta Joule (Danish Energy Agency 2013). As seen in Table 2, the total energy consumption will in 2050 be 562 PJ or 674 PJ depending on the scenario. The difference is due to alternative technologies and especially in the Bio+ scenario, the energy consumption is significantly higher, due to it being the only scenario that utilizes biofuel cars. Additionally, the amount of wind energy is the lowest, making this scenario the one with the highest energy consumption. The fall in net energy consumption will be due to “*savings, wind power, heat pumps, solar power and rationalizations*” (Danish Energy Agency 2013 p. 74).

Scenario	Wind	Biomass	Bio+	Hydrogen	Fossil
Fuel Consumption	255 PJ	443 PJ	710 PJ	192 PJ	483 PJ
Self-sufficiency degree	104%	79%	58%	116%	(¹)
Gross Energy Consumption	575 PJ	590 PJ	674 PJ	562 PJ	546 PJ

Table 2 - Danish 2050 energy scenarios

¹ Depends on Danish fossil production in 2050.

i) Introduction

The road to a society fueled by renewable energy has come increasingly into focus in today's society. Presently, the plans of the Danish government are that Denmark should use 100 percent renewable energy by 2050. This ambitious target represents a large shift from today where the percentage of renewable energy used is just 43 percent. In a report by the Danish Energy Agency to explore different possible scenarios for how to reach this goal, energy production through biomass is an important factor; indeed, two out of five scenarios in the report used biomass as the primary energy source to a greater or lesser extent. This thesis will be focused on these two scenarios using biomass as key energy sources.

Biomass has become an increasingly important alternative energy source globally, this thesis will investigate a single form of biomass in Denmark, the Energy Willow crop. Denmark needs to import a "*substantial amount of biomass*" (Danish Energy Agency 2013, p. 76) in order to fulfill their energy goals, however, according to Danish Energy Agency, Denmark has the potential to produce between 50,000 & 2.8 million tons of dry matter willow biomass annually, this could contribute substantially to the Danish energy sector.

Energy Willow has been grown in Denmark for many years, during a number of these years were subsidized by the government, however, as there are currently no subsidies, under current conditions, the future for Energy Willow looks bleak. The current paradigm of rent seeking behavior does not allow for the growth of Energy Willow, as it is not currently as profitable as other, more traditional crops. Looking at the farmer as an entrepreneur under economic pressure, they simply do not have the leeway to experiment with new crops, and thus, must go for the better known, safer options. After establishing these facts in the background section of this thesis, the research question becomes;

What role can Energy Willow play in reaching the Danish 2050 energy goals and is it desirable for society that Energy Willow plays this role?

Because it will be shown that without subsidies, there will be no growth in the Energy Willow sector in Denmark.

The answer to the research question is shown further on in the thesis in the section on externalities: Energy Willow could be highly beneficial for Danish society due to the externalities. But, how could we compensate for these externalities as by solely relying on the markets will result in tragedy of the commons, thus, if we want Energy Willow, we need the government to step up and support it.

To answer the research question, the thesis primarily uses a constructivist approach called pragmatism to analyze semi-structured interviews with the various stakeholders in the business of Danish energy sector. This allows us to consider the experiences and habits of the stakeholders to create meaning to our exploratory research into the issue of Energy Willow.

The theoretical section looks at the two primary theories of the thesis to investigate exactly who could compensate farmers for the externalities of Energy Willow. We use the theories of William Baumol (1993) on entrepreneurship to explain how the government as an institution influences entrepreneurial activities, hence if we want more Energy Willow, we need the government. Mark Blyth's (2001) theory of ideas as weapons and cognitive locks is used as a tool to look at the communication used to discuss the issues surrounding the Energy Willow in Denmark; the rent seeking paradigm, the 2050 goals and the discussion on local vs. imported biomass.

With these theories in place the operational research question becomes:

Should the Danish government promote the growth of the Energy Willow sector through the use of subsidies?

The analysis will then investigate these issues in-depth, primarily from the point of view of the stakeholders using data from the interviews conducted. First, how they view the rent seeking paradigm, and how this view influences their relationship with the government. Secondly, the thesis will investigate what the stakeholders think the optimal level of government interference in the energy sector is, to investigate how

they feel about the government promoting one form of energy over another. Thirdly, the thesis will look into the benefits and drawbacks of Energy Willow for Denmark. Then, an analysis into the discussion on local production versus imports will follow, before finally analyzing the hurdle of dissemination of knowledge as an entrepreneurial activity.

After the analysis, a discussion on the key assumptions of the thesis will follow. This discussion is separated into three different sections; 1) The institutional framework, 2) How ideas shape society and 3) Should the natural environment even be a priority. These three topics will finally allow the thesis to conclude on the research question.

2) Context

The inception of this thesis is based on the investigation into Energy Willow as a source of entrepreneurship. This investigation is done to illuminate the role institutions play in setting the agenda and prioritizing the direction in which society moves. To explore this topic, the thesis will look into the case of Energy Willow as a source of biomass for a number of reasons; Firstly, the move towards a CO₂ neutral society is a hotly discussed topic in Denmark today; the way to reach this goal is a topic of great interest. Secondly, while there is enough biomass today for the Danish requirements, every European country is moving towards the goal of CO₂ neutrality to a greater or lesser extent, and as such the need for biomass could explode in the future. The question of how to secure a source of biomass thus becomes crucial.

This section is dedicated to establishing the background of the thesis. The section will be split into five parts to provide the background on which Energy Willow can be explored. First, the thesis will look into the recent history of this relatively unknown crop to understand where the crop is coming from and the previous experiences that farmers have had with the crop. Then the section will look into the economics of Energy Willow to establish if the crop is profitable today compared to other crops. The importance of profitability will then be looked into, as the thesis will set up the assumption that the current prevailing paradigm in society is one of rent seeking behavior. Once this assumption is established, the thesis will look into the stakeholders

of the industry to understand who plays a role in the future of Energy Willow. Finally, an operational research question will be set up based on the conclusions that have been reached in this section.

This thesis is based on two reports from the Danish Energy Agency, and these two reports form the foundation of the exploratory research. The Danish Energy Agency is an important governmental agency that regulates energy production in Denmark, and is described in the actor section below. The two reports are: "*Kortlægning af potentiale og barrierer ved energipil, 2015*" 'Mapping of potential and barriers on Energy Willow' (Ugilt Larsen et al., 2015) and "*Energiscenarier frem mod 2020, 2035 og 2050,*" 'Energy scenarios towards 2020, 2035 and 2050' (Danish Energy Agency, 2013).

2.1) Basis of the thesis: Summary of the reports

With the goal of moving towards a CO₂ neutral society, a concrete plan is needed, because as shown in Figure 1, there is still a long way to go, and there are different options that can be chosen. In line with the focus of the two reports, the focus of the thesis will be Denmark and one of the possible ways the country can reach a CO₂ neutral state, using Energy Willow as a source of biomass. In the total power supply of Denmark, it can be seen below in Figure 2 that we are still very much reliant on oil and coal & coke as the main sources of energy, although there is a steady increase in the use of renewable energy in this period.

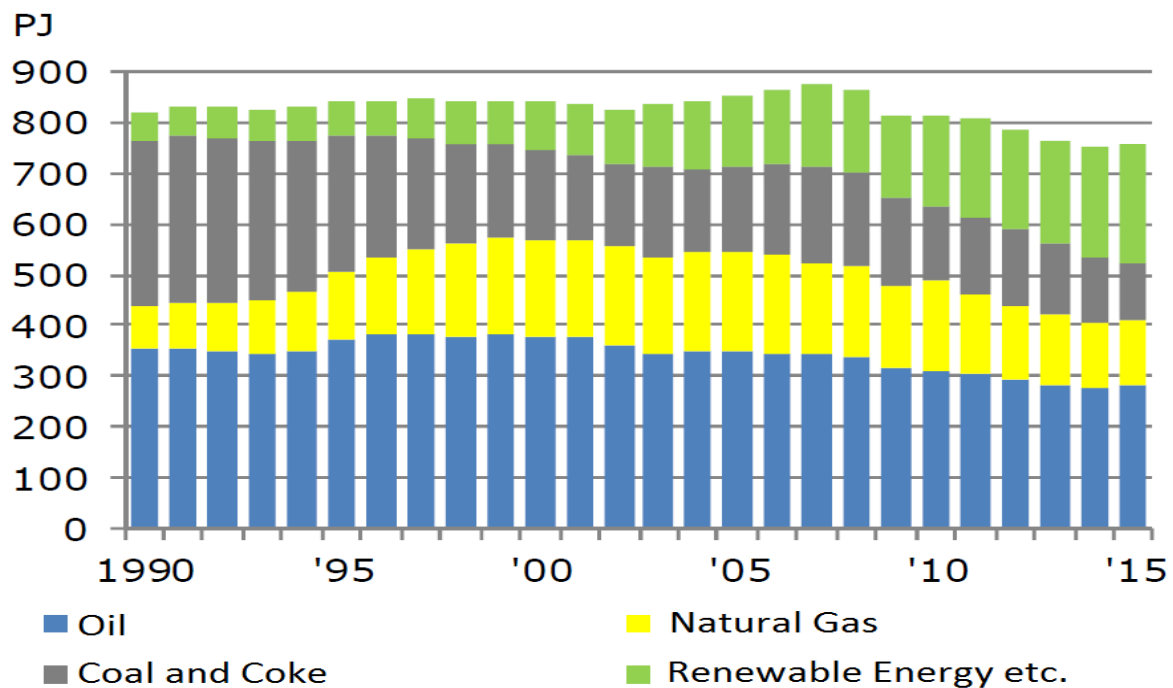


Figure 1 - Danish energy sources 1990-2015

Source: Danish Energy Agency 2016, p21

The scenario report is a suggested guiding plan towards the future environmental policy for Denmark and the questions are geared towards the goal of being fossil fuel independent in 2050. There are a total of five scenarios, of which this thesis will explore two. The five scenarios are: wind, biomass, bio+, hydrogen and a baseline fossil fuel scenario, the details of which can be seen in Table 2 above. The thesis will focus on the two biomass scenarios, which show that biomass has an important future in the energy production. With this baseline, Energy Willow will be explored from the perspective:

Bioenergy is a limited resource. Since Denmark is a small country, there are options with regards to whether one wants to regulate with the goal of creating a fuel burning system with large import of biomass or an electricity based system with limited bioenergy used on a level that Denmark can deliver by themselves. With 2050 as the goal year for fossil freedom, this decision would probably have to be taken shortly after 2020, since the large transitions, amongst others expansion of wind power, takes time. The choice rests especially on which degree of self-sufficiency is wanted. (Danish Energy Agency, 2013 p. 7)

The second report focuses on the potential of Energy Willow in Denmark. According to the report, Energy Willow has a potential production of up to 2.82 million tons, which requires about 230,000 ha of farmland (Danish Energy Agency 2015). This is a large increase from the 5,000 ha of farmland currently producing Energy Willow in Denmark. The report explores a number of reasons why Energy Willow is at the current underdeveloped state and how to improve upon conditions for Energy Willow as a biomass product. The major reasons for the lower than expected Energy Willow production are 1) the current reluctance on behalf of the power companies to buy Energy Willow (Ugilt Larsen et al., 2015); 2) The production of Energy Willow biomass in Denmark is very fragmented making the process of consolidating and selling the biomass to the market administratively heavy (Ugilt Larsen et al., 2015); 3) The motivation and knowledge of farmers: farmers seek profitability and they lack the knowledge on how to grow Energy Willow efficiently, which makes production suboptimal (Ugilt Larsen et al., 2015); and 4) Energy Willow has primarily been used on poor agricultural soil (Ugilt Larsen et al., 2015). Overall, the profits have been lower than expected. The thesis, furthermore, explores the multitude of benefits associated with growing Energy Willow as a source of biomass, which can be classified as externalities.

2.2) Energy Willow

Energy Willow is the broad name for a multitude of plants from the genus *Salix*. These plants are defined by belonging to the shrub part of the species. These plants are bred for the purpose of increasing the shrubs potential as a crop, and thus, becomes a domesticated agricultural plant (Ugilt Larsen et al., 2015). The thesis will define Energy Willow as an agricultural plant despite the current debate within the industry (Appendix 4). This debate is whether Energy Willow production should be classified as forestry or farming. This thesis classifies it as an agricultural product due to the fact, that Energy Willow use agricultural land and is eligible to the European Union (EU) rural development support (European Parliament 2013).



Figure 2 – Energy Willow grower (Henrik Bach) examining his Energy Willow crop

Source: Nyvraa, 2017

To transform the willow into energy it is most commonly chipped, dried and then burned in furnaces built for burning general dry matter biomass. These furnaces can be used in either the production of electricity, through the steam generation or as heating (Eide et al., 2012).

2.2.1) Recent history of Energy Willow in Denmark under the green growth policy

Energy Willow in Denmark is not an entirely new crop, there have been farmers growing the crop since the late 80s (Appendix 3). It has, however, been a bumpy road for Energy Willow growers in Denmark with wavering political support from the government of the day making it very difficult for farmers to set up long term strategies for the investment in Energy Willow plantations (Appendix 1). Up until 2009 there were no significant initiatives aimed at the growth of the Energy Willow industry, however, Henrik Bach, one of the largest Energy Willow growers in Denmark saw a sudden spike in sales of Energy Willow cuttings going from planting 80 hectares in 2008 to 800 hectares in 2009. This growth coincides with the introduction of the Grøn Vækst or Green Growth policy introduced by the Danish government in June 2009 in order “to ensure that a high level of environmental, nature and climate protection goes hand in

hand with modern and competitive agriculture and food industries” (Danish Ministry of Environment and Food, 2009 p.1). This policy was part of Denmark’s implementation of the EU rural development program discussed in more detail below. This agreement subsidized farmers for meeting certain requirements that contributed to the betterment of the environment whilst strengthening and growing the Danish agricultural sector. The effects of this policy are clear on when looking at the growth of both poplar and willow in the period of the Green Growth policy. This growth essentially shows, when the correct incentives are in place, the land can be made available for Energy Willow in Denmark, proving just how critical the right incentive and policy structure are to creating growth in the Danish Energy Willow industry.

Figure 4 below illustrates the amount of land in hectares in Denmark with willow and poplar between 2005 and 2013. As can be seen through this chart there was a fairly similar increase in the planted areas of both Energy Willow and poplar from 2008 through to 2013, during the period both the areas under Energy Willow and poplar almost tripled. Such a policy shows that at that point in time there was political will to promote Energy Willow, albeit for the purposes of environmental protection rather than a strict focus on the energy uses of the plant. In 2013, the Danish Energy Agency commissioned the Energy Willow potential report which serves as a basis for this thesis, the report outlined the great potential of Energy Willow, not only as a source of biomass for energy, but also highlighted the plant’s numerous other uses in cleaning water sources as well as removing unwanted nitrates from the soil on Danish farmland. This report, unfortunately, did not seem to have any significant impact on the Danish Energy Willow industry largely because the subsidies for the crop ended with the Green Growth policy in 2014.

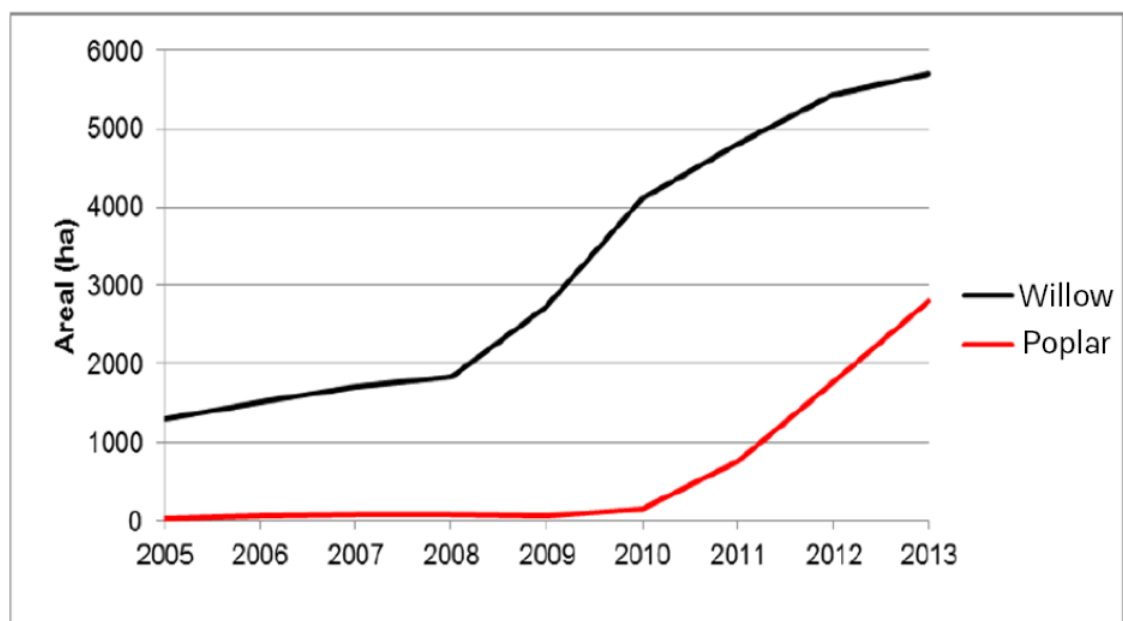


Figure 3 - Development of area with Willow and Polar on agricultural land in Denmark 2005-2013

Source: Jorgensen et al, 2013

During the period of the Green Growth policy, the Danish government's stance on willow changed numerous times creating a very unpredictable environment for those farmers that had already adopted the crop and introducing much uncertainty for those that were considering it as an option: "... from 2009-2015 the frames around the willow growing from the official Denmark was changed 6 times in 5 years and that is poison for every crop, for every initiative" (Appendix 3). This uncertainty was further exacerbated by the fact that the economic climate for farmers was particularly bad during this period and many farmers were under strong financial pressure, as crop prices were very low due to competitive forces. Those farmers that had opted to grow willow under the Green Growth policy, with the aim of growing it for the long term, were caught off guard when the Danish government cut the subsidies for Energy Willow, abandoning many farmers that had made considerable investments in Energy Willow, many of which would need to take out further financing to remove the willow again to plant other crops to try and recoup their losses from Energy Willow (Appendix 3).

Since the Green Growth policy ended in 2014 there has been no significant steps made by the Danish government to promote the growth of the Danish Energy Willow industry.

2.2.2) Economics of Energy Willow: a non-profit business

In this section, the thesis will consider some of the numbers surrounding the issue of Energy Willow. To make qualified assumptions on the economics of Energy Willow, many different numbers have been collected from secondary sources to build on the experiences of others. There have been several reports looking into yield of Energy Willow and its viability on the different types of soil. To do an economic analysis, sales prices are also necessary, and as outlined in Table 3, depending on the sources, this information varies greatly. Table 3 shows the different sources that have been used for data collection for the economics section.

Table X; Sources on the Economics of Energy Willow										
Source	Page Number	Soil Type	Yield t/ha/year	Calorific value GJ/t	Market price kr./GJ	Total Income kr./ha/year	Costs kr./ha/year	Opportunity Costs kr./ha/year	Net profits kr./ha/year	Net profits-opportunity costs kr./ha/year
Dubgaard et al. 2008	104-106	Marginal	8	18,03	47,4	6664	6436	0	228	228
Dubgaard et al. 2008		Sandy	10	18,03	47,4	8330	6436	2691	1894	-797
Dubgaard et al. 2008		Clay	14	18,03	47,4	11662	6436	6851	5226	-1625
*Market price is based on a estimate as a substitute for natural gas										
*Costs included; Production Costs,										
Olesen 2008	40	-	10-12	-	-	-	-	-	-	-
Ugilt Larsen et al. 2015	85	Sandy	4-7	8,03	44	-	-	903	27	-876
Ugilt Larsen et al. 2015		Clay	8-10	8,03	44	-	-	1921	906	-1015
*Yield; first number for the first harvest, then second number for subsequent harvests										
*Calorific value at 50% water content										
Jørgensen et al. 2008	116	-	12	-	-	-	-	-	-	-
Bach 2016	26	Clay	12	-	42	9240	3612	9308	5628	-3680
*Costs included; Production										
Jørgensen et al. 2013	36	Poor Sand	8	-	42	-	-	-	-	-
Jørgensen et al. 2013	36	Good Sand	10	-	42	-	-	-	-	-
Jørgensen et al. 2013	36	Moist Mar	12	-	42	-	-	-	-	-
Jørgensen et al. 2013	36	Clay	14	-	42	-	-	-	-	-
EA Energy Analyses 2010	94	-	12	8	-	-	-	-	-	-

Table 3 - Sources on the economics of Energy Willow.

As shown in Table 3, the data available on Energy Willow differ significantly, especially when looking at the profitability of Energy Willow in general when one takes opportunity costs into consideration. This question of opportunity costs will be covered in detail in the analysis, as these types of crops are greatly dependent on the commodity pricing of both Energy Willow, but also on the traditional crops. Interestingly, the three sources that calculate the gross profit all concluded that if this product is to be economically viable, then it needs support to compete with other crops (Bach, 2016; Dubgaard,

Hjort-Gregersen, Nissen, Jespersen, & Gylling, 2008; Ugilt Larsen et al., 2015). The only instance in which it is profitable to plant Energy Willow now, is on marginal land, on which nothing else currently grows (Dubgaard et al., 2008).

When looking at the yields, one can see some variance, and this variance is also one of the biggest problems for the wide scale adoption of Energy Willow as many farmers underestimate the care an Energy Willow field needs. As yield is a key metric, it is crucial to look behind this number, and Eide et al. (2012) did just that. As can be seen in Figure 5 below, the yield varies greatly depending on the level of attention it gets from the farmer, and the importance of this attention should, therefore, not be underestimated (Eide et al 2012).

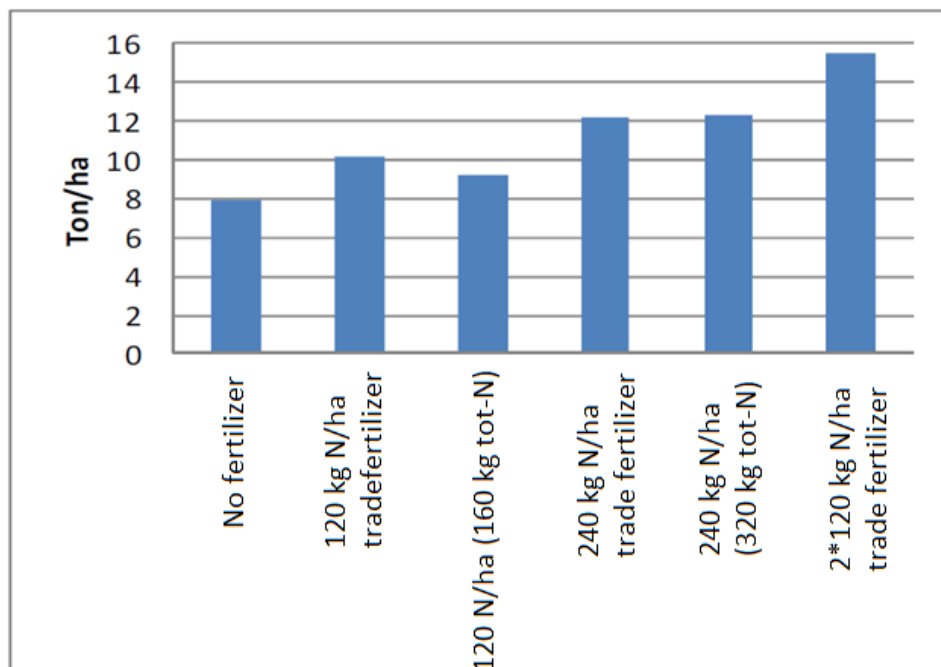


Figure 4 - Two year dry matter yield with differing levels of fertilizer *on poor sandy soil and first harvest cycle which tends to yield 20-30% less than subsequent harvests

Source: Eide et al. 2012

2.3) Current paradigm of rent seeking behavior

As with any business, farming today is largely driven by people seeking to make a profit through their activities. This is not to say that there are no other motivating reasons behind the farmer's reasons for farming, but it is still largely seen as a way to make a living in modern society producing crops and animals for sale to capitalist

markets in exchange for financial rewards. This profit or rent seeking behavior among farmers has become an established way of thinking for farmers and in many cases, is one of the most important stakeholders when selecting what they will use their land for.

