FRST 497

Forecasting the European Wood Biomass Market

An investigation of drivers that impact supply and demand

This paper aims to provide a forecast and policy recommendations for the European wood biomass market. With the European Union's 2020 climate and energy package deadline approaching, many countries are looking towards investing in clean energy alternatives. Wood biomass products have become one of the leading options in meeting this goal. However, the increase in demand for wood biomass has resulted in the rise of some issues that challenge the longevity of this industry.

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Table of Contents

Terms

Biomass – *Organic matter derived from living or recently living organisms*

DECC – *Department of Energy and Climate Change*

EU – *European Union*

Ktoe – *Kilotonnes of Oil Equivalent*

Mtoe – *Million Tonnes of Oil Equivalent*

MT – Million Tonnes

OPEC – *Organization of the Petroleum Exporting Countries*

RISI – *provider of information for the global pulp and paper industry*

Subsidy (Resource) – *a grant or a contribution of money*

Introduction/ Background

In 2007, the European Union introduced to the world its means to fight climate change. Titled as the EU Climate Package, its objectives was to increase 20% increase in share of renewable energy and a 20% cut in energy consumption by the year 2020 (Brack, 2015). This package was agreed upon by the 26 member states and since then many new forms of renewable energy initiatives have flourished. One of the most popular forms of renewable energy is biomass. Its wide recognition has been credited to the many advantages including renewability and versatility (Ladani & Vinterbäck, 2009). Aside from the most preferred source of biomass which is wood, biomass energy can be derived from other sources such as agriculture excess and organic waste (Brack, 2015). However, these alternatives are typically less dense in energy, more expensive to gather and manufacture (2015). The scope of this study will focus on the trends in various wood biomass products in Europe.

There are two popular forms that wood biomass is used in: hog fuel and wood pellets. Hog fuel, by-product of log manufacturing, is an unprocessed mix of wood bark and chips. It is inexpensive to produce and easily obtainable. Wood pellets, conversely, require some manufacturing but are denser and release greater amounts of energy when burned (WBA, 2014). Pellet usage in energy production was not popularized until 1973 during the oil shortage from the OPEC embargo (2014). Their introduction to Europe came 10 years after in Sweden, where wood residue was pelletized and shipped throughout the country as a result of this energy shortage. Figure 2 below shows the specialized types of boilers that must be installed in order to use wood pellets. These boilers, albeit expensive, maximize the energy efficiency and output when burning pellets. It has been found that the yield from burning two tons of pellets is equivalent to approximately the same output as one thousand litres of oil (WBA, 2014).

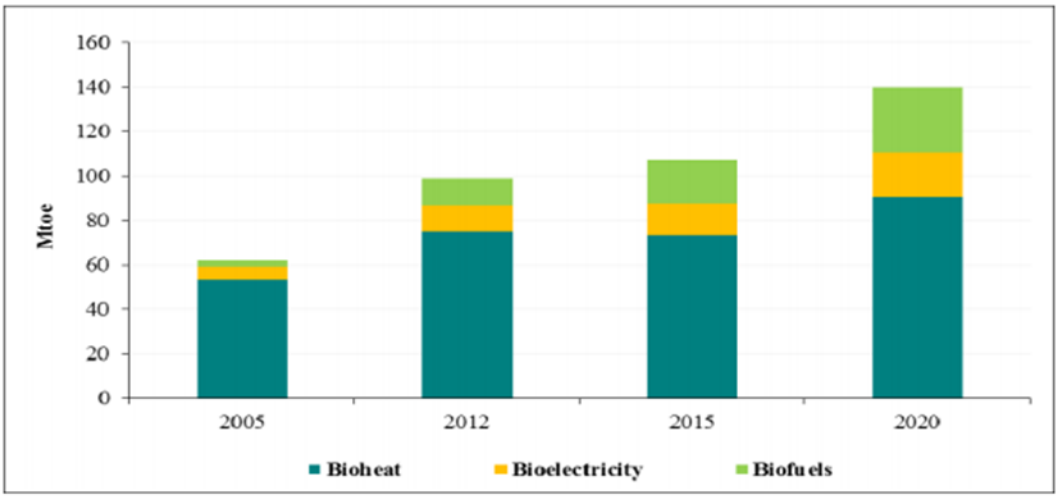

Figure 1 - European Commission on Energy outlook for biomass. Million Tonnes of Oil Equivalent (Mtoe) projected to 2020. Source: European Commission, 2014