“Successful production in each area will be influenced [by] limiting stakeholders: water, hail, wind, temperature, light, nutrition and markets. Variable levels of limiting stakeholders limit yields or reduce potential for profitability. Therefore, base crop selection on the availability of these stakeholders within a given location and growing season”. (Scully, 2014)

As shown through this quotation there are numerous important stakeholders that need to be considered when choosing what to grow on your land, one of which is the market. This emphasizes the importance that having a market to sell your produce to, plays for farmers in their crop selection process.

As has been shown in the section above on the economics of Energy Willow, the soil quality of a given area also plays a crucial role in the crop selection process for farmers: the higher agricultural quality the soil, the more valuable it is as with better soil quality farmers are able to get both better yields and higher quality yields leading to better market prices and in theory higher profits. The poorer soil requires the addition of expensive nutrients to increase yield and quality, higher quality soil requires much less of this saving the farmer time and resources in the long run essentially leading to higher profitability (Ssali, 2015).

In addition to this it is very common for farmers in Denmark to take out large loans to purchase and maintain farmland (Sørensen, 2017b). With this in mind, it becomes very important for farmers to be able to make a profit on their farming activities in order to be able to pay back their debt and earn a decent living. In 2016, Denmark saw record numbers of bankruptcies in the agricultural sector. The expectation is that 2017 and 2018 would likely see the same fate for many others. (Sørensen, 2017a, 2017b))

Furthermore, in March 2017, farmers in Denmark owed 380 billion Danish Kroners in Debt making them Europe’s most indebted farmers. With such high levels of debt and

the fact that since the financial crises in 2008, banks in Denmark have had to write off 11 Billion Danish Kroners in debt due to bankruptcies and non-payment by the agricultural sector, this puts a lot of strain on the farmers themselves. (Sørensen, 2017a)

Exacerbated by the large amounts of debt, low crop prices and the lending institutions' skepticism of the Danish agricultural sector; farmers are being forced to look at their most profitable options with no real freedom to experiment with new crops. This stems largely out of fear of not being able to pay back loans or ruin the chance of being able to access fresh lines of credit due to defaults on payments, further emphasizing the role of rent seeking behavior by Danish farmers. Unfortunately, with Energy Willow there is a period of between 2 and 3 years from when the first crop is planted to harvesting, which means that farmers will be without income for this period. This creates a large problem as many banks will not even consider financing a crop that has no payback for such a long period of time as this will mean that the farmers will not be able to pay the loans during this period putting further strain on the lending institutions. (Appendix 3)

As outlined in the section above, Danish farmers are the most indebted in Europe increasing the pressure on them to turn a profit on their land in order to pay back loans and be able to stay on their farms or face bankruptcy and liquidation. With such a negative economic climate for the sector, it makes it increasingly more difficult for farmers to focus on anything besides engaging in rent seeking behavior in order to turn a profit on their land. This often leaves the farmers in a position where they are unable to experiment with new crops either due to the lending institutions unwillingness to fund such activities or for fear of low profitability or limited market potential, leaving Energy Willow in a bad position in Denmark.

3) Stakeholders in the Energy Willow industry

So far, the thesis has shown that the economics of Energy Willow does not make sense in the current paradigm, if the focus is solely based on economic viability. When looking at introducing a new crop to Danish farmers, the activity can be considered an act of entrepreneurship as shown in the theoretical part below. The following section will explore who the stakeholders in the production of Energy Willow are and investigate the relationship between the Danish government as the main institution and the other stakeholders. This relationship is crucial to understand of the governments role in regulating the market for energy. Following the stakeholder map in Figure 5, the thesis recognizes that there exist many relationships between the different stakeholders, but by focusing on how these stakeholders relate to the Danish government to, explore how the Energy Willow situation fits with the Baumol and Blyth theories, in which institutions are the crucial focal point.

Stakeholder Map

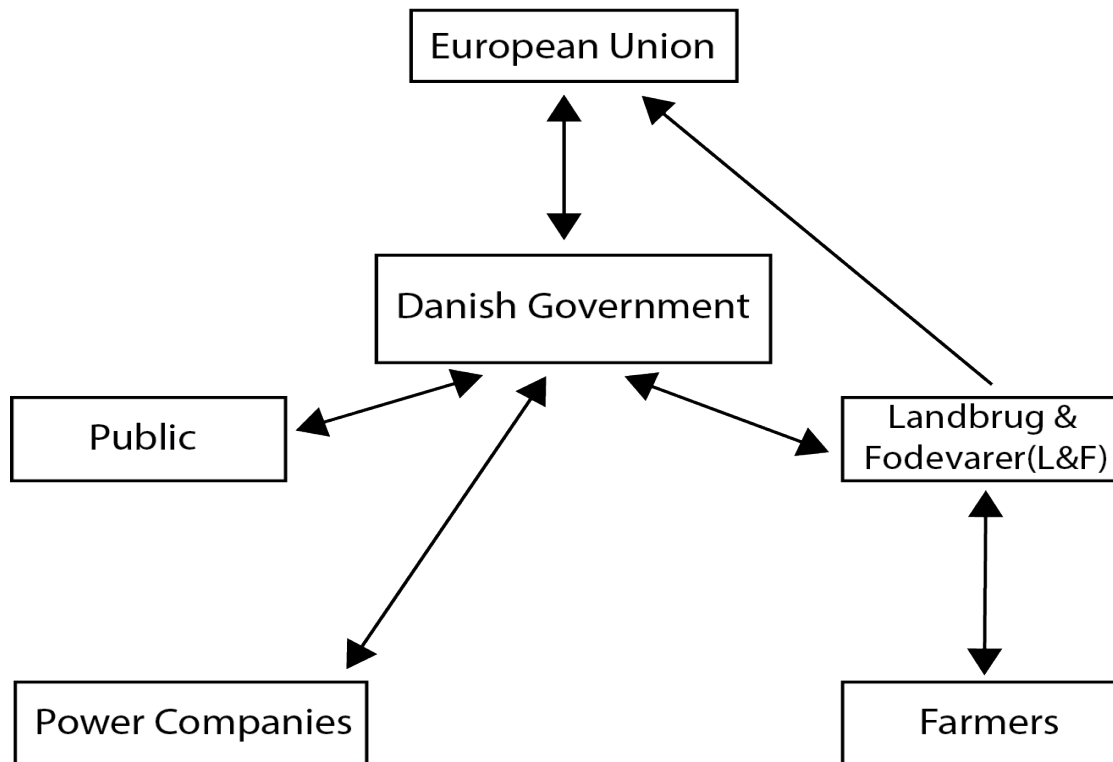


Figure 5 - Stakeholder map of the Energy Willow sector in Denmark

As can be seen in Figure 6 above, all six of these stakeholders are closely related, and it is of crucial importance to understand how they influence each other. The central focus of the stakeholder map is the government, to see how this institution is impacted by the rest of the stakeholders, when it comes to the decision making process. In the case of this thesis, the Danish Energy Agency represents the role of the government. It is important to understand the role of the government because institutions define the rules of the game, which influences how the entrepreneurship is done, and for what purpose. The second actor is the entrepreneur; the subject of investigation, as will be outlined in the literature review, the entrepreneur is a crucial figure for the development of the economy. The purpose of this thesis is to investigate the farmer as an entrepreneur and how they might start a new entrepreneurial venture around Energy Willow. As shown in Figure 5 above, the thesis focuses on six stakeholders; the farmers, the Danish Government, the EU, the public, the power companies and a lobby organization. How these organizations create an environment for entrepreneurship is

crucial to the entrepreneurial process.

It is important to note that none of these organizations are monolithic; they all represent an aggregation of stakeholders. The primary data collected in the process of writing this thesis is centered on this fact.

3.1) Danish Energy Agency (Energi Styrelsen)

The Danish Energy Agency is a department under the ministry of energy, supply and climate. The department works with national and international tasks in relation to production, supply and consumption of energy. Danish Energy Agency represents the energy interests of the government of Denmark, and is responsible for shaping and implementing energy policy in the country. Furthermore, they work with telecommunication and regulation of water and trash (Danish Energy Agency, 2017). Their mission is to ensure *“a climate friendly, effective and secure energy use and production”* (Danish Energy Agency, 2017, p.1).

As a governmental institution, the Danish Energy Agency is controlled by the ruling government, and must carry out their agenda. Thus, it is the task of the Danish Energy Agency to steer Denmark towards the political energy goals. One of the more ambitious goals is that Denmark must become fossil fuel independent by 2050.

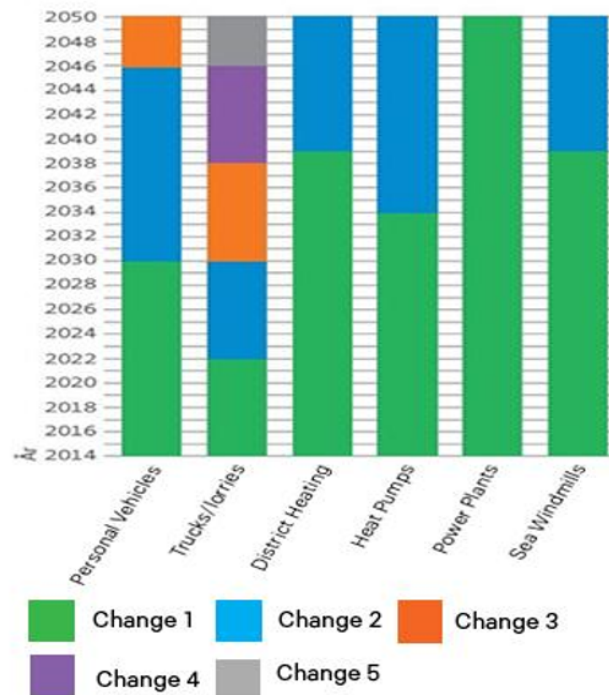


Figure 6 - Number of re-investments before 2050

Source: Danish Energy Agency, 2013

This can be done in a number of ways as explored in the report on energy scenarios, and the politicians will have to decide on the way forward. One of the issues here is the unwillingness of the politicians to pick a certain technology as being dominant (Appendix 7). For Denmark to reach independence from fossil fuels by 2050, a path, such as biomass will have to be picked soon because once money is invested into a project, the lifespan of such projects is long. As shown in Figure 7, a power plant built today will still be in operation in 2050. (Appendix 7 & Danish Energy Agency, 2013). Figure 7 shows the number of reinvestments that will be made on certain types of investments such as cars and power plants. The number of re-investments is important because once the decision is made for one type of for example car, then it takes a considerable amount before a new one is bought. As seen in Figure 7, particularly the investment into a certain type of power plant is a long term investment, and thus, the decision made today will still be in effect in 2050. Both windmills and heating pumps have such a long life span that only one reinvestment will be made prior to 2050. Thus, the decisions made today have a large impact on the future. Figure 7 also shows that the transportation sector is the one in which decisions can be delayed the longest. While this is the case, the scenarios still set up the choice between electric cars and bioethanol cars (Danish Energy Agency 2013).

The Danish Energy Agency as a part of the Ministry of Energy has great importance, because they are responsible for the implementation of the energy policy, and thereby, responsible to a large degree for the choice of energy sources used within Denmark. They essentially set the roadmap for which sources of energy are to be used and which sources will not be favored. This often happens using financial incentives and deterrents. In relation to Blyth's theory of path dependence, as described later, the choice of energy source can have a large impact on this, as once an energy source is selected, that energy source becomes the one that is used by the power utilities to produce energy for the country. As the investments required to establish new energy sources are often considerably large, these investments are expected to last many years creating a natural path dependency on these energy sources. As Energy Willow is an energy source, it is directly affected by the decisions of the Danish Energy Agency, and whether it falls into the category of favored or not favored energy sources.

In general, the Danish Energy Agency does not like to select winning technologies as this can lead to market distortions: *"there's sort of a mantra among politicians that we need to make regulation as technology neutral as possible and let business and private enterprise figure out what the most feasible, what the best technologies are."* (Kampmann, 2017). The EU is against competition policy regulations where governments directly subsidize their own industries. Indirect support is, however, possible, as seen in Denmark with the wind industry. In 2009, the Danish government was able to support wind energy through policy support mechanisms such as the implementation of an environmental premium of DKK 0.25/kWh for 22,000 full load hours which is the equivalent to 10 years of operation. This additional fee was added directly to the market price for electricity. (IRENA, 2013) This support to local industry is often linked to the size of the industry in question as in Denmark the wind energy is particularly large and creates employment within the industry. This choice of technology is something that is largely based on political will which as discussed in the limitations section below is a complex issue which is not dealt with in detail in this thesis. The main point of importance is, however, if a particular energy source is favored, how it can skew the market creating an unfair advantage for the supported technology.

3.2) European Union:

The EU is a political and economic union made up of 28 European member states that together cover a big part of the continent. The EU covers policy areas spanning from climate, agriculture, environment and health to external relations and security, and justice and migration. Policies created at the EU level need to be adopted by the individual member states in order to be implemented in each of the states. The EU as an actor is relevant to our analysis as the institutions of the EU are involved in shaping many of the policies that are implemented at the national level of many of the member states. These policies and frameworks are essentially new ideas that need to be accepted by the member states, who then implement these ideas and create a new 'path' for their respective countries to follow.

At an institutional level, the EU plays a large role in influencing the formation of policy at the national level in each of the 28 member states. As the focus of this thesis is to look at Energy Willow and its potential as a biomass source in Denmark, it is important to understand how the EU as an institutional player can have an effect on this outcome. The institutions within the European Commission that are of most interest to this thesis, are the Directorate General (DG) for agriculture and rural development and the Directorate General (DG) for energy, which deal with the policies that span agriculture and bioenergy sectors within the EU, both of which are topics related to this thesis.

The policy of most relevance to this thesis at an EU level is the European common agriculture policy (CAP) which is a very broad policy that “*ensures a decent standard of living for farmers, at the same time as setting requirements for animal health and welfare, environmental protection and food safety.*” (European Union, 2017a) As a second pillar to the CAP is the Sustainable Rural Development Policy, which is aimed at helping rural areas within the EU to meet economic, social and environmental challenges of the 21st century. The sustainable rural development policy is guided by a framework for rural development programs, which the member states use to draw up their own rural development programs based on the needs of their territories and addressing at least four of the following six principles: Dissemination of knowledge in the agricultural sector, enhancing competitiveness and improving the natural environment (European Union, 2017b).

With the six principles, the rural development program aims to promote innovation within the European agriculture sector while restoring, preserving and enhancing agricultural ecosystems and supporting the movement towards a low carbon and climate resilient economy (European Union, 2017b). As stated above the individual states need to draw up their own policies in line with the six principles and their own rural development needs but need to meet at least 4 of the 6 principles in order to qualify for funding. As these are only guidelines for the individual states, they do not necessarily need to follow them, but it is in their own, as well as broader society's, interest for them to do so as they have been drawn up in order to help each of the member states transition towards sustainable, carbon neutral economies.

In 2009 the EU introduced directive 2009/28/EC, a legally binding directive which created the renewable energy target of 20 percent renewables in final energy consumption by the EU as a whole by 2020. As this directive was essentially a new idea that was accepted by all member states, it became the new path that the EU member states needed to follow with regards to their respective energy policies in order to reach the goal of 20 percent renewable energy (Danish Energy Agency, 2015). As shown in Figure 8 below, the goals of each country vary quite widely showing just how divided the different countries are in accepting this idea and locking it into their policy frameworks. In Figure 8, one can also see that Denmark in 2015 was already ahead of the 2020 target of 20 percent: “[c]ountries like France, the Netherlands and UK will probably not reach their renewable energy target, while countries like Sweden, Denmark, Finland and Belgium will over fulfill their target.” (Danish Energy Agency 2015, p3) Additionally, the figure shows that some individual countries have set much lower renewable energy targets than others, again emphasizing how little traction this ‘idea’ has gained within some countries.

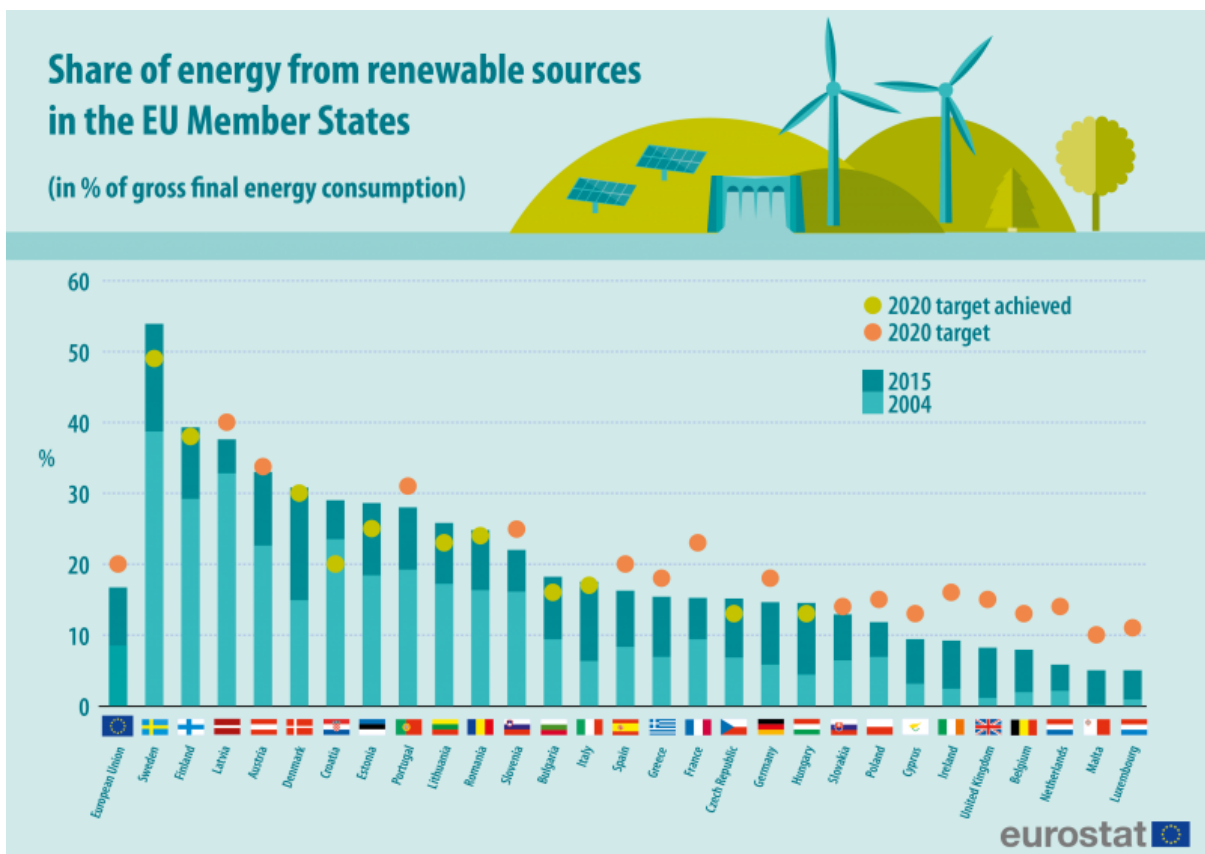


Figure 7 - Share of energy from renewable sources, 2004 and 2015

Source: Eurostat, 2017

One important concern when looking at EU as a whole is the economic differences between member states. Some of these countries have very large fossil fuel industries, and / or dependence on fossil fuels and it is, therefore, a much longer process to transition to renewables. Different stages of development both within the Energy Sector, and the economy in general contributes to this difference in levels of renewable energy usage. All of the member states are democracies, and they, therefore, must make policy based on public opinion. As shown in the section on the public as an actor, income per capita plays a large role in how concerned citizens are for the environment. It is, therefore, only natural for governments with poorer populations to focus their policy making elsewhere.

In November 2014, the European Council proposed for a recast of the renewable energy directive (2009/28/EC) which essentially sets the new goal for renewable energy use at a target of 27 percent by 2030:

“[t]he new framework sets out the European Union target of at least 27% for the share of renewable energy consumed in the EU in 2030. This target is binding at EU level and will be fulfilled through individual Member States' contributions guided by the need to deliver collectively for the EU.” (European Commission 2016 p2)

As illustrated through this quotation, the EU once again tried to emphasize the importance of the renewable energy goals by raising the bar from 20 percent to 27 percent, trying to create a stronger path dependency on renewable energy within the EU. With these targets being binding, the member states need to seriously consider how they can adapt their policies to be able to meet these goals and lock in the idea of renewable energy into their policy making process as well as gain the acceptance of their respective populations to be able to achieve the shift and meet the new targets. The renewable energy targets are a good example of how the EU is using an idea that renewable energy is a good thing and should be more heavily implemented in the member states energy policies, this creates a blueprint of how the issue should be perceived by the member states.

Based on current estimates from the EU, the use of biomass in the energy goals could contribute up to 60 percent or two thirds of the final 2020 renewable energy target of 20 percent. In order for this to happen, the use of biomass will have to roughly double by 2020 (European Commission 2017a) One of the ways in which the EU has tried to increase the use of biofuels is by decoupling the direct payments for farmers from what is produced. Before the EU would only support farmers through direct payments if they were growing crops that were in line with the EU quotas, with the decoupling of payments from production, farmers are granted the payments regardless of what they grow and for what purpose (food, feed, energy or material). In addition to this, in the agricultural sector is seen as one of the key areas, which has the potential to contribute to the large expansion of biomass supply in the EU. (European Commission 2017b)

In 2003, the European Commission under regulation No 1782/2003 established specific support for energy crops in order to assist the development of the energy crop sector as energy crops are seen as a way to help to improve the overall profitability of the farming business, contributing to the maintenance of farmland in areas where it is

needed from an environmental or sustainable development perspective. These crops are also important as they help improve soil stability and prevent irreversible damage to vulnerable areas. (European Commission 2005)

This regulation was in place until November 2008 when the European Commission revised the regulation due to the strong demand for such crops and development in the bio-sector. It was decided that aid for growing (annual) energy crops which includes plants such as Energy Willow would be discontinued and the market would take over in order to enable farmers to better respond to changing market demands. This change in policy could be seen as a reaction by the EU to the growth of the biomass and in particular the energy crop market within the EU to a point where they believe that it is no longer necessary for them to subsidize the annual energy crops as they used to. (European Union 2011)

3.3) Farmers

The farmer plays an important role in this thesis as the entrepreneur. The way in which the farmers act in the current environment is of crucial importance. When determining the stakeholders to promote entrepreneurship, this thesis focuses on how the institutions affect the innovation of farmers. The entrepreneur reacts to the way the environment is set up, with the goal of doing the best for themselves. If the rules of the game encourage building your own business and creating something new, then entrepreneurial energy will be spent in that direction. In the opposite case, if the system is setup to make it easier to make money by using litigious methods and short term profits over building something new, then entrepreneurial energy will be spent in that direction (Baumol, 1993).

A farmer, as used in this thesis, follows the definition used by the EU in the context of the Common Agricultural Policy: “[a] farmer is an individual (or group of individuals e.g. partnerships, companies, and other legal structures through which a business is conducted) whose holding is situated with the territory of the European Union or who exercises an agricultural activity.” (European Union 2016 p. 1)

In relation to this thesis, farmers are important players as it is the farmers who have the potential (land and resources) to grow the Energy Willow that can then be used as an energy source as well as be used for other externalities. We consider the farmer as an entrepreneur in this thesis as the farmers use their land to undertake an economic agricultural activity in order to make a profit or to earn or appropriate rent on the land. (Douhan & Henrekson 2008)

As shown in Figure 6 above, the farmers communicate directly with the farmer's union Landbrug og Fødevarer which in turn represents the farmers at a national and EU level raising the general concerns of the Danish farmers and relaying the information they receive back to them. By being reliant on L&F both for information on farming legislation and for best farming practices, it puts the farmers in a somewhat vulnerable position to the influence or ideas of L&F. With regard to Baumol's theory looking at the different kinds of entrepreneurship, farmers that can engage in L&F has a significant amount of influence over what information they share with the farmers which could have a direct influence over which direction the farmers choose to focus their entrepreneurial abilities (Appendix 12).

In Denmark the agriculture and food sector remain the largest economic sector employing an estimated 170,000 people giving it significant macroeconomic influence in the Danish economy. (Landbrug og Fødevarer, 2017). It is not only in the best interest of the government to maintain a good relationship with such an influential sector, but also to encourage the growth of the sector in order to create jobs and spur economic growth in Denmark. In line with Blyth's theory of ideas as weapons, it is important for stakeholders to be able to influence the ideas of the farmers to encourage growth and continue building up the competitiveness of the agriculture sector in order not to negatively affect growth in the other sectors that rely on agriculture in Denmark.

With regard to Energy Willow, as it does not yet have a well-established market in Denmark, it is natural that farmers may be more hesitant to switch to such a crop where the initial investment in setting up the production is high and there is also a higher uncertainty or risk in terms of the financial rewards: "*[w]illow as an energy fuel is economically vulnerable.*" (EA Energy Analysis, 2010 P.94) In addition to the uncertain financial incentives and rewards for Energy Willow, is the size of the potential market

that is willing to pay the stipulated price for the product. Up until now, the system that is in place has relied on the farmers to establish deals with local power stations to buy the willow at a stipulated price for a certain period. This system does not allow for free market dynamics to take place which power utilities rely on in conducting their business due to the competitive nature of the industry. (EA Energy Analysis, 2010)

3.4) Landbrug og Fødevarer (Danish Agriculture and Food Council):

In Denmark, unions and interest organizations play a large role in the economy and the farming sector is no different. L&F is Denmark's largest agricultural interest organization which is the result of a merger between five organizations: Danish Agriculture, the Danish Bacon and Meat Council, the Danish Agricultural Council, the Danish Dairy Board and Danish Pig Production. (L&F 2017) L&F represents the food and farming industry, Denmark's largest economic sectors including business, trade and farmer associations at a political level as well as conducts Research and Development (R&D) on behalf of the farmers and offers best practice and other such consulting services to its members. L&F is also present in Brussels representing the interests of the Danish food and agricultural industry at the EU level (Landbrug og Fødevarer, 2017).

Agrovi is a farmers' association representing farmers in one of the regions of Denmark and falls under L&F's umbrella organization. Agrovi specializes in advising its members on agricultural best practices in line with L&F's policies as well as works with L&F to promote their members' interests at a policy level (Appendix 6).

L&F itself has great influence on the political process (Abrahamsen, 2016). The organization had a turnover in 2015 of more than 1.4 billion kroner, employs more than 1,000 people and has a knowledge center called SEGES (Abrahamsen, 2016).

3.5) Energy producers:

Energy producers used in this thesis are those private and public companies that turn fuel (biofuels or fossil fuels) into heat, electricity and fuel for transportation, either through the combustion of the fuel or by the processing of the raw materials into combustible fuels. The energy is then sold to private and public users either as fuel for transportation or through a grid distribution network for heat or electricity.

In this thesis energy producers are a key player as they essentially decide which sources of input they will use to convert into the aforementioned energy sources (Appendix 6). The chosen energy source is often in line with the policies set up by the ministry of energy. For energy producers it is often the economic costs vs efficiency of using a particular fuel that makes them choose it over another (Ugilt Larsen et al., 2015). More recently, however, with the introduction of carbon emissions reduction frameworks these companies now have to consider the carbon emissions of the fuel as well as the economic aspects (Appendix 6). Large energy producers are often under pressure to meet certain regulations regarding CO₂ output by both legislators and the public, which in recent years has created a shift towards the use of more alternative fuels to fossil fuels as is the case in Denmark today. (Hansen, 2016)

3.6) Public:

As part of the research into the public as an actor, we have interviewed two academics to provide us with greater insights into how this actor could be seen. As these two academics specifically conduct research the energy sector, they can be expected to have greater knowledge in the field, but seeing as they are working to illuminate the area of our study; it still makes sense to view them as part of the public opinion.

The public as used in this thesis are all those persons that are part of a given society. In the case of Denmark, the public refers to all the people that live within the borders of Denmark. The public is crucial in the discussion on Blyth and how ideas become embedded in society. As the society is largely responsible for which policies are chosen in a functioning democracy such as Denmark. Politicians respond to the demands of individuals, groups and interest organizations who often try to influence

the direction of policies in their favor. The stronger the demands are and the more people there are behind policies often leads to these demands being translated into policy:

Shaping public policy is obviously different in Western-style democracies than in other forms of government. But it is reasonable to assume that the process always involves efforts by competing interest groups to influence policy makers in their favor. (Kilpatrick, 2000)

It is in this way that the public use their ideas as weapons to gain support from other members of the public to try and persuade the policy makers into creating policy in their favor.

As shown in Figure 6 above, the public and the government have a two-way channel of communication both of which have an interest in influencing each other. The government seeks to use its ideas or policy agendas to influence the public into supporting them during elections and the public in turn vote for the politicians in the hope that these policies come to fruition (Blyth, 2001). It is exactly this process that is of interest to this thesis as it is of utmost importance that there is public support for the energy policy for the government to move forward with policy making or they may face fierce backlash. As seen in Figure 9 below, the representative politicians create a law through the first seven steps, before it is finally passed as part of the 3rd processing (Folketinget 2017). In the case of Energy Willow, the governing parties come up with an idea regarding, for example, subsidies which they send to 1st processing. After 1st processing, the parliament's agricultural committee works on the proposal, with inputs from lobby groups. The politicians from different parties are elected to represent an agenda, and this agenda is what influences the process. Thus, the public does not directly influence the process, but only by communicating their reaction to the proposed laws.

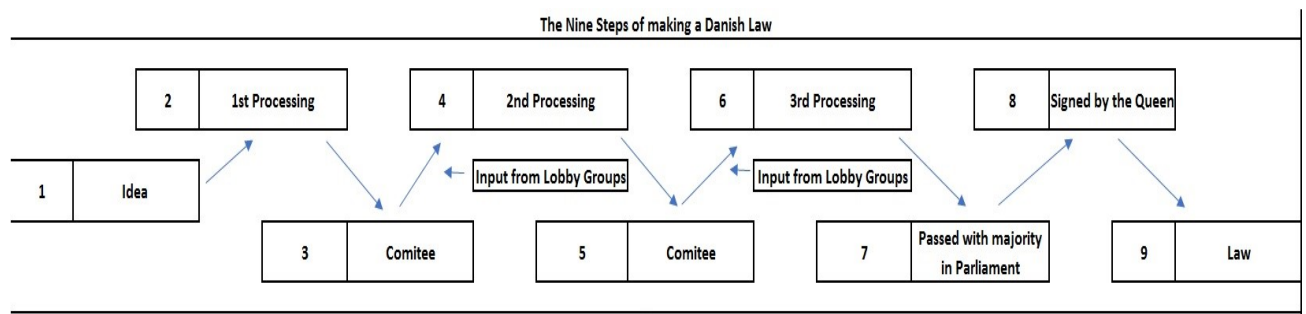


Figure 8 - The nine steps of making Danish law

Source: Folketinget, 2017

Prior to 2008 there where large public resistance to the government funding of new wind farms in Denmark, as members of the public feared damage or property value losses due to the wind farms around their properties. (Jeppesen,2014) In 2008, the government introduced new requirements that led to greater public support for the wind farms. This was done by introducing direct compensation to homeowners if there was a loss or damage to homes because of the windmills, in addition to this, shares in the windmill projects had to be offered to residents, giving them a direct stake in the projects. (Jeppesen, 2014) By gaining public acceptance, the government can keep their idea in circulation, eventually creating a reliance on this idea and leading to path dependence. Furthermore, with public support for such initiatives the Danish government can move forward with their ambitious goals of meeting the 2050 fossil fuel free society knowing that the public are behind their initiatives: “*Danes have committed to reducing emissions simply because they want to.*” (Greenpeace, 2014 p 6)

Denmark is generally regarded as one of the better functioning environmental democracies in the OECD: “[p]olicy making is open and consultative and a wide range of measures are in place to ensure public participation and stakeholder involvement, provision of and access to environmental information, as well as the right of administrative and legal appeal.” (OECD 2017 p.2) As shown in Figure 10 below there is a direct correlation between the affluence of a society and their concern about the environment: “[e]nvironmental issues have relatively higher salience in Danish public opinion than they have in other EU countries.” (Kosiara-Pedersen and Little, 2015, p.558). This is of importance to this thesis, because with a high concern for the environment and a relatively high GDP per capita, many Danish people currently pay

a premium price for energy that is produced from alternative sources which are non-destructive to the environment showing that concern for the environment is relatively high priority for them as without public support such initiatives would not be able to continue. (Danish Energy Association, 2012) With public support in their favor, Danish politicians have been able to create a platform for energy companies to use to shift their energy production from fossil fuels over to renewable energy sources while being publicly funded through taxes and other financial incentives.

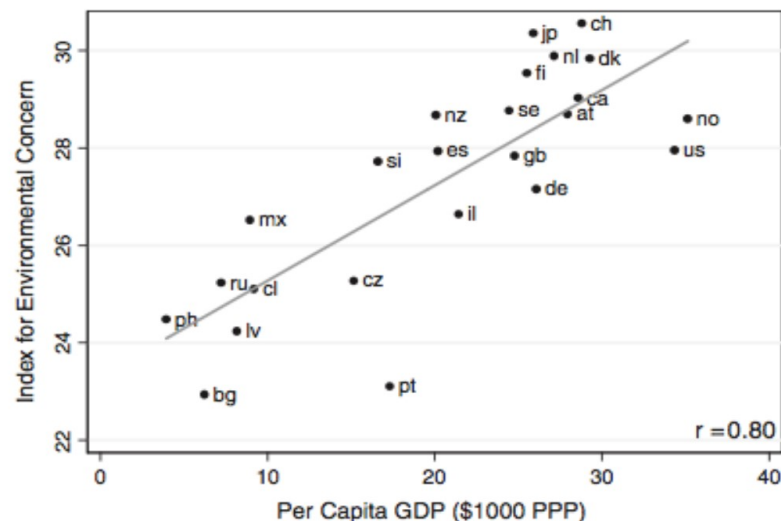


Figure 9 - Graph showing the relationship between environmental concern in selected countries and GDP per capita (PPP), 2010

Source: Franzen and Meyer (2009: p.226)

Key to Countries: Switzerland (ch), Japan (jp), Netherlands (nl), Denmark (dk), Finland (fi), Canada (ca), Sweden (se), Austria (at), New Zealand (nz), Norway (no), Ireland (ie), USA (us), Spain (es), Great Britain (gb), Slovenia (si), Germany (de), Israel (il), Mexico (mx), Russia (ru), Czech Republic (cz), Chile (cl), Philippines (ph), Latvia (lv), Portugal (pt), Bulgaria (bg).

If Energy Willow is not known to the public as an energy source as well as the numerous benefits to society that it could bring, it is highly unlikely that there will be any kind of public debate on the topic. If, however, the government and other stakeholders are to bring forward the debate on Energy Willow into the public forum, explaining the use of the crop as well as the numerous benefits that it could bring to Danish society, it could possibly lead the public into demanding more of it in the energy system. With such a demand, the government would be forced to consider how they could bring Energy Willow into the policy frameworks to promote its growth among Danish farmers.

4) Research Question

As it has been established that there is a great interest in Denmark today about how the country will reach the 2050 goals of fossil fuel independence with the five energy scenarios laid out by the Danish Energy Agency. The possibility of reaching these goals using biomass as a large source of this energy is a very real option. However, with many other countries also considering the shift to alternative fuels, demand for biomass is set to explode leaving Denmark in a vulnerable position if we cannot secure our own supplies. Following on from the operational research question above, it can be argued that the Danish government should promote the growth of Energy Willow through the use of subsidies. This, is largely due to the fact that willow not only provides a source of biomass that can be used to produce clean energy in Denmark, but also provides numerous other benefits in the form of positive externalities that can be calculated into a direct monetary value as shown above. These benefits are not only good for the direct environment in which the willow is planted but also for society at large. Using the theories of Baumol and Blyth has shown that understanding the role of stakeholders such as institutions is crucial in determining the role of entrepreneurship in a given society, thus the research question becomes:

What role can Energy Willow play in reaching the Danish 2050 energy goals and is it desirable for society that Energy Willow plays this role?

5) Theory and Literature Review

With Energy Willow being such a big source of innovation, the thesis will need to explore the issue of Energy Willow as a source of entrepreneurship. The goal of this chapter is to position the thesis in the existing entrepreneurship literature.

With the basis in the background material from the two aforementioned reports, the immediate goals of this thesis are established, as seeking to explore the potential to create a domestic production of biomass. The scenario report (Danish Energy Agency, 2013) clearly shows the importance of biomass to the energy sector and the willow

report (Ugilt Larsen et al., 2015) proves the substantial potential of Energy Willow as source of biomass. Creating a local production of biomass is important for several reasons. Firstly, consumption of biomass is increasing all over the world, and current global production is not sufficient to meet these requirements (Appendix 6 & 12). Secondly, the externalities of Energy Willow are highly beneficial for the Danish society, because these externalities improve both the CO₂ emissions of Denmark as well as improve the soil and water quality near the field. Finally, the willow crop can provide energy security to a system that is otherwise dependent on foreign energy inputs and intermittent power sources. All of these issues will be explored further in the analysis. To create this production, someone needs to start using agricultural land to grow this crop. Yet, currently a major barrier to the adoption of willow is the limited knowledge of how to develop/grow the crop and the poor financial outcome.

This crop clearly has potential; however, someone is needed to grow it, and for that to happen innovation need to take place at the Danish farms. Schumpeter defines innovation as “*the carrying out of new combinations*” (Schumpeter in Baumol 1990 p. 896). Within his framework, there are five different cases; New good, new method of production, new market, new supply of raw materials, and new organization of industry (Baumol 1990). Introducing an alternative crop such as Energy Willow is an interesting case of entrepreneurship because the introduction of Energy Willow constitutes a combination of all of these forms of innovation.

Energy Willow constitutes a new good for the farmer/entrepreneur, as this new crop, is relatively unknown as a large-scale cash crop. This is also the source of discussion surrounding the issue of agricultural biomass on two separate issues discussed later; the induced land use change and the issue of food security vs. energy security. Both of these issues stem from the fact that traditional farmers use agricultural land for food production. With this new crop, the focus would shift from food production to energy production.

Changing production from traditional crops with a yearly cycle to a perennial crop such as Energy Willow constitutes a major shift in the method of production, and this is a concern for farmers (Ugilt Larsen et al., 2015). Energy Willow’s triennial harvest cycle, the crop itself is on the field for 18 years as compared to one season for traditional

crops. This represents a negative element for farmers as it greatly reduces the individual farmer's flexibility to change crops depending on the current market prices (Ugilt Larsen et al., 2015). Another change is also the methods surrounding the planting, caring and harvesting of the crop, as Energy Willow is largely unknown, and most lack sufficient knowledge to achieve optimal results, a problem that can be alleviated through dissemination of knowledge (Ugilt Larsen et al., 2015).

For the farmer, Energy Willow is also a potential new market opportunity because of the shift from food production to energy production. This means that the farmers have to face a new category of buyers. They have to sell their crops to energy companies like HOFOR instead of their traditional buyers i.e. food or commodity companies. This new market as a source of entrepreneurship as used by Schumpeter, is one of the major concerns in the Willow Report from Danish Energy Agency. This concern is due to the fact that the Energy Willow farmers lack the organization on the energy market to secure better deals compared to the traditional crop markets which are well established and organized.

The shift to Energy Willow is finally a source of innovation in the sense that it requires a new organizational set-up of the industry. As has been highlighted before, the support organizations for farmers revolve around traditional food production. Another issue highlighted in the with both the interview with Henrik Bach and Henrik Rasmussen interviews is the problem of definitions, how is the production of Energy Willow defined is questioned by the industries involved; *"[t]he forestry industry sees us as farmers, and the farmers sees us as forestry"* (Appendix 4), this requires a shift for the traditional farmers coming into the production of energy.

The underlying assumption of the thesis is based on the work from Hall & Soskice on varieties of capitalism, in which they analyze three different views on capitalism, in which *"Each of these formulations captures important ways in which the institutions of the political economy affect economic behavior"* (Hall & Soskice 2001 p.5). As Hall & Soskice state that each of these perspectives work with institutions, we find the assumption that institutions affect the economy to be a reasonable assumption. For this reason, the thesis will look into the governance of agricultural biomass to understand the viability of the biomass market for Energy Willow. This ontological

stance informs the basic reasoning for why the thesis has chosen Baumol's approach to entrepreneurship and Blyth's information dissemination framework to provide two different theories to investigate the viability of Energy Willow. From the basis of Hall & Soskice, the two theories fit very well together in investigating entrepreneurship. The above quotation from Hall & Soskice neatly summarizes how the thesis intends to use the two theories to explore how Energy Willow can contribute to a CO2 neutral society. The quotation from Hall & Soskice fits, as Baumol is investigating the effect of society on one particular set of economic behaviors, namely how society affects the allocation of human resources. Following this point, the thesis intends to use Baumol as the analytical tool to understand the current situation and how entrepreneurs react to different scenarios. To understand how these scenarios come about, and to make recommendations towards the future, Blyth's framework will be used. This framework also fits quite well with the quotation from Hall & Soskice (2001), as the framework seeks to explain how the institutions change.

Additionally, the ontological position of Hall & Soskice (2001) fits very well with Baumol. The book *Entrepreneurship, Management and the Structure of Payoffs* (1993), has a strong focus on the effects of politics on entrepreneurship. This can, for example, be seen in the historical overview done on several significant countries in different time periods such as ancient Rome, early China, and Europe during the Middle Ages and the Renaissance (Baumol 1990).

Two aspects from the book are of particular importance. The first is one the structure of payoffs and how rent seeking behavior affects how entrepreneurship is done in a country. In this part of the framework, the concepts of productive, unproductive and destructive entrepreneurship is outlined as part of discussion on how entrepreneurship effects a country overall. The second aspect is on the way new knowledge is disseminated. This is very relevant in the case of Danish Energy Willow because Energy Willow is a relatively unknown resource, and how the growth of this is facilitated, is the subject of this study.

The thesis will look at farming as an economic activity with the potential of both beneficial and rent seeking behavior. Baumol looks at how the resources are focused in a country depending on the institutional setup. The thesis will focus on the farming

sector of the economy, and take an in-depth look at how entrepreneurs are encouraged to focus their energy in one particular direction. Baumol postulates that entrepreneurs can be defined as *“persons who are ingenious and creative in finding ways to add to their own wealth, power, and prestige.”* (Schumpeter 1991 p. 897). This is also the definition that we will use in our thesis to categorize the entrepreneur. Thus, when investigating the incentives to spend energy on something like Energy Willow which might not be the not financially viable, it is important to bear in mind: *“it is to be expected that not all of them will be overly concerned with whether an activity that achieves these goals adds much or little to the social product or, for that matter, even whether it is an actual impediment to production”* (Schumpeter 1991 p. 897-898). Expanding on this, there will be a discussion on environmental economics below, and on the externalities of both traditional farming and Energy Willow.

Positioning the thesis in the entrepreneurship literature, Shane and Venkataraman state: *“[p]eople make decisions on the basis of hunches, intuition, heuristics and accurate and inaccurate information, causing their decisions to be incorrect some of the time”* (Shane & Venkataraman 2000 p. 221), thus, the sources of information and what is considered becomes crucial when looking at Energy Willow. This directly links Blyth’s theory on path dependency to entrepreneurship as *“[a]lthough an opportunity for entrepreneurial profit might exist, an individual can earn this profit only if he or she recognizes that the opportunity exists and has value”* (Shane & Venkataraman 2000 p. 221). This is important because, it tells us something about of the paradigm guides entrepreneurship, as path dependency might keep some opportunities undiscovered.

5.1) Baumol: Entrepreneurship within institutions

According to Baumol entrepreneurship is always a part of society but *“[h]ow the entrepreneur acts at a given time and place depends heavily on the rules of the game - the reward structure in the economy”* (Baumol 1990 p. 894). This section will begin by defining the act of entrepreneurship as innovation and working with the three different concepts to separate entrepreneurship; Productive, unproductive and destructive. Then the thesis will look in-depth into the question of imitation as entrepreneurship, and the effort and opportunities imitating could give established Energy Willow farms.

Baumol uses three definitions to look at the outcome of entrepreneurial activities. These activities are guided by the rules of society, and the rules determine which kind of entrepreneurial behavior that will be engaged (Baumol 1993). As opposed to Schumpeter's ideas on innovation, Baumol states that some entrepreneurial activities will not benefit society as a whole. Behavior such as rent seeking benefits the individual engaging in the activity, but hurts society as a whole. Baumol's third proposition states *"[t]he allocation of entrepreneurship between productive and unproductive activities, though by no means the only pertinent influence, can have a profound effect on the innovativeness of the economy and the degree of dissemination of its technological discoveries."* (Baumol 1990, p. 909). Thus, it becomes crucial for the thesis to understand how the activities are ranked today.

How entrepreneurs act within the rules of society will be a large part of the thesis. Specifically, Baumol's framework is important due to the nature of externalities. Energy Willow brings a host of benefits to society as outlined the chapter on the externalities of Energy Willow. These benefits are not of direct economic value to the individual entrepreneur, but rather society at large. Since the value is not reflected in the market price, there is a market failure (Appendix 7). Today, Energy Willow cannot compete with other types of crops (Appendix 6 & 12), however this ignores the external benefits that society gains.

In Baumol's framework, the three concepts will be crucial to the thesis as they will inform the discussion and the narrative supporting the thesis. One particular aspect of this chapter will be focused on the normative discussion on Energy Willow in an effort to define the production of this crop as productive entrepreneurship.

The second part of Baumol's framework used in the analysis is the mechanisms of technology transfer. According to Baumol, imitation is a major part of entrepreneurship (Baumol 1993). The thesis will explore how the knowledge on Energy Willow is disseminated to farmers, and the goals of the different stakeholders when spreading this knowledge. As seen in the stakeholder map, they are all closely related, and have a large influence on each other. Dissemination of knowledge is a crucial aspect of knowledge creation, *"[t]hus the subsequent improvements after the earliest innovation*

are, characteristically, of critical importance, and it is often the imitator rather than the original inventor or innovator who is responsible for those improvements” (Baumol 1993 p. 182). This also emphasizes a second point of the discussion on Energy Willow; does it simply need to become more widespread to be more valuable to society?

The thesis works with Baumol because as seen above, it puts an emphasis on both institutions and entrepreneurship, which will give a well-rounded analysis on the potential for Energy Willow today. Looking at the later work based on Baumol’s theory, the focus is on either how institutions affect entrepreneurship or dissemination of knowledge. A look into how institutions affect entrepreneurship has been done in several different directions. Murphy, Shleifer & Vishny look deeply into the stakeholders that determine whether rent seeking behavior or entrepreneurship is an attractive choice. Their evidence shows that *“the allocation of talented people to entrepreneurship is good for growth, and their allocation to rent seeking is bad for growth”* (Murphy, Shleifer & Vishny 1991 p. 522). This direction of inquiry is not applicable to this thesis, because the focus will be on the behavior of one group in society, farmers, rather than the allocation between groups. Another direction this line of inquiry can take is on a macro level. When comparing countries, such as done by Hall & Jones (1999) in their paper on why some countries produce more output per worker Hall & Jones claim *“the primary, fundamental determinant of a country’s long-run economic performance is its social infrastructure”* (Hall & Jones 1999 p. 95). This line of inquiry, while important, does not fit into the goal of this thesis, in which the focus will be on a single country, rather than multiple. On the other hand, research focusing on entrepreneurship looking into dissemination of knowledge such as Antonelli (2007), focus on number of patents and macro level economics. Antonelli looks into how institutions can help generate knowledge and increase dissemination. The thesis will use some of the results of these studies, while focusing on one particular type of innovation rather than on the overall level of innovation.

5.2) Mark Blyth

Mark Blyth’s theory of path dependency and ideas as weapons as used in *The transformation of the Swedish model: Economic ideas, distributional conflict, and institutional change* looks at the transformation of the Swedish model of economic

regulation during the 1930s and 1940s from an ideational perspective. Blyth looks at how the emergence of new ideas caused the breakdown of the social democratic Swedish economic model and not only the structural stakeholders as it may seem from the outside. Blyth uses three main concepts to explain how ideas are used to reduce uncertainty: ideas as institutional blueprints, ideological weapons and cognitive locks (Blyth 2001).

This section of the thesis will explain how Energy Willow as a substitute to other forms of biomass and traditional crops can be used as a new idea to challenge the existing institutional norms and standards. It is the idea of Energy Willow that can be used to challenge the dominant views of today, both the views that traditional crops and other forms of biomass are more economically viable and just as beneficial to society as the Energy Willow.

Ideas as an institutional blueprint is the first concept used to explain how an idea is introduced in uncertain circumstances when rational options may not be immediately available. These ideas are used to create new potential paths for stakeholders to follow as alternatives to the uncertain options: “[i]deas are important precisely because they reduce uncertainty, give content to interests, and make institutional construction possible.” (Blyth 2001 p. 3) Once the idea has been accepted by the stakeholders it can then become a ‘*blueprint*’ which can be used as a foundation for institutional change. Institutional change can happen when the idea has caught on with enough influential people that are able to make the changes to the institutional framework. Concerning this thesis we will look at the idea of Energy Willow as a potential biomass source in Denmark to help meet the 2050 Danish energy goals. The idea of Energy Willow as a potential biomass source will be looked at from the perspective of six different stakeholders, the Danish public, a Danish Energy Willow farmer, the government (Ministry of Energy, Supply and Climate), the European Union, a Danish power and heat provider and Denmark’s largest agricultural lobby group (Landbrug og Fødevarer). These perspectives will be used to help establish the argument for Energy Willow as a potential source of local biomass in Denmark. The relevance of these stakeholders in connection to the theory is that in order to understand Blyth’s theory on how ideas can be used as weapons, it is important to understand the perspectives of each of the stakeholders being discussed and the relationships between these

stakeholders. As can be seen in the stakeholder map in Figure 6, there are multiple stakeholders involved in the Danish energy system. In particular, with respect to establishing a favorable environment for local production of Energy Willow in Denmark, all of which have their own agendas when it comes to biomass as an energy source. These sometimes differing agendas can be said to be the ideas that could be used as weapons for each of the stakeholders when trying to convince the other stakeholders to buy into their ideas. Additionally, the stakeholders are important, in order to understand the entrepreneurial environment and how this shapes their behavior, as per Baumol's theory.

With the second concept, using ideas as '*ideological weapons*', where the accepted ideas can be used to challenge existing institutions through scientific and normative critique proving how current institutions are to blame for the existing problems. "*In deploying economic ideas as weapons, agents can restructure existing institutional arrangements by defining not only the causes of a perceived economic problem but also the solutions for dealing with it.*" (Blyth 2001 p. 4) As Energy Willow is seen as both an alternative to traditional crops grown on agricultural land today and as an alternative to other biomass sources it is exactly this idea that challenges both traditional farmers and the biomass energy sector as institutions. By establishing a well-developed argument using scientific and normative critique of existing solutions and practices, those in favor of Energy Willow can create a powerful argument to prove that current solutions, traditional farming methods and other sources of biomass, are less beneficial to both farmers and society than they may believe. In addition to this, they can show that Energy Willow can actually provide solutions to some of the problems faced by farmers and society through the positive externalities that Energy Willow could produce.

The last concept is that of ideas as '*Cognitive locks*' where the ideas that have gained momentum among the stakeholders and become embedded then create a new framework within which all stakeholders must act (Blyth 2001). Once the newly established frameworks become the accepted as the standard it creates a new path dependency, a perspective "*in that initial decisions and conditions almost irreversibly affect subsequent decisions or occurrences which ultimately produces an outcome which can be estimated.*" (Wesleyan University 2017 p. 1) With path dependency,

ideas are locked in and as times goes on become increasingly more difficult to break the norms. With regard to this thesis we look at two aspects of cognitive locks, the first of which is that of the current situation in Denmark where economic value is seen by farmers, the government and energy companies as the most important factor when analyzing the value of a particular crop or energy source. It is this idea that has become locked and embedded into the institutions that govern the agricultural sector today, creating the biggest hurdle to introducing new crops and a new idea of value creation to the stakeholders. Once an idea has become locked in, it becomes the norm it is said to be path dependent where stakeholders continue to use a particular idea because it is the norm or standard way of thinking and has been done that way in the past.

The second aspect this thesis will look into is establishing the idea that Energy Willow could be a potential biomass source and viable crop for farmers to grow as well as the idea that externalities produced by Energy Willow could also be taken into consideration when calculating the value of a crop and potential energy source. This requires a change in thinking or the stakeholders to buy into the proposed way of thinking about the issue. If enough of these stakeholders buy into this line of thought provided by the scientific and normative arguments and the ideas stick, they could eventually become locked in becoming the norm or standard. If this norm or standard gets used enough over time it can create a path dependent way of thinking as we see with the current way of valuing crops and energy sources today.

5.3) Relationship between Baumol and Blyth, the role of ideas

According the ontological direction that the thesis has taken, it was decided to use Blyth's theory of path dependency and ideas as weapons as this was found to fit best with Baumol's entrepreneurial framework - Baumol's work on the dissemination of knowledge. It was decided that Blyth's theories would make a good fit to this thesis as Blyth looks at how ideas can be used as a powerful change making tool to change the views and overall path decision makers go down when forming laws and seeking to influence their stakeholders. Once ideas are set in motion and are accepted by decision makers they can create a new path for those in the future to follow. This ties

in very well with Baumol's historical overview of entrepreneurship; path dependency plays a crucial role in how entrepreneurship unfolds in any given society. A good example of this can be seen looking at the ancient Chinese empire in which the system was set up in a way to promote learning already established knowledge and it was frowned upon to create new knowledge. Merchants were seen to be a lower class of citizen emphasizing the role of path dependency in the society: *"[i]t has been claimed that this led those who had resources to avoid investing them in any sort of visible capital stocks, and that this, in turn, was a substantial impediment to economic expansion."* (Baumol 1990 p. 10) As shown through this quotation, there were no incentives for those with the resources available to invest them in anything that could create wealth as they faced the risk of this wealth being taken away from them by the emperor at the time.

Another crucial link between the selected theories is that of Blyth's theory on ideas as powerful weapons in creating change and Baumol's theory of productive, unproductive and destructive entrepreneurship. When looking into the case of entrepreneurship in agriculture in Denmark, the most crucial driving factor is the ability to make an economic profit despite the potential consequences to society (Petersen and Arnfred, 2016). This idea that rent seeking behavior is the norm and that it is the most commonly used way to determine the value of a given crop can lead to both unproductive and destructive entrepreneurship in society. This is largely due to the fact that the broader and long term social costs of a particular crop are not considered important in crop selection today. This way of thinking has become locked into many decision makers' ways of thinking and has become the path dependent way of valuing crops in Denmark (Dunnet, 2013). This thesis will emphasize that in order for Energy Willow to be considered as a viable option for farmers, the decision makers will need to change their current path dependent ideas about crop valuation and incorporate the societal costs or externality values into these calculations.

It is for the aforementioned reasons that this thesis has used Blyth's theory of path dependency and ideas as weapons as opposed to other similar theories on path dependency, such as one of the more popular pieces on the effects on political decision making by Paul Pierson 'Increasing Returns, Path Dependence, and the Study of Politics.' This piece focuses solely on political decision making and how it is affected by path dependency and how the longer these processes stay on the same

path, the harder they are to break out of (Pierson 2000).

On the other end of the spectrum are the theories on path dependency that focus solely on the economic aspects of path dependency such as a paper by Ron Martin and Peter Sunley called 'path dependence and regional economic evolution' which focused on the development of economies in different regions based on the different path dependencies in these regions (Martin and Sunley 2006). Blyth's theory was selected as it became very clear that in order to explain the underlying reasons why Energy Willow was not being used to its full potential in Denmark, as well as what role the path dependencies of both the politicians and the farmers (entrepreneurs) played, a theory that straddled the divide between politics and economics was needed. It was found that Blyth's theory met these requirements and was better suited to helping link the two theories used in this thesis smoothly.

6) Methodology

This chapter will be dedicated to exploring the methodology used in answering the research question. The thesis is based on a social constructivist approach called Pragmatism, which will be the first topic of this section. This exploration of the social constructivist method will show how the thesis intends to work with the knowledge gathered and used throughout. Using a methodology within the framework of social constructivism has certain implications for the ontology and epistemology of the thesis. These implications will be discussed in the second part of the section. The methodology also has certain consequences for the way the thesis can be used, and these consequences will be discussed in the section on reliability and limitations. The section on reliability is necessary due to the importance of applicability of the conclusions in this thesis. Following this line of reasoning, the last section will be on the limitations of the thesis, to discuss the weaknesses of the thesis.

6.1) Social constructivism as a pragmatic approach

Social Constructivism is a methodology built on the ontology that humans develop within a social context and that knowledge in general is created through interactions with others (Moses & Knutsen 2012). Thus, the methodology puts a great emphasis on the social aspect of human existence; indeed, this is what guides everything. There are several different directions within social constructivism, one of which is used throughout this thesis.

The approach of this thesis assumes that, like living organisms, an organization is shaped through experiences, which encompasses the collected knowledge and learning of an organization over time. (Elkjaer & Simpson 2010). Pragmatism offers a fluid understanding of organizations, which goes well with the evolution of ideas as proposed by Blyth, by focusing on “*the continuous and emergent waving together of social selves and social situations*” (Elkjaer and Simpson 2010, p. 79). The methodology is based on four pillars; 1) experience, 2) inquiry, 3) habit and 4) transaction (Elkjaer & Simpson 2010). Experience is critical because an organization is “*...an ever-changing movement of meanings...*” (Elkjaer & Simpson 2010, p. 76). These meanings are defined by the experience of the stakeholders, and thus an organization is shaped by collective experiences. This notion is critical for Blyth’s framework on ideas and how they shape the environment. Experience is also critical for Baumol as it defines the behavior of entrepreneurs in a given system.

6.2) Ontology & Epistemology

This chapter will explain and justify the epistemological and ontological view, which guides the thesis. This view will explain some of the assumptions made in this thesis, and help look at some of the more intangible phenomena, which this thesis seeks to uncover. Such as the political institutions and how the decisions from such institutions affect the entrepreneurship of farmers.

Assumptions about reality are defined as the ontological approach of a methodology (Moses & Knutsen 2012). The thesis assumes that truth is subjective, as it is shaped

by experience and communication. The subject of the thesis's inquiry is defined by the fact that "*the meanings of events and objects in the present moment are inseparable from the continuity of experience*" (Elkjaer & Simpson 2010, p. 79). This necessitates the inquiry into social transactions to explore the perspective of others. As such, the thesis will put an extra focus on the data collection to ensure that the data is as close to the subject as possible. To facilitate this, as discussed below, the thesis will use a method called semi-structured interview, to allow interviewees the time to address issues they find important (Kvale, 2008).

Assumptions about knowledge are defined as epistemology (Moses & Knutsen, 2012). As in the ontological discussion, Pragmatism defines knowledge as something relative to the individual as based on their experiences, however "*experience is more than just knowledge*" (Elkjaer & Simpson, 2010, p. 63). Experiences can be transferred and have a social dimension which is critical to Blyth's notion of how ideas shape knowledge and reality. Context is not purely subjective, but objective situations are defined by subjective experiences. The understanding of these experiences change over time, and thus, an interpretive methodology is necessary to understand these experiences. Doing interpretive methodology means understanding the situation from the perspective of the actor, because meaning and focus changes due to different ideas and context.

The first concept is experience. Experience is the subjective knowledge each actor gets from any action or event. Experience specifically denotes "*the dynamic relationship between knowledge (or meaning) and action in the conduct of the living present*" (Elkjaer & Simpson 2010, p. 80). The foundation of these experiences is based on objective events, which are understood from a subjective perspective. Experiences can be shared, and the act of sharing also changes the meaning of the event (Elkjaer & Simpson 2010). As the thesis uses a deductive research method, experience from previous researchers becomes a balancing act to avoid their bias influencing the interviews.

Inquiry will be the second concept of the methodological approach to the thesis, this term, taken from Pragmatism is centered on the creation of knowledge through reflection upon experiences. Inquiry is a normal part of everyday life, for any change

to happen, inquiry into the current state is necessary (Elkjaer & Simpson 2010). This quest, seeking change is called inquiry and defined by “*interweaving of social agency, reflection and experience, and demonstrating the creative potential for new thinking in all social actions.*” (Elkjaer & Simpson, 2010 p. 67). Thus, inquiry becomes a natural part of the thesis’ methodology. To answer the research question, the thesis will use the frameworks of Blyth and Baumol as mentioned above. These theories provide the understanding of current mental maps and the experiences gained through the interviews with farmers will converge to conclude on the research question.

Habit is the essence of the thesis’ analysis. The environment shapes organizations, through habit. These habits provide social context (Elkjaer & Simpson, 2010) and “[e]nvironments are constructed through the social interactions and relationships arising between individual stakeholders and from their actions” (Hatch & Cunliffe, 2013, p. 73). Hence, habits will be a key focus to understand the interactions that shape the organizations in the investigation. These habits are not fixed, furthermore, change in these habits provide the change in society at large, which has an effect on both the political institutions and the entrepreneurs (Elkjaer & Simpson, 2010). To illuminate changing habits, Blyth’s framework provides a lot of experience on ideas as weapons and blueprints for a way to change how society thinks. And the conclusion that ideas function as cognitive locks is linked with Elkjær and Simpson’s idea on habits.

The final guiding principle of Pragmatism is transaction. Transaction is how the interaction with others to define the social self: “[t]he relationship between individual and organization is not guided by individuals’ choices but by the transactional interplay between the two” (Elkjaer & Simpson, 2010, p. 72). As already established, everyone is governed by his or her experiences, inquiry and habits, thus, investigating the interaction between parties will aid in understanding the social self of the group. Understanding the interplay between different stakeholders will be critical for the thesis. There are several stakeholders that all have some influence on the agricultural sector, and this thesis aims to investigate this influence and how it guides the farmers’ decision making process. Pragmatism allows the thesis to work with the issues around Energy Willow in several important ways: 1) An interpretive methodology allows for the opportunity to work with information from biased sources in a way to represent their

frame of mind, and how they intend to use their ideas on biomass in general and Energy Willow in particular as a weapon. How Denmark will become CO₂ neutral in the future is a crucial topic that involves a lot of resources, and everyone has an agenda. 2) The four concepts of Pragmatism allow for a thorough investigation into the social issues and will give the thesis a reliable way to deal with a complex issue such as entrepreneurship. 3) For the thesis to yield the best results, methodology must match the methodology of theories (Moses and Knutsen 2012), and both of the frameworks used utilize a constructivist approach to a certain degree.

6.3) Reliability

The purpose of a reliability analysis is to show the applicability of the thesis towards research in general. Only once reliability is shown, the conclusions can be said to be valid according to humanist research (Moses & Knutsen 2012).

In Pragmatism, the question of reliability is based on two assumptions about the world. 1) As with most constructivist theories, truth is assumed to be subjective and in flux (Hope and Waterman 2003; Moses and Knutsen 2012). 2) The notion reproducibility (Elkjaer & Simpson 2010). Thus, even though reproducibility is a goal in any research, it can only be an approximation as the experiences of the interviewees change constantly, and their answers might not be the same today as they were at the point of interview. In addition, the research is influenced by the experiences of the writers, which also influences the research process (Hope and Waterman 2003; Moses and Knutsen 2012). To provide a balance to the interviews, several sources of secondary data are also used. In this case, the conclusions can be said to be valid because all of the secondary data is freely available and everyone can test the conclusions using this data.

The two reports that are the cornerstones of the research were created for a specific purpose by the government of Denmark. By using these reports, the thesis is reliant on as nuanced perspectives as possible. This bias is also partly responsible informing the authors positioning in the literature due to the backgrounds and preconceived ideas the authors may have had prior to beginning the research. In addition to this, by using a social constructivist methodology, this research is virtually unreplicable unless the

researcher is able to set up the same social context as the one the authors are imbedded within. Following the choice of Pragmatism, the social context is defined by the four pillars; 1) experience, 2) inquiry, 3) habit and 4) transaction. As the social context is continuously evolving, it becomes important to understand the limits these four pillars impose on the research. The thesis is shaped by the researcher's prior experiences and the experience of the interviewees until that point, which given time will change. During the inquiry phase, the assumptions of the authors will be challenged, and thus uniquely formed. Habit puts a limitation on the thesis in the way that the context of the authors might not encourage them to explore in certain directions, simply because we cannot conceive them. The limitation of transaction is that, when the thesis is sent to the stakeholders, it might change some of their experiences on Energy Willow, and thus, directly impact the field of study.

Secondly, as we have decided to use semi-structured interviews as the main tool for primary data collection, by doing so we have decided not to use other methods of data collection which may inhibit to some extent the data collection process. As with any method of data collection, there are certain limitations in using semi-structured interviews. Of these limitations it was found that the most pertinent to this thesis were those of 1) The issue of 'equivalence of meaning' 2) Prejudices, stereotypes and perceptions of the researcher and 3) The unique characteristics of the interviewee. The issue of 'equivalence of meaning' or misunderstanding between the interviewer and interviewee, this misunderstanding could happen both ways from the interviewer to the interviewee and vice versa creating challenges when interpreting the information after the interview.

A second limitation of this method of data collection is the prejudices, stereotypes and perceptions of the researcher, which may have an influence on the responses of the interviewee. As the researchers have their own preconceived ideas about the interviewee, the questions may be tailored or asked in a particular way that could have an effect on the response. The third identified limitation of semi-structured interviews is that of the unique characteristics of the interviewee. As semi-structured interviews have an element of flexibility, it allows for the interviewer and interviewee alike to ask and answer the questions relatively uninhibited. This can create an element of uniqueness to the responses which could make it more difficult to make

generalizations on the industry in question (Teijlingen, 2014).

Thirdly, the limitation of time and resources was identified as a key limiting factor to this thesis as this research falls under a strict time limitation by the University of six months from beginning to end. This was further constrained by the fact that there are only two authors responsible for researching and writing the thesis all within the given timeframe. These limitations have meant that there has always been focus on time constraints, which could have caused the writers to prioritize certain areas of research or sections of the thesis seen to be more important than others in order to reach deadlines. Should there have been more time and resources available for this process the research time could have been lengthened in order to gain a more nuanced and well-rounded view of the Energy Willow industry in Denmark. This could have been achieved through allocating more time to each of the different sections of the research process from identifying stakeholders to the time dedicated to interviews.

Fourthly, due to the nature of this research into the field of alternative energy, which is currently receiving a lot of interest from policy makers and the public around the world, such social trends and timing of these trends play an important role in the availability of information on the topic. Along the lines of the theory of Mark Blyth, this theory has been written at a point in time where there are many different interest organizations trying to lay their foundations for why each of their given solutions is the best for achieving fossil fuel independence both in Denmark and in Europe as a whole. This conflict of different technologies has led to much debate over which technologies should be used moving forward and in some cases shedding more light on certain technologies over others for various reasons. If this thesis had for example been written at another time point where coal had been a favored energy source in Denmark, the available literature and experts may have had completely different opinions on the topic of Energy Willow and alternative fuels as a whole. These trends and the timing of them are obviously beyond the control of the authors and are, therefore, not easily mitigated, however the authors are aware of the role that timing and social trends play on the availability of and effects on the research on the topic.

Finally, this thesis has purposefully avoided looking in-depth into the political decision making process around the choice of energy systems used in Denmark. This is largely due to the complexities that politics and in particular Danish politics adds to the

decision making process in policy making. Much of this process is focused on inter party power relations in parliament. This complex process, although very important to the choice of energy source used in Denmark is beyond the scope of this thesis.

6.4) Research Design

This section of the thesis sets out to establish the basis for how the research used throughout this thesis was conducted and what type of research was used to write it. The first part of this section looks at the type of research used, namely a mixed method using an abductive research design and the reasoning behind this choice. As this thesis is aimed at the exploration of whether Energy Willow can play a role in the Danish 2050 energy goals it is by definition an exploratory study. The second part of this section addresses the reasons behind the use of exploratory research in this thesis. In order to obtain empirical material used in this thesis it was decided to use semi-structured interviews, largely due to the flexibility it allowed us in adapting the interviews to the particular interviewee and to try and best understand their point of view on the research topic. The reasons behind the choice to use semi-structured interviews are discussed in more detail in the next part of this section followed by the interview guide that lays out the different groups of questions used in the interviews as well as the adaptations that were made during the interview process.

6.4.1) Mixed method

As the topic of Energy Willow in Denmark is one in which qualitative data alone does not give you a very clear picture of the true benefits of the crop, it was decided to use a mixed method approach. This was done so as to be able to use quantitative data in the form of economic data provided by the two reports by the Danish Energy Agency in order to show these benefits numerically compared to substitute crops. The economic data that was used was used in the background section in order to give the reader a clear understanding of the economic aspects of growing Energy Willow as well as quantify the measurable externalities. In addition to the semi structured interviews, data from secondary sources has been used in order to be able to take a more in depth look at the two reports that this thesis is based upon as well as other economic data that can provide a more well-rounded picture of the Danish Energy

Willow sector. By using a mixed method approach, it allows us to be able to view the Energy Willow industry from the perspectives of stakeholders, academics as well as from other data sources providing a more nuanced view to the issues than any of the sources could do alone and providing a good foundation for the exploratory research method used in this thesis. (Foodrisc resource centre, 2016)

6.4.2) Exploratory and Abductive Research

When this thesis was started, it was decided to use the two reports from the Danish Energy Agency as the basis for the research, this served as both a source of qualitative and quantitative data for the thesis which was necessary as we were going to explore the question of what role Energy Willow can play in achieving the fossil fuel free goals of Denmark by 2050. This thesis does not intend to offer any final or conclusive solutions to the current state of Energy Willow in Denmark, but it is merely to give the reader a better understanding of the topic. It is however important that exploratory research has an objective and in the case of this thesis, the objective is to find out whether Energy Willow is a sustainable solution for Denmark in helping to reach the 2050 energy goals. The thesis will offer recommendations based on the research and the theoretical frameworks of Blyth and Baumol. The main advantages of doing exploratory research are 1) It allows the researchers to be flexible and adapt to changes in the research focus, 2) It is an effective research method in creating groundwork for any future studies on the topic in focus, and 3) Exploratory research can potentially save the researcher's time by determining at an early stage what is worth pursuing and what is not working. (Dudovski 2017)

Due to the nature of exploratory research, the researcher should be able to change their direction upon finding new data or new insights that may take the research into a different area than initially planned for. This was the case for this thesis as the researchers initially started out with the idea to interview farmers in particular areas of Denmark in order to better understand the entrepreneurial perspective. Upon realizing that Energy Willow was not well-known among Danish farmers it became clear that it was necessary to refocus the research to understand why this was the case. The research focus then shifted to understanding why Energy Willow was not well known to the farmers, it therefore, became necessary to get the perspectives of experts and

other stakeholders in the field of Energy Willow and bioenergy in Denmark. The shift in focus meant that the research became about more than just the entrepreneur but also about all the stakeholders that have an interest in biomass as an energy source including the EU, the Danish Government, power companies, farmers, and the general public.

Exploratory research is by definition initial research which can help form the basis for more conclusive research. Exploratory research “[t]ends to tackle new problems on which little or no previous research has been done.” (Dudovski 2017) As such it was chosen that the main source of information would be the semi-structured interviews in order for the researchers to be able to gain as much insight into the topic from the interviewees as possible and shed light on a relatively under researched topic. The interviews were combined with the two energy reports from Danish Energy Agency, one of which consists of the energy scenario analysis which is a primary source of information and the second one which looks at the potential of Energy Willow in Denmark which is a secondary source of information for this thesis.

After spending a significant amount of time exploring the aforementioned topic, it was found that it was necessary to keep going back and adjusting the results in order to be able to better fit with the chosen theories, the research then became more abductive in nature. An abductive research method is a form of inference which goes from an often incomplete set of data or observations describing something to a hypothesis that is able to best explain or account for the data or observations. Abduction is seen to be a kind of theory-forming or interpretive inference of something. The theoretical perspective that best fits with the observations is chosen and can be adapted based on further interaction with the data or further observations. (Rivadulla, 2013)

Finally, it can be said that by using a combination of these two methods, the researchers were able to save time in the research process. This was largely due to the ability to be flexible in the research approach as we were able to change the main research focus at an early stage due to greater insight into the topic while still maintaining the overall direction of the thesis and not influencing the integrity of the analysis.

6.4.3) Purposive sampling

To find the interviewees for the research done in this thesis, we engaged in purposive sampling (Lærd dissertation 2017). Purposive sampling relies on the subjective judgements of the researcher when selecting objects for observation. Usually, when doing purposive sampling, the sample size is often small, because as opposed to probability sampling with the goal of making generalizations, the main focus of purposive sampling is to focus on a particular characteristic of the population (Lærd dissertation 2017).

In the case of this thesis, we have been conducting expert interviews in the manner of purposive sampling. This was done because the goal of the thesis was to accumulate specific knowledge about Energy Willow from the stakeholders within the energy sector. By focusing on specific individuals with this type of expertise, we, as researchers can utilize their experience to look at the specific views on Energy Willow from the different stakeholders.

6.4.4) Semi-structured interviews

As this thesis intends to research what role Energy Willow can play in reaching the Danish 2050 energy goals and the desirability of this for society, it is important to consult the experts in the field directly in order to gain a better understanding of the current role Energy Willow plays in Denmark today and how this role could change moving towards the 2050 target. There are multiple ways of doing this, however, for this thesis we have found that the use of semi-structured interviews will be of most value in understanding the role Energy Willow could play in the bioenergy sector. The main reason for doing so is that we have chosen to use a mixed method, but primarily qualitative based in the analysis. The qualitative research method looks at the interviewee's lived everyday world. In order to answer the research questions, the thesis looks at the everyday life of the interviewees to understand the current paradigm of both Energy Willow and alternative energy in general. By getting a snapshot of how they think, the thesis aims to understand the current environment in which the interviewees are in as this environment is in a state of constant flux.

Moreover, as the topic of Energy Willow as an energy crop in Denmark has only been partially researched it was necessary to conduct primary research by speaking directly to the different stakeholders that have an effect on Energy Willow in Denmark. To this aim, the use of semi-structured interviews allows us to capture the interviewees' message directly from them, which is a very powerful tool for the researcher as it leaves less room for misinterpretation than many other forms of data collection: *"[i]nterviews are one of the main research methods used by social researchers, providing the opportunity for direct interaction between the researcher and the research participants."* (Matthews & Ross 2010 p 218)

As the thesis is based on a set of interviews with diverse stakeholders from different institutions with diverging agendas it was important that we were able to elicit and capture the opinions and feelings about Energy Willow from each of the participants in order to be able to fully gauge and understand their position on the topic. (Matthews & Ross 2010 p 219) It was important that interviewees were free to answer the given questions and discuss the topic in their own words and from their own viewpoint. The interview allows the researcher to capture the views of the interviewee from their perspective and allows for the researcher to get a better understanding of the interviewee's perception of their own lived world. As stated by Kvale, 2008, *"[a] semi-structured life-world interview attempts to understand themes of the lived daily world from the subjects' own perspectives. This interview seeks to obtain descriptions of the interviewees' lived world with respect to interpretation of the meaning of the described phenomena."* (Kvale, 2008, p. 1) Although the topic of Energy Willow was common to all interviews, the interview needed to be flexible and accommodating of the different positions and organizations that were being interviewed, making semi-structured interviews a good fit.

From the outset, it was known that the interviewees would be in a variety of different settings and so it was important to be able to accommodate for this with the chosen data collection method, to make them comparable. As the semi-structured interview *"can be used in a wide variety of settings, from interviewing an elderly person in their home through to interviewing a government minister or the chief executive of a company."* (Matthews & Ross 2010 p 225) With each different setting, comes new challenges such as words having different meanings and it is important to think of

setting and context when planning which sort of interview is to be used for the data collection, again the semi-structured interview allowed for the flexibility of different environments without interfering with the interview itself. This flexibility was also important when interviewing certain persons who did not have much time and needed the questions beforehand to prepare themselves appropriately, which semi-structured interviews allowed for.

6.4.5) Interview guide

This section of the thesis will look into the different sections of the interview guide, which was used to conduct all ten of the interviews used in this thesis. By using semi-structured interviews as the primary method of empirical data collection, because all of the quantitative data stem from secondary sources. Semi-structured interviews allowed us a certain amount of flexibility in terms of the structure of the interview guide, giving us room to make changes to the guide to accommodate the different stakeholders that were interviewed. It was decided that the basic structure of the interviews would be the same for all interviewees but the questions would change slightly to accommodate for the different sectors that each interviewee represented.

Name	Position	Date of Interview
Kristjan Jespersen,	PhD fellow at CBS	17/01/2017
Henrik Bach,	Energy Willow farmer	23/01/2017
Søren Ugilt Larsen,	Senior Bioenergy Specialist at Danish Technological institute and editor of the Willow Report (Ugilt Larsen et al. 2015)	25/01/2017
Henrik Kruse Rasmussen	Project Coordinator and Energy Willow specialist at AGROVI and Co-author of the Willow Report (Ugilt Larsen et al. 2015)	26/01/2017

Christian Erik Kampmann,	CBS professor	30/01/2017
Damien Plan	Team Leader - EU DG Agriculture and Rural Development G. 4 – Arable Crops and Olive Oil	6/02/2017
Rune Duban Grandal	R&D at Energinet Denmark	9/02/2017
Lars Martin Jensen	Senior Advisor at Danish Ministry of Energy and Supply	10/02/2017
Anders Evald	Chief consultant at HOFOR and biomass specialist (Anders speaks on his own behalf and not on the behalf of HOFOR)	23/02/2017
Thomas Holst	Senior advisor on Climate, Energy and Plants at L&F	31/02/2017

Table 4 - List of interviews

Table 4 shows the interviews conducted to facilitate this thesis. All initial contact to the interviewees was made through email. The email contained information about us, as well as the topic and a request for an interview either at a location suitable for the interviewee or over the telephone or skype. Some participants requested more information than others, before agreeing to an interview and once the interview data was set some of the participants asked for the questions to be sent to them prior to the interview in order to prepare sufficiently.

Before the start of each interview the interviewees were asked if they had any problems being recorded during the interview. It was made clear that the recording was only to be used for transcription processing and that all direct quotations used would be sent to the interviewees for their approval prior to submitting the thesis. This was done in order to create an atmosphere of trust and put the interviewee at ease

during the interview and so that they were aware of the need for recording the interview.

The interviews began with an introduction of ourselves and how we would proceed with the interview. We informed the interviewee that we would ask some questions and then listen to their thoughts on the topic. We then briefly introduced the thesis topic to them. The level of detail of the introduction was dependent on the level of communication prior to the interview. This introduction consisted of informing the interviewees that we were writing our master thesis looking into whether or not Denmark can reach its 2050 energy goals using the two Danish Energy Agency Reports' scenarios as a basis for the thesis. It was then explained that we wanted to look particularly at Energy Willow and whether or not it could be a possible contributor to the energy goals and if so to what extent it could be used in reaching these goals and the desirability of doing so.

If the interviewees were not aware of the scenarios we briefly outlined them. The first question of each interview was about the interviewee themselves and their role in their respective organization. As the interviewees all held different positions at different institutions this question was adapted to the different institutions. This question was left out in the cases where we knew the role of the interviewee in such a way that we felt it unnecessary to ask. An example of how this was adapted to the context of the interviewee can be seen in Appendix 7 in the interview with Christian Erik Kampmann where the interviewee was a lecturer of ours and we were aware of his background so it was deemed unnecessary to ask this question during the interview.

The second part of the interviews focused on the Danish 2050 energy goals. This section was separated into numerous sub questions looking at whether the interviewees thought that the 2050 energy goals were realistic or not in their opinion. Depending on how the interviewees responded, a further question was asked on whether the interviewees felt that the two biomass scenarios were realistic and achievable and how Denmark may be able to achieve these goals. This set of questions was used to establish whether the interviewees believed that there was any real possibility of the Danish energy goals being reached by 2050 and how they envisioned this happening. We used the further question looking at whether or not

biomass could contribute to these goals to try to understand if there was space for Energy Willow to play a role in achieving these goals through contributing to the biomass goals. This helped inform the authors about the position of the interviewees in the current paradigm on environmental goals, and to understand how they see a possible solution.

The next area of focus was looking into the matter of local production of biomass vs imported biomass and whether or not this issue should be considered and to what extent it should be considered when looking at the biomass scenarios and the contribution of biomass to the overall energy goals. This question was used to ascertain whether the interviewees believed that local production of biomass was important in reaching the energy goals as Energy Willow would be one of the ways in which Denmark could achieve local biomass production.

The next focal area in the interviews was looking at what the biggest challenges in the opinion of the interviewee were to achieving the biomass scenario energy goals. This question was aimed at getting the interviewees to think more about biomass and the biggest challenges today that the biomass sector is facing as well as potential future challenges that they believed may hinder the two biomass scenarios from being realized. An example of how this question was asked can be seen in question 1D in the interview with Christian Erik Kampmann in Appendix 7.

The next focal area was looking at the role of institutions in the promotion of biomass in Denmark. The two main institutions that were asked about were the EU and the Danish government, seeking to better understand what role they currently play and what role the interviewee thought that they should play in promoting or regulating dry matter biomass in Denmark.

The externalities of Energy Willow were the next area of attention where we briefly explained about the various benefits that Energy Willow brings to the environment such as the increased biodiversity and the uptake of nitrate from the soil in which it is planted in. We then asked the interviewees if they believed these additional features or externalities should be compensated for in some way as they bring a definite and calculable advantage to the society in which the willow is planted. As the externalities

play a large role in this thesis it was important for us to ask this question and get as much insight into the interviewees' thoughts on the topic in order to make a well-rounded analysis from the different stakeholder perspectives on the topic.

The final focal area of the interviews was focused on the entrepreneurial aspects of Energy Willow in Denmark. The interviewees were asked if they were to give advice to a young farmer starting out today, would they then advise them to look into biomass energy crops or more traditional crops. This question was asked in order to ascertain whether the interviewees would advise new farmers to look into Energy Willow and the reasons why they would or would not advise the farmer to do so. This gave us good insight into the thoughts of the interviewees both towards the future of Energy Willow as well as their general thoughts regarding the future of Energy Willow in Denmark.

The interviews were ended by checking if there was anything left out from the interview and that we had all the information that was needed in order to proceed.

7) Operational RQ: No subsidies, no willow

Today in Denmark it does not make financial sense for farmers to grow Energy Willow. This is largely because the current paradigm in Danish agriculture is one in which rent seeking behavior is the norm. As shown in section 2, only if the government prioritizes Energy Willow through subsidies, can farmers make money growing Energy Willow and it is, thus, possible to promote the growth of the sector. Thus, the priorities of the governing institutions have been shown to be of great importance to the Energy Willow sector in Denmark. This leads us to the operational research question of:

Should the Danish government promote the growth of the Energy Willow sector through the use of subsidies?

8) Literature review: externalities – How does Energy Willow benefit society and how can we encourage growth in the industry?

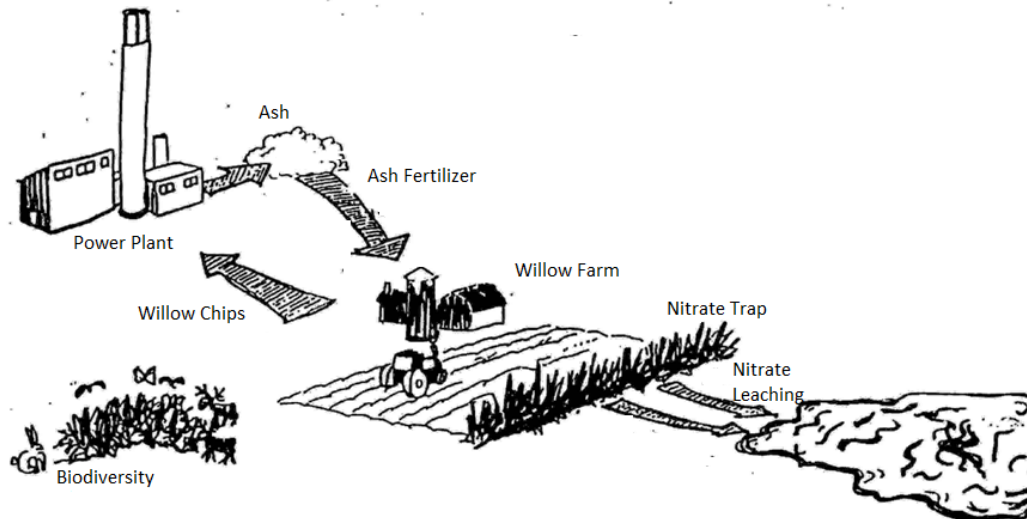


Figure 10 - Energy Willow Externalities

Source Nyvraa b, 2017

This section of the thesis looks into the underlying literature used in this thesis to explain the concept of externalities. Externalities are the benefits of Energy Willow that come about as a consequence of growing it commercially and are not reflected in the market prices (Wills, 2006). This is done from the basis of the operational research question above which assumes there will be no growth in the Danish Energy Willow industry if there are no subsidies in place. In the case of Energy Willow there are numerous positive externalities which cannot be accounted for in the market price of the crop. Furthermore, this section will show the links between both Blyth's theory on entrepreneurship and Baumol's theory on entrepreneurship and Energy Willow.

The literature review on the topic of externalities is important for the classifications used in the thesis, and for the normative discussion on when entrepreneurship is productive, unproductive and destructive respectively. Using externalities, allows the thesis, in the discussion to take both economic value and value that the market cannot measure into account.

For the literature review, the thesis will look at material written about environmental economics, especially focusing on common goods, to see how the literature deals with this issue. Then this section will look into how EU and the government value different externalities and the concerns that the EU deals with. Once this is established, we will analyze the impact of different crops and their externalities for a discussion on what different crops contribute to society.

As mentioned above, externalities are consequences of economic activities, which affect other parties without being reflected in the market price. Externalities can have either negative or positive effects for other parties. These market failures are prevalent in the discussion on the environment due to the simple factor that all environmental effects are externalities (Wills, 2006).

The thesis will look at two different sources for a literature review. The main sources chosen are the original work on tragedy of the commons by Garrett Hardin (1968) and the book by Ian Wills on environmental economics (2006). Garrett Hardin's seminal work is a crucial cornerstone of economic literature, and we chose to adopt his definitions directly, to get a discussion on tragedy of the commons in its purest form. Tragedy of the commons fits well with Blyth's theory on entrepreneurship because it also concerns itself with how society evaluates different activities, and how common goods will always suffer if there is no intervention from the government in effect, making the market unable to solve the issues that arise from tragedy of the common. The one solution to tragedy of the commons that is proposed is turning common goods into private goods, by making them excludable, gaining the ability to exclude others from enjoying the goods (Wills, 2006). In this thesis, we cannot currently exclude others from enjoying the externalities of Energy Willow, because it is impossible to exclude people from enjoying the effects of less CO₂ in the atmosphere or enjoying less polluted streams and ground water (Wills, 2006). Therefore, a market solution is not possible.

The second major piece of literature used in the thesis on externalities and environmental economics, is the book *Economics and the environment* by Ian Wills (2006). According to Wills the environment is made up of different resources, and "How

we use those resources depends on the signals and incentives we receive, from either the market or our government” (Wills 2006, synopsis). This resource based view of the natural environment fits well with Baumol’s perspective of the entrepreneurial environment, as he also puts a large emphasis on how institutions affect the behavior of the stakeholders.

Many externalities, when dealing with the environment, such as clean ground water, CO2 uptake and biodiversity, are externalities because of how the markets function. There are two externalities that define these issues; they are non-excludability and rivalry (Wills 2006). Non-excludability is the term used for when one cannot exclude others from enjoying a particular good. For example, CO2 is non-excludable because one cannot be excluded from using the atmosphere, we cannot build a bubble around a country that pollutes more than others. Moreover, the effect of CO2 emissions is shared by everyone. Rivalry is the factor that describes consumption, whether the use of a good by one person places a limit on everyone else’s use. Goods such as biodiversity or CO2 uptake are defined as common pool resources (Wills 2006), because they are non-excludable and rivalrous, thus, creating the problem coined by Garrett Hardin’s tragedy of the commons. In this situation, it is human nature to exploit the resources as fast as possible to create maximum value for the individual regardless of the harm done to society (Hardin 1968). Markets cannot solve the issues surrounding common pool resources, leading to market failures (Hardin 1968; Wills 2006). To solve this market failure, government regulation is necessary, as the government can focus on the benefits to society rather than the individual (Wills 2006). This view on how the government can interact and influence the environment fits well with both the theories used in this thesis, and can, therefore, be used as a satisfactory explanation for how environmental economics work.

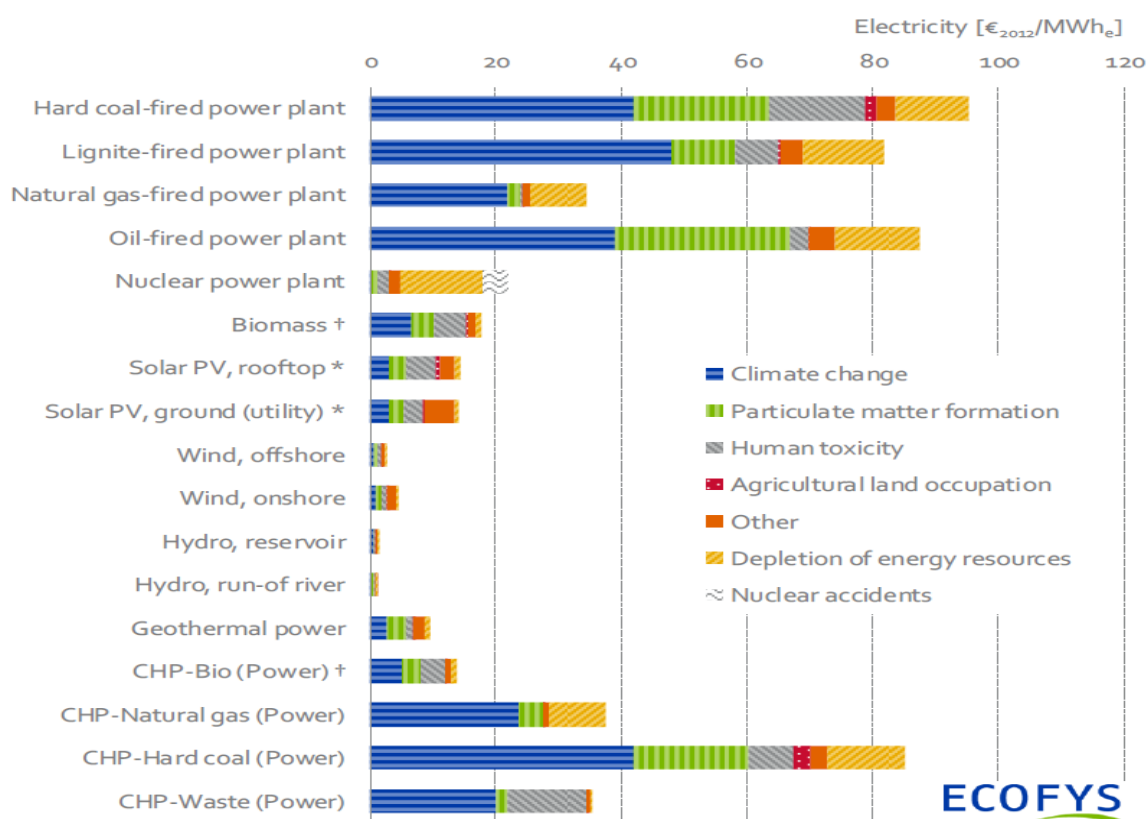


Figure 11 - External costs per technology for electricity technologies, EU 28 weighted averages (in Euros 2012/MWh)

Source: European Commission, 2014

Different organizations look at the question of externalities differently. In the report done by ECOFYS for the EU, the focus is on the costs of different energy alternatives, and their external costs. In Figure 12 it can be seen that biomass has a much lower level of external costs than fossil fuels, and as such is a good substitute for other energy sources, as the impact is much lower than more traditional energy sources.

Instead of looking at the reduced external costs, the Danish Energy Agency looks at how much value a hectare of Energy Willow brings to society in general. In valuation of externalities calculation, they focus on how CO₂, biodiversity and others can be evaluated as having economic value (Dubgaard et al., 2008; Olesen, 2008). This is done on a per hectare per year basis, to evaluate how much net benefit it brings. When looking at it from a net benefit perspective, this calculation is interesting for a viability analysis of Energy Willow as an energy source (Ugilt Larsen et al., 2015). This estimate also provided the interest organization L&F, with a goal for lobbying, as their current goal is to achieve the amount calculated in the report as subsidies for farmers

growing Energy Willow (Appendix 10).

Climate Effect	Sandy Soil			Clay Soil		
	Tons CO2 equiv. /ha/year	Quota price kr./ha/year	Price from effect catalogue kr./ha/year	Tons CO2 equiv. /ha/year	Quota price kr./ha/year	Price from effect catalogue kr./ha/year
Reduced Nitrous Oxide emission	0,25	38	124	0,19	28	93
Increased carbon binding	1,2	183	600	1,2	183	600
Total		221	724		211	693
Environmental Effect	Sandy Soil			Clay Soil		
	Kg/ha/year	Kr./ha/year		Kg/ha/year	Kr./ha/year	
Reduced nitrogen	25	577		12,5	288	
Total Environmental Impact	Sandy Soil			Clay Soil		
		Quota Price	Effect Catalogue		Quota Price	Effect Catalogue
kr./ha/year		798	1301		499	981

Table 5 - Impact calculation measured in kr./ha/year on externalities

In Table 5 above, a summary of the externalities calculation can be seen. The Danish Energy Agency looks at two different environmental impacts, as these both are easily quantifiable and measureable (Larsen et al. 2015). Two different prices are used to calculate the value of the CO2 depending on whether one wants to use the EU CO2 quota pricing or a measurement from the Effect Catalogue done by the Danish government in 2013, in which they estimated a cost for reducing CO2, and the value of reducing it by one ton. These two differing ways of measuring impact are interesting from an environmental economics standpoint, and extended to Baumol, interesting when discussing the case of productive entrepreneurship.

In Table 6 below, some of the externalities from biomass compared to regular crops can be seen. A minus indicates that the type of biomass decreases the effect compared to agriculture centered on wheat production, a plus indicates an increase and a zero indicates no change. When the effect is in brackets, the effect is uncertain (Jørgensen et al., 2013). This table shows one of the reasons why Energy Willow has been chosen as a focus of study. With the numerous positive externalities that Energy Willow creates, it is a very beneficial crop for society at large. The Danish Energy Agency estimates that the societal benefits of Energy Willow is 800-1300 kr. pr. ha pr.

year on sandy ground and 500-950 kr. pr. ha pr. year on clay ground (Ugilt Larsen et al., 2015). As outlined above, this societal value is not accounted for in the market, and the thesis will look into how the benefit could be compensated and how that changes the value of the crop for the individual farmer.

Biomass	Nitrate Leaking	Carbon Content in Soil	Pesticide Use	Biodiversity	ILUC
Slurry	(-)	-	0	0	0
Straw	0	-	(-)	0	-/0
Wood Waste	0	-	0	-	0
Household waste for biogas	(+)	+	0	0	0
Macroalgae (Seaweed)	(+)	(+)	0	(+)	-/0
Intercropping crops	(-)	-	0	0	0
Wheat Whole seeds	0	-	0	0	0/+
Corn Whole Seeds	0	(-)	(-)	(-)	+
Turnips	0	(-)	0	0	0/+
Rapeseed oil for non-food	0	0	0	0	+
Energy Willow	-	+	-	+	+
Miscanthus	-	+	-	(+)	0/+
Rotation Clovergrass	(-)	+	-	+	+
Afforestation	-	+	-	+	+
Extensively renewable grass	-	+	-	+	+

Table 6 - Externality comparison of biomass crops

Looking further into the numbers, some of the literature reviews Energy Willow's potential for CO₂ reduction. In the report from the Danish Energy Agency it can be seen that Energy Willow contribute to the reduction, however, the inherent cost associated with this measure makes it a contested issue. The issue of yield per hectare is a part of the calculations that both the Danish Energy Agency and Copenhagen University has done and which were discussed above. As can be seen in Table 7, following the cost calculations seen in the chapter above, the price of CO₂ reduction is highly variable depending on the soil type. (Landbrug og Klima p. 108). Looking at the societal costs, with these calculations, if CO₂ reduction was the only goal, then Energy Willow is a comparatively expensive solution as the goal for the future reforms on CO₂ pricing is to set the price of one ton of CO₂ at 30£ (261 kr.) (Neslen 2015).

Reductions Costs with the use of energy willow in powerplants, kr/t CO2 equiv.						
Budget Economics				Soceital Economics		
t CO2-equiv./tts						
Nitrous Oxide Reduction	0,027					
Reduced Fuelconsumption	0,037					
Reduced emmisions with burning	1,05					
Total without carbon storage in soil	1,114					
Carbon storage in soil	0,157					
Total with carbon storage in soil	1,27					
Soil Types	Marginal	Sand	Clay	Marginal	SAND	Clay
Societal Costs (kr./tts)	301,00	461,00	766,00	406,00	622,00	1034,00
Reduction costs without carbon storage in soil (kr./ton CO2-equiv.)	270,20	413,82	687,61	364,45	558,35	928,19
Reduction costs with carbon storage in soil (kr./ton CO2-equiv.)	237,01	362,99	603,15	319,69	489,76	814,17

Table 7 - Reduction costs with the use of Energy Willow in power plants, kr/t CO₂ equiv.

8.1) Indirect Land Use Change (ILUC)

The term indirect land use change is contrived to measure the unintended consequences from the expansion of biofuels in cropland (Rosillo-Calle and Johnson 2010). By expanding biofuel production into farmland, traditional food crops get displaced into previously unused areas such as forests. This process might increase the level of CO₂ in the atmosphere as the areas that gets displaced typically absorb high levels of CO₂ (European Union 2016d) as well as incur other externalities as explored below.

8.2) Conclusion to externalities

By looking at externalities, we can see that these positive effects on society fit with Baumol's idea of productive entrepreneurship. When looking at Energy Willow, there are quite a number of positive externalities, two of which can be measured directly in terms of economic value as a benefit to society.

When looking at the way environmental economics work, dealing with the issues of market failure is the government's responsibility, as in the rent seeking paradigm, they are the only ones who can focus on the benefits of everyone rather than just focusing on the individual level.

Hence, to answer the operational research question from the above; based on the assumption that we should benefit society as much as possible, the government should subsidize the growth of Energy Willow to the extent that the crop provides society value, to encourage farmers to benefit society as much as possible.

9) Analysis

9.1) Stakeholder views on the paradigm of Danish 2050 biomass scenarios and how this influence their relationship with the institutions of Denmark

This section of the analysis will focus on the second part of the interviews, providing the basis for the entire analysis. The basis stems from an exploration into how each of the stakeholders, in addition to the two professors, view the potential for a CO₂ neutral Danish society in 2050 based on realizing the biomass scenarios outlined by the Danish Energy Agency. By analyzing this, it will allow the thesis to investigate their broader perspective on biomass before going in-depth with Energy Willow. Investigating their perspectives will allow the authors to consider how the habits of the interviewees shape their current way of thinking, on the topic of biomass in general.

The view on the paradigm is important for both the theories used in the thesis. It is important because the paradigm shapes the environment, and understanding the paradigm, thus, becomes crucial. From the perspective of Blyth, this level of analysis is important because we need to understand the baseline paradigm, before we can understand how the different stakeholders aim to use their ideas as blueprints for a new way to use Energy Willow.

To investigate how the paradigm shapes the relationship between the individual stakeholders and the government, we will partly use the interviews, but will rely on secondary data since this subject can often be quite hard to observe from a single interview with each individual (Hatch & Cunliffe, 2013). Each of the six stakeholders were introduced in the background, this section will expand on these stakeholders and their influence on Energy Willow in Denmark. Following Figure 6, the stakeholder map of the Energy Willow sector in Denmark, the focus of the thesis will be the relations between the stakeholders and the government.

9.1.1) Academics

The two professors are the first part of this analysis. While they are not directly part of the stakeholder map, they still represent a great level of experience in the field of energy production, and will, thus, be used to illuminate the paradigm of biomass and the 2050 goals.

The first interview with an academic was with PhD fellow Kristjan Jespersen (Appendix 3). When looking at how he perceives the paradigm of reaching the 2050 goals, he seems quite pessimistic. This is because the current paradigm ruling his students and former students is negative. As when some of the students he teaches gets hired by big companies, they get a sort of fatalistic view of the world, in a sense that we are already past the point of no return, so why should we try to deal with it. In the same vein, his students seem to give up and say that they as individuals cannot make a difference alone, so why should they spend any effort. This last problem in the paradigm is a classic tragedy of the commons issue.

The second academic interview was with Professor Christian Erik Kampmann (Appendix 7). When talking about the scenarios for the 2050 goals, Kampmann seemed certain that Denmark could reach the 2050 goals, but it requires a lot of effort from the relevant institutions, such as investments into one path of technology. As for which kind of technology that Kampmann believes that the government will take the largest role in reaching the 2050 goals, he states that wind power is the most likely one, but only if the government soon chooses it as the source of power going forward (Appendix 7).

In terms of biomass, Kampmann stated “[i]’m quite skeptical of what you can call first-generation biomass, things that will require taking farmland away from food production towards energy production.” (Kampmann, 2017). This quotation highlights that the issue of ILUC is a strong concern within the academic environment. According to Kampmann, biomass grown from marginal land is more promising for the future despite the lower yields because you avoid the issue of substituting and competing with regular food crops.

The carbon debt issue is also a strong concern for Kampmann, because the planet is at an extremely sensitive point. Thus, biomass technologies that rely on long growth periods will create a carbon debt that the planet can ill afford. This issue is somewhat lessened in the case of Energy Willow because it has such a fast growth period. Therefore, from the perspective of the academics, the current paradigm on the 2050 goals can be said to be one of optimism, but there are several issues with the prevailing ideas of society. These concerns are what defines the relationship between academics and the government. It is the job of academics to investigate phenomena occurring in society, and to suggest ideas on how society functions and can change based on solid scientific research (Moses & Knutsen, 2012). Looking at what Jespersen and Kampmann wish to achieve, the interviews show that both believe we can reach a CO₂ neutral society, if the right changes are made in the institutions. These changes are the weapons that can be used to change the current paradigm. Looking at Energy Willow, it seems that especially Kampmann does not believe that this crop on regular cropland is the solution for Denmark. The concerns regarding issues such as ILUC are according to Kampmann too detrimental for society.

9.1.2) The Danish Energy Agency

The Danish Energy Agency as a political organization is strongly affected by how the overall paradigm is shaped. This is the organization tasked with carrying out the policies on behalf of the government, and as such, the object of the analysis. When looking at how they interact with the 2050 goals, Lars Martin Jensen (Appendix 10) sees two issues as important to address. The first one is that the scenarios report was made under a different government. This distinction is important in the political sphere, as the report is situated within the paradigm of the last government. While the report is still the official goal of the Danish government in general, Jensen warns that the way in which policy makers see these goals might have changed.

The second issue is one of commitment. Kampmann states that an issue with the government is their reluctance to pick a specific technology as the means to reach the desired goal of CO₂ neutrality in 2050 (Appendix 7). This is also highlighted in the interview in which Jensen very firmly described the scenarios as extremes rather than actual scenarios, and clarified, that any real solution would be a mix between the different solutions (Appendix 7). The problem with this is that a paradigm in which the institutions do not commit to a single solution is that it might cause the problems we see today with Energy Willow. Commitment and consistency to a single solution would give the entrepreneurs a stronger indication of the optimal direction. As investigated in the background on the Danish Energy Agency, with the timeframe on some of these investments, making a choice is paramount, a fact that Kampmann greatly emphasizes (Appendix 7).

9.1.3) The EU

As previously stated, the EU is in an interesting situation when looking at the paradigm of the institutions, and how it will affect entrepreneurship. By representing the 27 member states, there are a lot of interests that are being represented, as well as multiple different ideas on how entrepreneurship should be governed. The goal to reach a higher level of independence from fossil fuels is common across Europe. When looking at possible solutions to reach this goal, biomass is a strong contender. In the interview with Damien Plan (Appendix 8), it was clearly stated that biomass is a

viable solution; however, it must be from crops dedicated for energy production rather than food production (Appendix 8).

The EU plays an important role in the agricultural sector, as they set up the framework within which the government can act. Plan made it very clear, that the EU is very willing to support Energy Willow, however, they can only provide 80 percent of the total subsidy, and the national government has to decide the direction of these subsidies and fund the other 20 percent, consequently, the EU can only encourage the farmers to a certain degree, the rest is dependent on the Danish government.

The relationship between the national governments and the EU is one of two governing forces that both influence the activities of the entrepreneurs. One way the EU influence entrepreneurship in farming, is by setting up subsidies, with some stipulated goals. These goals are a way for the EU to assist and enable national level policy makers to set up more long term, productive policies for broader societal benefit: “[s]ustainable agriculture has an important role to play in preserving natural resources, reducing greenhouse gas emissions, halting biodiversity loss and caring for valued landscapes.” (European Commission, 2012 a) By doing so, the EU is trying to shift the path from short sighted, purely rent seeking behavior, to more long term mutually beneficial farming practices for both the farmers and society at large.

A Danish example of this can be seen through the February 2016 Danish farming package proposal which enables farmers to use increased amounts of nitrogen and up to 20 percent more plant growth inhibitor in their crops (Petersen & Arnfred 2016). Both chemicals can be harmful to the environment and create health problems to those that ingest it directly or indirectly. (Petersen & Arnfred 2016). Policies such as these are promoted as a way for farmers to be more efficient which is to the detriment of the environment, effectively further promoting rent seeking behavior among farmers.

From Blyth’s perspective, we can also see a difference in how successful farming is perceived, as the EU seems to promote the idea of sustainable and holistically beneficial farming practices as the best way to move forward. The Danish government on the other hand is seen to be promoting rather short sighted agricultural practices with the most benefits to the farmer rather than shared with society.

With regards to Baumol's theory of entrepreneurship, the EU, by funding or subsidizing types of agricultural activities such as energy crops starts to shape and set the entrepreneurial direction that the entrepreneurs will follow. By removing that subsidy, it opens the energy crop sector up to the market which allows the entrepreneur to figure out if their product can be competitive with the available substitute crops. Unfortunately, in the case of Energy Willow in Denmark, without the subsidies, the market is unwilling to prioritize willow. This is due to the legislation surrounding the industry, which does not want to commit to a single technology as the best long term solution, but rather prefers to let the market decide the goal (Appendix 7). This means that in Denmark the entrepreneurial direction that is set is often the one which the entrepreneur can achieve the highest return and not the one that is most beneficial to society or the entrepreneur in the long term.

When looking at the subsidies from the perspective of Blyth, one could argue that the subsidies are an idea used as a weapon to create path dependence. By using subsidies, the authority that makes the subsidies available is effectively using them to get farmers interested in a crop or sector that they might otherwise not be interested in without the incentive. By getting farmers to switch to a crop or sector, the governing authority can create a path in which the farmers may continue to follow at which point the subsidies can be removed as the farmers may have become so dependent on the crop that it becomes unfeasible to switch and a market has been developed around the product making it even more costly to change over to another solution.

9.1.4) Farmers

When looking at the relationship between the farmer and the government, following Baumol's theory on entrepreneurship, the government has a large influence on the level of adoption of Energy Willow. In the interview with Henrik Bach (Appendix 4), he clearly recognized the rent seeking paradigm as a problem for the adoption of Energy Willow. With farmers feeling pressure from the banks, they do not have the necessary freedom to experiment with alternative crops. The initiative to make a change in crops could come from the farmers, however as outlined in the theory from Baumol, it

requires the right societal paradigm. If the paradigm is focused on everyone doing their best for society, rather than making money, it is conceivable that farmers could adopt Energy Willow on their own. Since the farmer as an entrepreneur has the goal of achieving economic benefits and social recognition, if society rewarded farmers that did 'good' by the natural environment with prestige, some farmers might adopt Energy Willow without subsidies, to make it as financially profitable as traditional crops. This was also seen in the interview done with Henrik Rasmussen (Appendix 6). In the interview, he clearly stated that Energy Willow is a viable crop for the farmers of today, but it depends on their priorities. If they want something other than profit such as better biodiversity from their lands, then Energy Willow is a viable crop. This goes to show the importance of the prevailing paradigm on the entrepreneurial activities of farmers.

In the other direction, the influence on the government from the level of the farmers, the relation is mainly facilitated by their interest organization L&F. According to Henrik Bach, trying to influence policy makers yourself is extremely difficult, and from his personal experience following up one's actual promises is almost impossible. He has previously been visited by high level politicians on his farm, however little happened afterwards, and he has personally become disillusioned with Danish politicians.

The relationship between farmers and the institutions that govern them is in line with Baumol's ideas on how institutions influence and shape the entrepreneurial environment. The Green Growth policy shows in practice the ability of the Danish government to influence the decisions of farmers using policy measures as well as economic incentive schemes. In line with Blyth's framework theory of using ideas as weapons the Green Growth policy highlights the ability of the regulators, in this case the Danish government to use their ideas as weapons to create a change in the farmers' crop choices.

Regarding Energy Willow, due to the various positive externalities which will be discussed in-depth below, farmers that grew willow under the Green Growth policy were essentially able to attract multiple subsidies through different initiatives within the policy. For example, the planting of perennial energy crops such as Energy Willow was tax deductible, in addition to this; grants were made available for farmers who planted

crops that resulted in a significant decrease in nitrogen in the soil. (Danish ministry of environment and food, 2009)

9.1.5) L&F

As an interest organization for Danish farmers, L&F is in an interesting position within the debate on Energy Willow. This organization represents the farmers' interests, and they see the current paradigm as both a priority and concern. The current paradigm is putting great pressure on the farmers, and the total number of farmers on a national level has decreased by more than 50 percent over the last 30 years (Hansen, Larsen, & Meyer-Dissing, 2014). This coupled with the fact that last year, the largest number of Danish farmers in history went bankrupt, means that rent seeking behavior is a great priority, and for farmers that have economic trouble it is a necessary fact of life. The organization is made up of all kinds of farmers, so they have very diverse interests in the field of agriculture, which can become both a strength when applied overall, but also a weakness when you look on the focus on individual crop types. One of their big priorities is the promotion of local production, they think that Energy Willow should be grown domestically, the benefits are nice, but not enough for farmers to choose this type of crop. When they talk with farmers they look deep into the reasoning behind the decision because you need a strong conviction to grow Energy Willow despite the lower profits (Appendix 6; Appendix 12).

The size of L&F is important when looking at the political situation because it allows L&F to lobby and work towards certain results. One of the ways this works is through research funding, as:

“When you work with research on farming, it is incredibly difficult to attract adequate funding, without involving the sector itself. It is almost impossible”
(Christian Fink Hansen in Abrahamsen 2016, translated from Danish p. 1).

This, according to Abrahamsen, influences some of the conclusions that are drawn, and *“it has become more difficult to separate the professional work done by SEGES from the political interests in Landbrug og Fødevarer”* (Abrahamsen 2016 p. 1). This power allows L&F to have great influence on the Danish government, which can be

seen in the agricultural legislative package called “Landbrug og Fødevarer Pakke” in which most of the suggestions from L&F were implemented and some of the conclusions from SEGES were directly used by the politicians as weapons, following the framework from Blyth, using ideas as weapons (Abrahamsen 2016).

In this thesis, L&F is relevant because of its role as a powerful organization representing farmers at a political level helping to shape Danish agricultural policy which includes how land is used and how funding is allocated to the farmers and for which crops. With such power, this organization is a key element in the farmers’ decision making process from year to year when they need advice on what they should use their land for. They are also vital to the farmers as they help shape the agricultural policy in Denmark, which the farmers should adhere to maximize their earnings potential and staying within the confines of the law (Appendix 6; Appendix 12).

9.1.6) Energy Companies

When looking at how the power companies view the current paradigm, as discussed above, the power plants are embracing the idea of biomass to a large degree and moving towards a CO₂ neutral future, by making some of the long-term investments now into biomass fueled boilers for their power generation plants. Like the other stakeholders, the power companies are also in the rent seeking paradigm, and for the move towards biomass to make sense, they must get the fuel as cheaply as possible. When looking at the issue of Energy Willow from the perspective of the power companies, there are certain stakeholders that are necessary to consider. For the power companies the issue of Energy Willow as a source of biomass is a controversial one. The first premise that is important to consider when looking at Energy Willow from the perspective of the power companies is “*Why would they bother with Energy Willow if there is plenty of cheap biomass abroad*” (Appendix 6). The issue is one of effort; since they have plenty of wooden biomass, the power companies have no incentives to deal with a type of biomass that is harder to utilize than the existing wooden biomass. For the power companies, it then becomes solely a matter of price, and as shown above, at the current price, Energy Willow is not profitable for farmers.

In general, it can be seen that power companies are adopting biomass, but in the interviews in which we spoke about the priorities of the power companies, Energy Willow does not make much sense at the moment. The same can be said for the experiences in the willow report, in which the power companies do not consider Energy Willow a substitute, simply because of current market conditions (Appendix 11).

9.1.7) The public

It is almost impossible to say anything in general about the public as a stakeholder on the Danish energy market. As was clearly shown in the background section, we know that due to the relatively high economic level of Denmark that the public care more about the environment than many other European countries. In the interview with Jespersen (Appendix 3), it was also revealed that the public is putting pressure on the power companies and the government to provide environmentally friendly alternatives in power generation.

In the specific case of Energy Willow, it is doubtful if the general population knows much about the crop. An infomedia search of all Danish newspapers reveal that none of the major news outlets have mentioned Energy Willow in the last 12 months, and if you exclude news outlets dedicated towards farming, the mentions of Energy Willow are few and far between (Infomedia, 2017).

9.2) Optimal extent of institutional interference in the energy production sector from a stakeholder perspective

This section of the thesis will look into what role institutions should play in the Danish energy sector according to the interviewees, using the frameworks of Blyth and Baumol to guide the analysis. This section discusses the questions raised in the fifth part of the interviews as shown in the interview guide above, looking at the views of the different interviewees of what role institutions, such as the Danish government and the EU DG Environment and DG Energy, should play in regulating the Danish energy

sector. Firstly, a general view will be shown through the perspectives of the two academics that were interviewed, followed by the views of the stakeholders in the Danish Energy Willow sector.

These perspectives serve as a general view of the role of the government and EU in the energy sector in Denmark. It is common knowledge that academics try to shape ideas through their academic work in the forms of written papers, speeches and interviews. Regarding the role of the Danish government in the energy sector, it was clear that they both academics thought that the government plays a critical role in governing the sector (Appendix 3; Appendix 7). However, there were diverging views on the extent to which the government should be involved. The importance of creating long term policy stability for the energy sector is of utmost importance due largely to the sheer size of the investments that are made in energy infrastructure and the R&D that goes into the development of new technologies in the sector. Without stability and consistency in energy policy, it will create very little incentive for the private sector to get involved for fear of policy changes that could add more risk to their investments. An example of this can be seen in the Danish Energy Willow sector where the government's stance on the sector changed six times in five years making it a very difficult environment to navigate and scaring off potential farmers from entering into the business. (Appendix 1) This would have obvious repercussions for the energy sector in the case of Energy Willow, as it would be foolish of an energy supplier to switch to using Energy Willow knowing that there is great policy instability in the sector, which could affect the supply of the willow to the power plants.

A second role of the government mentioned by Kampmann was that of using taxation systems as a means to influence or deter the use of different kinds of technology. This too is a way in which the institutions are able to use their authority to help shape an idea that something is good or bad by either promoting its development or not. By creating a tax on a particular product or sector, the government is essentially creating the idea that there is a negative implication for supporting the sector through taxation. On the other end of this, by incentivizing a specific energy source or sector, the government is promoting the idea that that sector should be supported and there is a reward for doing so by use of subsidies, for example. By using this form of incentive, the government is essentially participating in creating the entrepreneurial path that

these incentivized industries will follow. By creating an incentive for a particular sector will attract entrepreneurs into that sector as seen in the Energy Willow sector during the Green Growth policy. (Baumol, 1990)

It was clear that although Kampmann viewed the role of the government as crucial, he stated that the government does not like to choose winners in the energy markets due to the market distortion this can create, ultimately, leading to very expensive solutions that risk not being adopted by the market. However, due to the length of the investments needed in the energy sector, the government needs to choose a winner to some degree in order to incentivize investment in a particular direction. By doing so, the government essentially creates a blueprint for the direction the energy sector will take. For example, in the case of Denmark, there has clearly been a preference towards wind energy, which has attracted both government subsidies in the form of green energy tariffs and taxes, which go towards the sector which have led to large private investments in the sector, making Denmark a pioneer in the field. Recently, however the Danish government backtracked on this due to the high costs of the renewable energy due to the added taxes and tariffs of wind energy for the Danish citizens. (Byttner, 2016) With high costs of energy people will use less of it, making it less profitable for the energy companies and eventually leading to less supply of it, very much in line with the paradigm of rent seeking behavior. Without the subsidies, less private investment has been made available for wind energy, signaling that the initial blueprint of wind energy being the ideal blueprint for Danish energy needs has failed.

Jespersen brought up the question of whether the role of government should be one of purely regulatory or participatory or a combination of these. This is an important question as depending on which role the government chooses to take will determine to a large extent how the sector functions. For example, in Denmark there is no requirement for energy companies to report on the efficiency of their energy plants. (Jespersen, 2017) However, with the government involved in energy production, they have started reporting on the efficiency of their own energy plants which has helped to open up the discussion on failures or areas of weakness. This has allowed the energy companies to build on these failures, whereas without the state participation there would be no real incentive for energy companies to report on such failures. With this

in mind, the active participation of the state in both the energy sector and in the policy making arena can create an environment favorable to innovation in the energy sector which in theory could be positive for the Energy Willow sector, possibly enabling it to play a larger role in helping Denmark reach the 2050 energy goals as well as benefiting society through its numerous positive externalities.

With regard to the EU and in particular the DG Energy and the DG Environment, Jespersen stated that the EU is already involved by promoting the role of the circular economy and the maximization and efficiency of existing systems. This is an important point as it highlights that there need not be heavy investments in new fuel sources and infrastructure but more a focus on how to make the existing systems as efficient as possible, maximizing the potential of these systems. Further, Jespersen mentions the fact that it is not necessary for all countries to have the same processes or energy systems but rather be able to share information on the systems in place which could help to maximize the potential of these systems by learning from other countries. This would also help in the selection of new energy systems as countries could share best practices so that other countries do not need to make the same mistakes twice. Kampmann mentions that the EU could play a role in three main areas 1) By supporting general technology platforms 2) By supporting the integration of existing energy networks in the EU 3) Through the advancement of the Emission Trading System (ETS) that is already in place today in the EU.

The support for technology platforms for example by supporting the hydrogen platform in Germany, by doing so the investment into this platform could benefit other EU countries as they would not need to pay for the development costs as those would have already been absorbed by Germany with the help of the EU. If the Energy Willow sector were to receive this kind of attention, best practices could be developed and shared with other member states creating an industry where development costs would not need to be absorbed by each country trying to support the growth of willow. This would make it easier to attract growers as markets would be easier to reach and systems already developed by the first movers with the support of the EU.

By supporting the development and integration of energy networks for example by promoting the development of a 'super grid' between the EU member states for the

seamless sharing of energy between countries. As the balance of alternative energy is not equal in all countries, by having such an advanced grid network, countries with the alternative energy infrastructure could send energy to other countries seamlessly (Appendix 7). This would mean that countries without large alternative energy infrastructure could use alternative fuels without having to invest in the alternative energy infrastructure right away. This would both build up the physical energy infrastructure in Europe, but also help through regulation by encouraging the growth of institutions and energy markets in Europe, trading electricity across borders in Europe on a larger scale and more efficiently.

The ETS already plays a role in European energy, but could be emphasized more and prices could be heightened in order to create more incentive for companies to lower their emissions. This would provide energy producers with the necessary incentive to make the switch over to alternative or carbon neutral fuel sources such as biomass as it is one of the cheapest sources of alternative fuels.

For subsidies for Energy Willow	Against subsidies for Energy Willow
Henrich Bach (Energy Willow farmer)	· Danish Energy Agency
· L&F	· Energy Companies
· Agrovi	
· EU	
· Academics	

Table 8 - Stakeholders opinion towards subsidies for Energy Willow based on interview data

From a stakeholder perspective, there were differing views on the role that institutions should play in regulating the energy sector. There were those that believed that the government should let the market figure out the best source of fuel in line with the

regulation and on the other side those that believed that a subsidy on Energy Willow would be a good way to promote the growth of the sector, this can be seen in Table 8 above. Those stakeholders that have a strong relationship with farmers were the ones most in favor of subsidizing the willow both as a means to create employment and wealth for the farmers but also as a way to kick-start the growth of the industry. On the other side were those more closely linked to the energy sector who believed that the sector is able to find the best solution through market dynamics and that subsidies were an unsustainable way of developing the Energy Willow sector.

From an EU perspective, the EU already plays an active role in the European bioenergy sector subsidizing the sector through various subsidies that are in place through the rural development program. However, the EU Rural Development policy stipulates that it will only support up to 80 percent of the cost of the subsidy and the remaining 20 percent must come from the national government. (Plan, 2017) For this to happen it requires the national government to implement a rural development policy meeting the requirements of the EU. By doing this, the EU essentially uses its ideas about biofuels as weapons hoping to get the individual nations to subscribe to their ideas and create a path for the member states, which they will hopefully invest in themselves, creating a blueprint for their future energy use and eventually become path dependent on the renewable sources of energy.

The promotion of bioenergy is part of the EU's promotion of alternative fuels to help the member states reach their 2020 targets in time. The individual countries are bound by the EU to reach their required targets, essentially forcing their ideas onto the individual nation states. As has been seen in Denmark, the previous government created their own blueprint towards renewable energy targets in the form of the Danish 2050 energy goals, investing heavily in renewable energy systems from wind energy to Combined Heat & Power (CHP) stations. In line with Baumol, this promotion of renewable energy creates the entrepreneurial pathway in a given society as the entrepreneurs seek out opportunities where they are able to match demand with supply. In this case the opportunity of renewable energy systems and fuel in line with the energy policy surrounding the energy goals.

The Danish government through the Danish Energy Agency has a differing opinion on the topic of renewable energy and biofuels in particular, as can be seen in Table 8 above. The Danish Energy Agency does not believe that subsidizing a crop such as Energy Willow is a viable solution as it is their belief that the most important factor when choosing the fuel source of energy within the framework of the energy policy is that the fuel needs to be competitive on price. (Larsen, 2017) Even though there is the potential to receive EU funding to subsidize biofuels in Denmark, it requires the government having to create a policy in line with the EU's rural development plan on a national level as well as having to pay the additional 20 percent of the subsidy. This is seen as an unnecessary cost for the Danish government as there are still many other options for biofuels that do not need any government incentives. As seen above with the case of wind energy, the Danish government stopped their support for wind energy due to its high monetary costs despite it having positive externalities for Danish society at large. Again this emphasizes the role of the current paradigm of rent seeking behavior in Danish society. This opinion is in line with the requirements of the energy production sector as it is in their best interests to keep their production costs as low as possible in order to maximize profits. If the energy source had additional taxes on it for example through the costs of the externalities, it would mean higher energy prices and lower demand for the energy, decreasing profits for the energy producers. Within the framework of the current energy policy, energy producers are not forced to buy any particular source of fuel as long as they meet their CO₂ requirements. By doing so, energy companies are able to source the cheapest renewable fuels in order to keep the prices at the desired rates for the consumers and maintaining their own profit levels.

On the other side of the argument are the Energy Willow farmers, L&F and Agroví all of which believe that a subsidy for Energy Willow is the only way to promote its growth in Denmark, which will have a positive outcome not only for the environment but also the economy through job creation in the sector. L&F uses its large support base as leverage to influence policy makers to create a favorable policy environment for their farmers.

The link between these three stakeholders is clear as L&F represents the farmers in parliament and Agroví is a subdivision of L&F, supporting farmers on a more local level

feeding information back to L&F in order to best serve their farmers interests. The argument from all three of these stakeholders was very much aligned, as they believe that a subsidy would be a necessary incentive to get farmers to look into Energy Willow commercially. This is in part due to the tough financial time many farmers are going through in Denmark as explained earlier in the thesis and partly due to the policy instability the government has shown in the past. If there is no guaranteed income for the farmers, they will not take a risk on new crops as many of them have debts that need to be paid and without a guaranteed income they will get no further financial support from credit institutions. This once again very clearly illustrates the need for monetary rewards for farmers in order to incentivize them to follow a particular path. Without a financial incentive, there is no reason for a farmer to shift path from one where they make an income that allows them to pay their debt and hopefully live a decent life to one where there is no guaranteed income or established market for their crops. Once again, this highlights the current rent seeking paradigm that Denmark is in.

9.3) The benefits and drawbacks of Energy Willow for Danish society

This section of the thesis will look into the various benefits and drawbacks of Energy Willow for Danish society. The benefits that will be looked at are both those related to the benefits of using Energy Willow as a CO₂ neutral biofuel as well as the other positive quantifiable and non-quantifiable externalities that come about from growing the crop on Danish land. The main drawback to Danish society is that of ILUC, which as discussed earlier in the thesis is the term used to measure the unintended consequences from the expansion of biofuels in cropland displacing other crops such as food crops which is a topic of much debate in many developed countries today.

As an energy source Energy Willow is carbon neutral, meaning that there is no net release of carbon dioxide into the atmosphere from the burning of it in an energy plant. There can be an additional carbon footprint in the farming, processing and transportation of the willow to the final destination. However, this would be the case with most other fuel sources and with Danish Energy Willow this footprint would be

much lower than if the fuel source was to come from outside of Denmark and travel long distances to its final destination. These additional steps that add to the overall carbon footprint of a given fuel source often create the issue of carbon debt, which essentially means even if the fuel source is carbon neutral by itself, the additional steps needed to get it to the site in which it will be converted to energy add more carbon to the process than the fuel would eliminate. (Kampmann, 2017) In the case of Danish Energy Willow, we have calculated the value that this carbon offset brings to Danish society in the economic section earlier in the thesis. The carbon offset value of Energy Willow to Danish society as used by the Danish Energy Agency differs greatly depending on the yield per hectare and the type of soil in which the willow is planted. In sandy soil the value is 724 DKK per hectare and in clay soil this value drops to 693 DKK per hectare due to the decrease in output per hectare. (Ugilt Larsen et al, 2015) The benefit of reduced carbon emissions is one which has the backing of all stakeholders in the energy sector, however there are multiple ways of achieving this and Energy Willow is only one of the ways of doing so. As both the EU 2020 energy goals and the Danish 2050 energy goals have a large focus on the reduction of carbon emissions produced by energy production, Energy Willow is an ideal substitute to any fossil fuel today solely from a carbon emission reduction perspective. Both the EU and the Danish government have set up a path towards reducing the carbon emissions of the Danish energy sector, however, broad that path may be. As discussed by Kampmann and Jensen, the Danish government does not like to choose winners but as the deadlines get closer, it is imperative that the government steps up the focus on finding and backing viable solutions to reach these goals or face being left behind.

In addition to the reduction of carbon emissions in the Danish energy sector, the Energy Willow produces a number of other benefits to Danish society, both quantifiable and non-quantifiable. These benefits include the 1) increased uptake of nitrates from the ground, both lowering the amount of nitrogen leakage into the groundwater supply and increasing the soil quality 2) carbon storage in the soil 3) the increased biodiversity that willow creates 4) reduced pesticide consumption (Dubgaard et al., 2008; Olesen, 2008; Ugilt Larsen et al., 2015) .

These positive externalities are seen as key value creators for Energy Willow as without these, the Energy Willow would be just as valuable in monetary terms as many

other sources of biomass in Denmark. During the period under the Green Growth policy, there were government subsidies aimed at paying farmers for some of these externalities in order to fulfil the water framework directive which had a positive benefit on Danish society (Appendix 3). As seen earlier in the thesis this led to relatively large growth in the Danish Energy Willow sector. These subsidies can be seen as a way in which the Danish government can promote productive entrepreneurship within Denmark by incentivizing farmers to adopt willow, which essentially creates positive value for society through its positive externalities and burning as a carbon neutral energy source. Unfortunately, these subsidies were cut with the end of the Green Growth policy leaving many farmers who are still creating these positive benefits for society without compensation for doing so. According to the Danish Energy Agency, the value of the reduced nitrogen leakage alone is worth 577 Kr per hectare on sandy soil and 288 Kr per hectare on clay soil giving Energy Willow a total calculable externality value of 1301 Kr per hectare and 981 Kr per hectare respectively on sandy and clay soil. Figure 13 Below is a chart illustrating a very conservative earning potential of farmers of Energy Willow in Denmark with and without a subsidy of 500 Kr to compensate for CO₂ reduction as per the EU CO₂ price and nitrogen uptake. This value is calculated for clay soil which gives the farmer the lowest subsidy for nitrogen uptake. As is clearly visible, without a subsidy, Energy Willow is only slightly more financially viable than continuous grasses and oats. With the addition of the minimal subsidy, the Energy Willow becomes more valuable than both winter rapeseed and feed rye making it much more financially attractive to farmers. If however, you were to add the total externality value as calculated above of 1301 DKK and 981 DKK respectively, Energy Willow would become more economically viable than any of the most common traditional crops in Danish agriculture, making it appealing to those in the current rent seeking paradigm that are mainly interested in the financial benefits of a crop over other stakeholders.

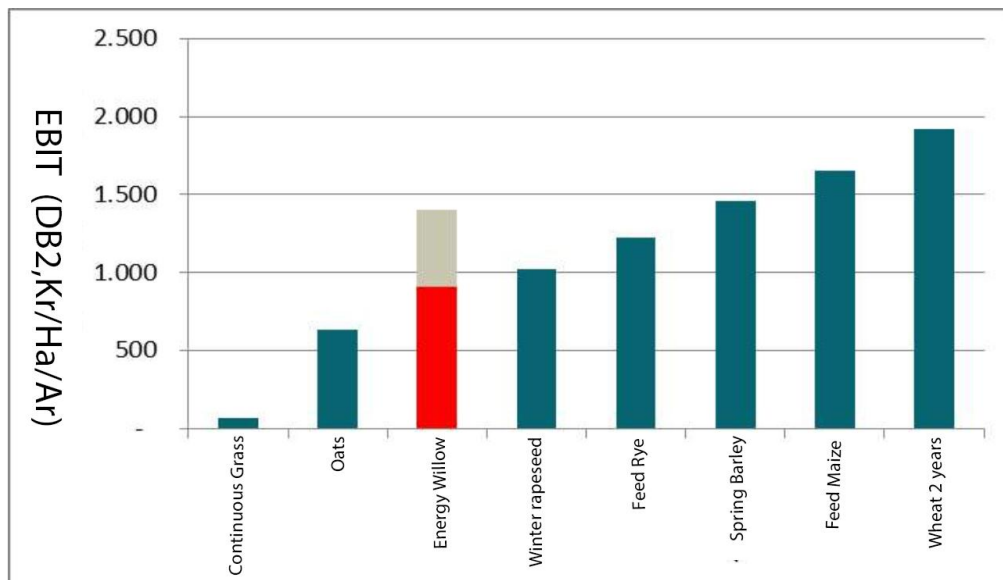


Figure 12 - chart illustrating pay-out for Energy Willow in Denmark with and without subsidies compared to other crops.

Unfortunately, just knowing about this value does not automatically mean that the farmers will be compensated for it as traditional energy markets do not account for such things as these externalities are beyond their scope of work. There needs to be regulation in place in order to internalize the externalities that can help to correct these market failures as was the case under the Green Growth initiative. This could be in the form of taxes on farmers that pollute too much or a subsidy to promote the use of the crop for the purpose of its externalities as was the case under the Green Growth policy. (Jensen, 2017)

On the negative side, there is a big debate among the stakeholders in the energy sector about the negative effects that energy crops can have on society, the largest of which is that of ILUC. The issues of food security versus energy security is one with many complexities and angles to it, with energy crops and Energy Willow in particular this debate is particularly well known. As mentioned by Jensen, many of the farmers in Denmark are already constrained in using their land as certain parts of the land are not arable, meaning that crops cannot be grown and if they are to cover all the arable land they do have with Energy Willow, there will be no space for food production. The problem in doing so is that there will still be a demand for food so the food production will need to move elsewhere creating more carbon emissions in the production of the food. As shown in the Danish Energy Agency report which uses the example of the US when there was a large shift towards corn for bioethanol production. This actually

had an overall negative effect on carbon emissions in the US as despite the fact that the land was being used to create a carbon neutral source of fuel, the demand for food was still high so the food needed to be grown elsewhere creating more emissions for the production of the food in another location. (Danish Energy Agency, 2015) In relation to Baumol, although growing Energy Willow could be seen as the promotion of productive entrepreneurship for society, it can actually end up being destructive entrepreneurship by proxy, unintentionally causing more harm than good to society.

An interesting observation during the interviews was that the issue of ILUC was raised more by the interviewees than any of the positive externalities. This could be seen as a result of the current rent seeking paradigm where stakeholders are more inclined to promote the idea of food crops being of more importance than energy crops as they provide more financial rewards to the farmers, despite the fact that Energy Willow produces more positive externalities for society, albeit largely uncompensated ones.

Contrary to this argument, from an EU perspective, on a policy level the EU actually promotes the growth of non-food energy crops in its member states going against the idea that ILUC is negative for society: *"[w]hen you have non-food energy crops, and Willow is one of them, there is definitely political support I would say, to develop this type of energy crop, the so called non-food energy crops."* (Plan, 2017) Of course even with policy support on an EU level, the national government's need to support an initiative in order to make it policy on a national level, but on the other hand if the national governments do not create policy in line with the EU proposals their farmers do not get access to the funding. This, as seen earlier in the thesis is a way in which the EU institutions are able to promote their ideas to national governments aligning with their rent seeking paradigms. In the case of Denmark, the government was able to attract the EU subsidies for non-food energy crops through their water framework policy under the Green Growth initiative. This had a very positive outcome for Energy Willow as farmers began to move towards Energy Willow due to the financial viability of the crop under the incentive scheme. This proved that for those farmers that adopted Energy Willow in this period, ILUC and food security were not necessarily major driving stakeholders but the financial payoffs were. This point was backed up by the Danish Energy Agency that made it clear that biomass is the same no matter where it comes

from so it is most preferable from a political standpoint to grow it locally in order to create jobs, giving revenues to the farmers. (Jensen, 2017)

One argument against ILUC is that of using the non-arable land such as wetland to grow Energy Willow, which is a feasible solution, and was a solution that was mentioned by multiple stakeholders during the interviews, both as a means to combat ILUC but also to increase the production of Energy Willow in Denmark. This thesis is written on the basis that arable land could be used to grow Energy Willow, competing with traditional food crops. This is largely due to the better soil quality of the arable land that can provide much higher yields than non-arable land, which is the main factor in determining the economic viability of the Energy Willow. In addition to this, by only growing Energy Willow on non-arable land such as wetlands, there would not nearly be enough willow biomass to meet the energy needs of Danish energy companies. This would, therefore, make it unviable for both the farmers and the energy companies, as they would seek alternatives with more steady supplies.

9.4) Local vs imported biomass

This section of the thesis will look into the various issues surrounding the topic of locally produced versus imported energy in Denmark. The main focus will be on three main practical and economic implications of relying on imported rather than locally sourced fuel. These concerns are 1) The security of supply of fuel 2) Job creation, and 3) The environmental cost of importing fuel. Each of the three concerns will be discussed and analyzed in relation to the interviews held and the theoretical framework of the thesis.

The first major concern is that of the security of energy supply that is needed in order for the country to function properly. Today, the majority of Danish biomass is imported from countries as far away as Canada, sending the biomass in large container vessels to Denmark (Appendix 3). Although this is still an economically viable source of fuel for Danish energy companies, it does create a dependence on foreign suppliers, which is always a risk if there is to be any hitches in the supply. This has been a topic of debate among European policy makers as they are of the belief that the EU should be promoting the use of European biomass as opposed to importing it from outside the

EU, however at this time European biomass cannot compete on price or scale of supply. (Plan, 2017)

Another case for using locally produced biomass with regard to the security of supply as explained by Henrik Bach is if there is to be a particularly harsh winter and the ships are not able to get into the harbors close to Denmark. This could create a barrier to supply, which essentially means the energy companies would need to find alternative sources of fuel in good enough time not to run out and interrupt the energy supply. (appendix 4) Of course, this scenario is very unlikely but it is something that needs to be considered by those developing the energy policy when looking at the risks of sourcing fuel from outside the country where the fuel is needed. Another more likely scenario is that of a global increase in demand for biomass which could see at least in the short run there being a shortage in supply to meet the demand, leaving energy companies in a vulnerable position. This will not only affect the price of the fuel but also the supply during the periods when demand is very high. This is an issue of large concern to energy companies as it is vital for energy companies to be able to predict demand and supply of fuel as well as secure prices into the future in order to keep energy prices stable, once again emphasizing the role of rent seeking behavior in the energy sector. If there is to be a sudden surge in demand this will almost definitely have a negative effect on the price of the fuel source, leaving energy companies in a tough position as they are heavily regulated in terms of prices they can charge for energy. (Grandal, 2017) If their fuel price is to suddenly spike, they may be left in a very difficult position when trying to increase their energy prices to reflect the increase in fuel prices. As mentioned during the interview with Thomas Holst (Appendix 12), Denmark uses a lot of biomass as it stands and is set to increase this usage into the future. Currently and in the past Denmark has always imported the majority of its fuel so why should it be any different with biomass in the future?

The second issue in the debate about local vs imported biomass is that of job creation. As the creation of employment is a large topic of discussion among all politicians and policy decision makers, it is no different regarding the biomass sector. The main argument is that if we are able to produce a product ourselves, creating jobs and an industry locally, why would we import it and send the jobs outside the country. This was one of the focal areas of the interviews. From the perspective of the EU, it was

clear that the use of biomass produced within the EU was the most preferable due to the consequences of this on employment within the EU. On a more local level, there was a similar opinion from both the L&F and the ministry of energy that Danish biomass would of course be the most ideal situation from a political perspective in terms of creating jobs and an industry.

“Biomass is biomass but if you look at it from a political perspective then obviously it creates more jobs to use domestic biomass rather than foreign because in Denmark it gives some revenue and income for farmers if you use domestic biomass but with imported biomass the jobs go to another country.”(Appendix 10)

However, from the economic perspective the political arguments hold little weight as Danish biomass is far costlier than the currently imported biomass alternatives and not necessarily superior, making it very difficult under the current rent seeking paradigm to use local biomass instead of the cheaper alternatives.

The third issue is that of the environmental cost of using imported biomass in Denmark. As biomass is itself supposed to be used in reducing CO₂ emissions it seems very counterintuitive that there is a negative CO₂ impact in getting the fuel to the site where it is to be burnt in order to reduce this same effect: *“[i]t is amazing to think of it sailing woodchips from Canada to Denmark is more economical than growing Willow in Denmark.”* (Larsen, 2017) This was an issue that was raised by multiple stakeholders during the interviews, with a large emphasis on the fact that despite these long distances and the prices of transportation of the biomass, it is still cheaper than producing it in Denmark making it economically unviable for energy producers to consider Danish Energy Willow. This once again showed how the short term economic aspects or the rent seeking paradigm is of more concern than the long term environmental impacts of the fuel source itself.

9.5) Dissemination of knowledge to new growers of Energy Willow/ Considerations to new entrepreneurs/farmers

This section will look into the spread of new knowledge to entrepreneurs. To understand the dissemination of knowledge and the activities that are relevant for the spread of new farmers growing Energy Willow, we will look into how three different entities try to influence farmers, and their choice of crops. The first is Bach, an entrepreneur in northern Jutland who has been working with Energy Willow for a long time, working to both grow new and more efficient strains of Energy Willow and to produce new and better machines. The second is L&F, the agricultural interest organization already working to spread different kinds of knowledge within the sphere of agriculture. Finally we will look into what the government wants when looking at the willow report and the interviews with Jensen and Grandal (Appendix 9).

It was shown above that according to Baumol, the spread of knowledge is an important factor when looking at entrepreneurship, because the spread of new innovations contribute a great deal to the economy. Spreading existing experiences and also helping new entrepreneurs overcome some of the barriers to make production more efficient. One example of this can be seen in Figure 5, in which the importance of fertilizer on the growth of Energy Willow is shown, as finding the optimal level is of crucial importance to optimize profits. This was highlighted both in some of the interviews (Appendix 6; Appendix 12) and in the secondary literature. A lot of the new farmers who tried their hand at growing Energy Willow suffered from their old habits and lack of experience in the field. This caused the fields to have a much lesser output than expected, thus, hurting the economics of Energy Willow.

When speaking with Bach and visiting his farm, it was shown that the way Bach tries to be a source of innovation, subsequently, disseminating knowledge through leading by example (Nyvraa 2017). By going to conventions and having his own YouTube channel, with a standing invitation for anyone to visit his farm, Bach attempts to show farmers how his experience in the field of growing Energy Willow since 1980 (ibid.) has formed some very efficient habits, that allows Bach to make a living growing Energy Willow.

L&F works as a point of dissemination of knowledge regarding new agricultural methods, including Energy Willow. They work to distribute the newest knowledge regarding growth methods, and they are also working as the consultants when the farmers are looking for recommendations towards new crops they should consider (Appendix 6; Appendix 12). Thus, they become a strong influence on the direction farming takes in Denmark (Appendix 6; Appendix 12). When directly asking the two working for L&F how they deal with the topic of Energy Willow, the demands of the paradigm and how it influences entrepreneurship is clearly seen.

In their advice towards new entrepreneurs, they are both cautious when talking about recommendations for new farmers. They would not outright say no, but said you need a different motivation than rent seeking, and this motivation has been clearly shown as the governing principle for many farmers, reducing the viability of Energy Willow, when looking at different motivational stakeholders. A problem is also the length of time that Energy Willow is on the field, because of the volatile policy environment. L&F is reluctant to recommend anything and the inability to accurately predict the economics throughout the lifespan of the crop hurts the viability of the crop.

To L&F, the crop has potential, but they are also facing pressure because it is expensive to have consultants specialized in a crop few are using. This results in a hen and egg problem, because you need more farmers to justify more consultants, and you need more consultants to spread the knowledge of Energy Willow to get more farmers.

The Danish Energy Agency as a representative of the government is responsible for the transition of the Danish energy system towards the 2050 goals, and as such is responsible for spreading the knowledge to stakeholders on how the government envisions this change happening. When talking to the public organization Energinet, which is the transmission company for Denmark, the idea that the government refuses to commit to a single branch of technology was reinforced. In line with the paradigm of rent seeking behavior, cost is king, and the market has to figure out the path towards a CO₂ neutral society by itself (Kampmann, 2017 & Grandal, 2017). This is the idea that the current government seeks to spread.

10) Discussion

The purpose of this chapter is to discuss three key assumptions that guide how the analysis is conducted. The guiding principle is applied to a general setting to discuss the applicability of our conclusions. The purpose is also to serve as a starting point for the recommendations of thesis. Expanding on these will allow us to discuss the future of Energy Willow in Denmark, and how we see the future of Energy Willow.

The first assumption is that it is important to understand the institutional framework to draw conclusions about entrepreneurs. The second assumption is the importance of ideas on the institutional environment. The final assumption is that the natural environment is something we should take care of, this is a crucial assumption because as is repeatedly stated, we have to choose if we want Energy Willow or if we do not care about CO2 emissions.

10.1) The importance of an institutional framework

The thesis has chosen Baumol's theory as one of the key theories to guide how we see and analyse entrepreneurship in Denmark. This has several implications for the recommendations that we can make based on the thesis. The baseline of this section is that we live in a society in which the government plays a big role in everyday life. Baumol allows us to understand how this role influences entrepreneurship and the allocation of talent.

We have shown that it is important to understand the institutional framework because of its role as a guiding force; both for investments and for individual efforts. In the case of energy production in Denmark, the government has to pick a direction for investments, as the lifespan for these investments are long, so to reach the desired goals in 2050, the government has to choose, and this has to be done soon. This was highlighted in the specific case of Energy Willow, in which it was shown that farmers as entrepreneurs heavily rely on the support of the government to try new crops. If the government as the organization that influences entrepreneurship decides that externalities are something that should be compensated, then entrepreneurship would naturally follow. The government has, however, to decide if they want Energy Willow,

because as shown, the rent seeking paradigm is too strongly permeated in Danish society, and without governmental support Energy Willow just is not profitable.

Understanding the institutional framework provides the thesis with a way to recognize how entrepreneurs chose their path when doing innovation. Looking at institutional level we can understand that if the government provides a hint that something new is the future, someone might try it out, but as can be seen in the case of Energy Willow, without continuous attention, the entrepreneurial activities will cease. This way of promoting entrepreneurship from an institutional perspective, becomes especially interesting with the insight that different institutions might promote entrepreneurship that is unproductive or even destructive for society as a whole. This could also be the case in energy production, because it will not be cheap to reach the 2050 goals, and if the institutions focus solely on rent seeking, we might never get there, and still continue to use fossil fuels in the future.

By setting up positive environmental externalities as the benchmark for productive entrepreneurship in Danish farming, we put a clear dividing line between different kinds of farming, and this could constitute a problem for the thesis, if it turns out that strong economic growth is the solution to the problems of the future. By looking at how the governments shape entrepreneurship we run the risk of overlooking new types of innovation that could completely disrupt the way society functions today, and the externalities that we found important, such as clean ground water, might not even be a concern in the future.

10.2) Ideas shaping the institutional environment

Ideas are used as a means to influence others perceptions and interactions with certain issues. This thesis has served to show how ideas have been a powerful factor in creating and shaping the paradigm of rent seeking behaviour in Denmark, which has led to several particularly big challenges for those seeking to create an environment conducive for growing Energy Willow on agricultural land in Denmark.

As was shown earlier in the thesis, there is a prominent rent seeking paradigm prevalent in Denmark. This paradigm is very evident in the agricultural and energy sectors that were the subject of discussion in this thesis, with farmers and energy companies both seeking to reap the largest financial benefit for their respective products and services. In the case of the farmers, it became apparent that the idea of financial rewards was strongly established within the sector with many farmers facing increasingly tough global competition and a majority of them with large outstanding debts that need to be repaid in order to continue farming, thus, shaping the paradigm. This rent seeking paradigm has led the majority of farmers to select the crops they grow based on the market price for their crops over all else. Much of the time, this crop choice is to the detriment of the natural environment and society at large through the need for increased fertilizer and pesticide use in order to try and keep yields as high as possible and get the maximum financial return.

The same can be said for the energy sector as they too are focused largely on the cost of the inputs to create energy at the lowest possible price for the consumers, while maintaining healthy profits, again showing the role of rent seeking behavior in the sector. It is this paradigm and the ideas about the importance of making the maximum profit that has created the path dependency on using fossil fuels and the reason why it is so difficult to break this path dependency as the entire global energy industry has been following this path for so long. Due to the increasing pressure put on the energy sector by both the EU and the local government through the renewable energy goals on both national and supranational levels, energy companies in Denmark have been forced to break away from this path dependence on fossil fuels and seek alternative energy sources, while trying to maintain their profits. In the case of energy producers, they now have to choose between the various sources of renewable energy that they are going to use to produce energy within the new framework of the EU and Danish government, however that framework does not dictate which fuel source should be used giving the freedom of choice to the energy companies. Because of the paradigm of rent seeking behavior they are in, energy companies choose the most economically viable solution that allows them to cut their emissions in line with the new frameworks while keeping their profits as high as possible.

Unfortunately for Danish Energy Willow, this means that it is not an economically feasible solution under the current policy framework as it needs to compete on prices with many other biomass sources which offer the energy company similar benefits. In this current rent seeking paradigm without significant policy support Energy Willow could not be a viable option largely due to the competitive forces at play between the farmers and the energy companies. On the farmers' side they want to get the highest price possible for their crops and on the other side, the energy companies are trying to pay as little as possible for their inputs.

If however, the idea of the value of externalities was to become influential enough to shape the policies and create a blueprint that would reflect these market failures, compensating the farmers for the externalities without negatively impacting the profits of the farmers or energy producers, the Energy Willow could play a significant role in helping Denmark to achieve the 2050 energy goals while at the same time benefitting both the farmers and Danish society at large through the various positive externalities it produces.

There is a clear disconnect between the policies that are in play and the goals that have been set by the Danish government with regard to the energy and agricultural sector. The idea of rent seeking behavior in both sectors is clearly being reinforced by the policy makers who use their ideas to shape policies that to a large extent support this paradigm in order to maintain the support of the farmers and the energy sector, whilst at the same time keeping the costs for the policy makers as low as possible in order to stretch their budgets elsewhere. While this path dependency on the rent seeking paradigm may be seen as the norm in society, there is a critical need for a change in this path dependency on solely monetary benefits in the agriculture and energy industries. This shift will require new ideas to take hold and the alignment of all stakeholders' ideas in order to become the blueprints for a fossil fuel free Danish society that takes the environmental consequences of short term policy making into serious consideration.

10.3) The natural environment as a priority for society

The prioritization of the natural environment is a topic of debate among and between policy makers and citizens globally. In Denmark, this is no different, as shown in the section on stakeholders earlier in the thesis, citizens of countries with more developed economies tend to be more concerned about the preservation of the natural environment. Despite this concern, Denmark still gets a fairly significant amount of its energy from non-renewable sources that are known to have an adverse effect on the environment through increased CO₂ emissions being released into the atmosphere. In addition to this, the Danish agricultural sector, being the largest economic sector in the country, in order to stay competitive with global producers have had to make their own production as efficient as possible, most commonly by means of increased use of fertilizers and pesticides. This, combined with the fact that farmers in Denmark are faced with the toughest economic conditions they have been exposed to in decades, creates the need for them to find any means possible of staying financially viable, often to the detriment of the natural environment. This is an effect of the rent seeking paradigm as described in this thesis, it has created a system in which despite society's desire to preserve the natural environment, will prioritize financial rewards first. As was explained throughout this thesis farmers were first and foremost concerned with the financial viability of a crop over its provision of benefits to society in the long run. When the correct financial rewards were put in place in the form of subsidies, many farmers began to adopt Energy Willow and once these subsidies were disbanded, the farmers once again switched to something more profitable in order to reap better financial rewards.

Energy companies in Denmark were shown to be in a similar position, in that they are very much concerned about the natural environment, knowing that their industry is the cause of much of the environmental damage today. This combined with society's ever increasing demands for environmental preservation which have influenced policy makers to take action have been leading causes for the shift towards more renewable energy in Denmark. For the energy sector, again despite their concern for the natural environment, is driven primarily by the cost of the energy prices and the fuel sources they use to create that energy. At the end of the day they are trying to provide the cheapest energy for their consumers while reducing their carbon footprint. Due to EU

and local regulation, which has seen a large shift towards the promotion of the use of renewable energy sources, energy companies have been put in a situation where they need to focus their business in line with the new regulatory environment and targets. To do so they are able to choose between a number of renewable energy and fuel sources which allows them to produce reasonably priced energy while at the same time, reducing their carbon footprint on the Danish environment and meeting their energy targets. Unfortunately, with the high costs associated with production in Denmark, Energy Willow cannot currently compete on price with foreign substitute biomass, making it unattractive to Danish energy producers who would not see any financial benefits from using it as a fuel source. In addition to this, Danish energy companies would not be credited with creating the other positive externalities associated with Energy Willow explained earlier in the thesis as the credit would be given to the farmer creating these externalities on their land.

From a purely economic perspective, looking at the benefits that Energy Willow can provide, first in terms of the nitrate uptake which can help continuously purify contaminated groundwater, as well as help the soil recover and improve crop yields for farmers without the need for additional chemical additives. If left un-remedied, contaminated water sources could end up costing the Danish society much more in the long run with the required processing and filtration that would be needed to purify the water. Although this requires investment in the short term, the long term benefits will be valuable for society. It is imperative that the thinking changes from seeing these possible solutions such as Energy Willow as 'costs' to society, but rather as investments to secure a fresh water supply in the future.

The same goes for the reduction of nitrates in the soil, if the farmers continue to over utilize the soil and continuously introduce fertilizers and pesticides without giving the soil a natural rehabilitation period, it will eventually work against the farmer. This will end up costing large amounts of money for the fertilizers and pesticides which will make their crops more expensive and less competitive while creating pollution to the detriment of greater society. This will become a negative cycle, which the farmers will struggle to get out of if they do not make the necessary sustainable choices in the short term which will have a positive impact on them in the long term.

With all the above in mind, it is clear that Energy Willow technically has the ability to play a significant role not only as a source of biomass for Danish energy production but also to provide Danish farmers and greater society with the added positive externalities highlighted earlier in this thesis. This requires that the paradigm in which Energy Willow is seen by farmers, energy companies and the policy makers is changed and aligned. The alignment of this paradigm needs to be one in which the Energy Willow is not only seen as merely a source of biomass for energy, but as a tool for helping shape sustainable agricultural practices and cleaning polluted water supplies in Denmark as well as the other benefits the crop can bring to society.

I think that Energy Willow is like we would say in Denmark 'a kinder egg', it can both make a fuel which can be used and has a place in the market, but can also have these positive externalities and services which can be used to fulfil another requirement in the EU and water quality. (Appendix 10)

Together with the paradigm shift will need to be a policy shift with a more holistic approach to both the energy and agriculture sectors with a long term perspective in mind, giving farmers and energy sector investors' peace of mind in their investment decisions moving forward.

II) Conclusion

This thesis aims to represent an exploratory study on the role institutions play on entrepreneurship within the farming sector in Denmark. With a foundation in the two reports by the Danish energy agency looking into the potential of Energy Willow in Denmark, we began trying to figure out why despite it's huge potential as indicated in the reports, there is so little Energy Willow grown in Denmark today. The reason why this is relevant in today's society is due to the fact that Denmark is trying to find ways in which it can reach its 2050 fossil fuel free goals, Energy Willow is potentially one way in which these goals can be realized.

One of the core principles used in the thesis was Baumol's notion of productive, unproductive and destructive entrepreneurship. These principles are what guide the entire thesis, as Baumol defines productive entrepreneurship as something that

benefits society. To that end, we used the notion of positive externalities as a measuring tool for when something is productive entrepreneurship or not, and this is exactly what makes Energy Willow so interesting, because it has a large number of positive externalities, two of which can be directly measured economically. Energy Willow as productive entrepreneurship is what led us through exploratory research to the research question:

What role can Energy Willow play in reaching the Danish 2050 energy goals and is it desirable for society that Energy Willow plays this role?

Currently, Danish farmers tend to follow the paradigm of rent seeking behaviour with regards to the way they approach business and entrepreneurship. This is because the average Danish farmer has a substantial debt to be repaid, which affects the way in which they do business. Farmers need to prioritize profits above all, in order to pay back their debt. This is reinforced by the fact that 2016 was the year with the highest number of farming bankruptcies in Danish history. Thus, having the freedom to experiment with new crops, with lower profits and no incoming cash flow for the first year is quite rare, resulting in almost no Energy Willow being grown in Denmark today. However, if Denmark as a society demands Energy Willow, it can be made available. It was shown that there had previously been a subsidy on Energy Willow growth, and that this subsidy succeeded in promoting Energy Willow amongst Danish farmers. Thus, it was shown that the lack of Energy Willow is a consequence of purely economic reasons.

Our research focused on the stakeholders within the sector of Energy Willow, we interviewed different stakeholders so as to collect empirical material through semi-structured interviews. The semi-structured interviews were analysed using a constructivist methodology called pragmatism. This methodology allowed us to work with the experiences and habits of the interviewees in the analysis. Experience and habit are two defining traits of human interaction, and using pragmatism gave us the tools to understand how the stakeholders work within the current paradigm of rent seeking behaviour.

To analyse the data, we were directed by two major theoretical frameworks 1) Baumol's analysis of institutions was applied to understand how entrepreneurial activities are promoted within a society; 2) Blyth's role of ideas directed us in analysing how society decides the drivers of regulation, this was shown by the interactions between the different stakeholders and the influences of each of these on the formation of regulation in the agricultural and energy sectors, having a direct impact on the adoption of Energy Willow in Denmark.

Through the analysis, we were able to answer the question posed above. It was found that despite there being a huge potential for Energy Willow as well as a demand for the attributes that the Energy Willow brings such as the reduction of nitrates in the soil and groundwater. It was established that many of the stakeholders that were interviewed emphasised the role of profits in the agriculture and energy sectors. This reinforced the idea that the rent seeking paradigm that Denmark is currently locked into, prevents farmers and energy companies which represent both the supply and demand sides, from seeing Energy Willow as an economically viable option today. So although Energy Willow has the potential to play a significant role in Danish energy production as well as the fact that it can provide a clear solution in meeting the public's demands for better environmental conditions, the fact that the public is largely unaware of Energy Willow's presence prevents this from happening. In addition to this, the government's current policy framework does not allow for this potential to be reached. It can be said that if the government was to shift their focus to a more environmentally focused paradigm, such as one based on encouraging long term environmental benefits, as opposed to short term economic benefits, the Energy Willow sector could be able to play a much larger role. However, it will require significant investments and a long term strategic focus in order to be able to realise this potential.

By interviewing the following stakeholders; Two academics, two from the Danish farmers union Landbrug og Fødevarer, one from a power company, one farmer currently growing Energy Willow, one representative from the EU, one from the power distribution company in Denmark and one from the government, we found that 1) Each of the stakeholders see the paradigm of rent seeking behaviour as something ingrained in society, and in order for Danish society to make changes to this, the

institutions that govern entrepreneurship for farmers such as the ministry of agriculture should create monetary incentives, such as changing the paradigm to encourage other goals besides profits within entrepreneurship will be futile, 2) This view was made especially clear when asked about the optimal level of government interference on how entrepreneurship works today. Everyone except the power companies and the Danish energy agency believe there should be some kind of subsidy to incentivise growth of beneficial crops, and therein lies the role for Energy Willow in the future.

This led to a discussion on the three different topics of 1) The importance of an institutional framework 2) How ideas shape the institutional environment and 3) Should the natural environment be a priority for society. This was done in order to show the correlations between the chosen theories and the findings as well as critically examining the assumptions of the paper and to shed further light on the potential of Energy Willow in Denmark.

Institutional frameworks are crucial in the discussion of the growth of the Energy Willow sector as they provide the structures in which entrepreneurs are governed. This framework can either work in favour of something or against it, as shown with Energy Willow while there is institutional support through subsidies it worked very much in favour of Energy Willow spurring growth in the sector. When the subsidy was removed and the institutional support dwindled, Energy Willow became less popular among farmers (entrepreneurs) illustrating how vital this institutional framework is in promoting the idea of Energy Willow in Denmark.

The role of ideas in shaping the institutional environment is crucial as it is ideas that form the basis for the institutional frameworks that can either support or oppose Energy Willow. Ideas are used to create blueprints for the way we want society to look and once accepted, those ideas become embedded in society and help shape the way we view certain things. It was shown that although the idea of alternative energy sources are seen as good by both the policy forming institutions and Danish society at large, the Idea of these energy sources being profitable is more important in the current paradigm showing that the idea of profits guides the way energy sources are viewed by the stakeholders.

The consideration of prioritizing the natural environment was the last point of discussion which looked at whether or not it is necessary to prioritise the natural environment and if so to what extent. It was established that the higher the general economic conditions are within a country, the higher concern the citizens have for the natural environment around them. Despite this general concern for the environment, Denmark still gets a large percentage of its electricity from non-renewable sources which was shown to be largely a question of economics. It was clear that among farmers in Denmark, even with a concern for the environment the current financial situation that many of them find themselves in as well as the policy environment governing their activities have led them into being largely profit driven, irrespective of the potential harm they are causing to the environment. It was also shown in this thesis that although it may be safe to avoid facing the harm caused to the environment presently, if left unresolved the costs of rectifying these issues in the long run will be much higher both to the policy makers and to society.

Regarding the direction of future research, we see it going one of two ways based on our thesis. One is to further explore how the institutions can be encouraged to promote more productive entrepreneurship. Here, the notion that profits are the most important aspect of entrepreneurship would be challenged, and Blyth would be further explored to see how exactly such a paradigm shift could happen. The second direction future research could go is to explore the viability the other scenarios to encourage the Government to soon choose a preferred energy solution, as the market needs an indication to facilitate infrastructure investments towards the 2050 energy goals.

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Appendix:

Email Correspondence:

- 1) Email correspondence from Henrik Bach, Energy Willow farmer – Henrik@nyvraa.dk
Email date: 2/2/2017
- 2) Email correspondence from Damien Plan, Representative of the EU DG Energy - Damien.plan@ec.europa.eu
Email date: 2/2/2017

Recorded Interviews:

All interviews available at the following link as well as on USB sticks provided:

https://1drv.ms/f/s!Aqlwt_GNEfq3bjvjNnSjXDGjLIA

- 3) Interview with **Kristjan Jespersen**, PhD fellow at CBS – kj.msc@cbs.dk
Interview date: 17/01/2017
- 4) Interview with **Henrik Bach**, Energy Willow farmer – Henrik@nyvraa.dk
Interview date: 23/01/2017

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- 5) Interview with **Søren Ugilt Larsen**, Senior Bioenergy Specialist at Danish Technological institute and editor of the Willow Report (Ugilt et al. 2015) – slar@teknologisk.dk
Interview date: 25/01/2017
 - 6) Interview with **Henrik Kruse Rasmussen**, Project Coordinator and Energy Willow specialist at AGROVI and Co-author of the Willow Report (Ugilt et al. 2015) – hkr@agrovi.dk
Interview date: 26/01/2017
 - 7) Interview with **Christian Erik Kampmann**, CBS professor – cek.ino@cbs.dk
Interview date: 30/01/2017
 - 8) Interview with **Damien Plan**, Team Leader - EU DG Agriculture and Rural Development G. 4 – Arable Crops and Olive Oil - Damien.plan@ec.europa.eu
Interview date: 6/02/2017
 - 9) Interview with **Rune Duban Grandal**, R&D at Energinet Denmark – rdg@energinet.dk
Interview date: 9/02/2017
 - 10) Interview with **Lars Martin Jensen**, Senior Advisor at Danish Ministry of Energy and Supply – lmj@ens.dk
Interview date: 10/02/2017
 - 11) Interview with **Anders Evald**, Chief consultant at HOFOR and biomass specialist (Anders speaks on his own behalf and not on the behalf of HOFOR during the interview) – aev@hofor.dk
Interview date: 23/02/2017
 - 12) Interview with **Thomas Holst**, Senior advisor on Climate, Energy and Plants at L&F – thl@lf.dk
Interview date: 31/02/2017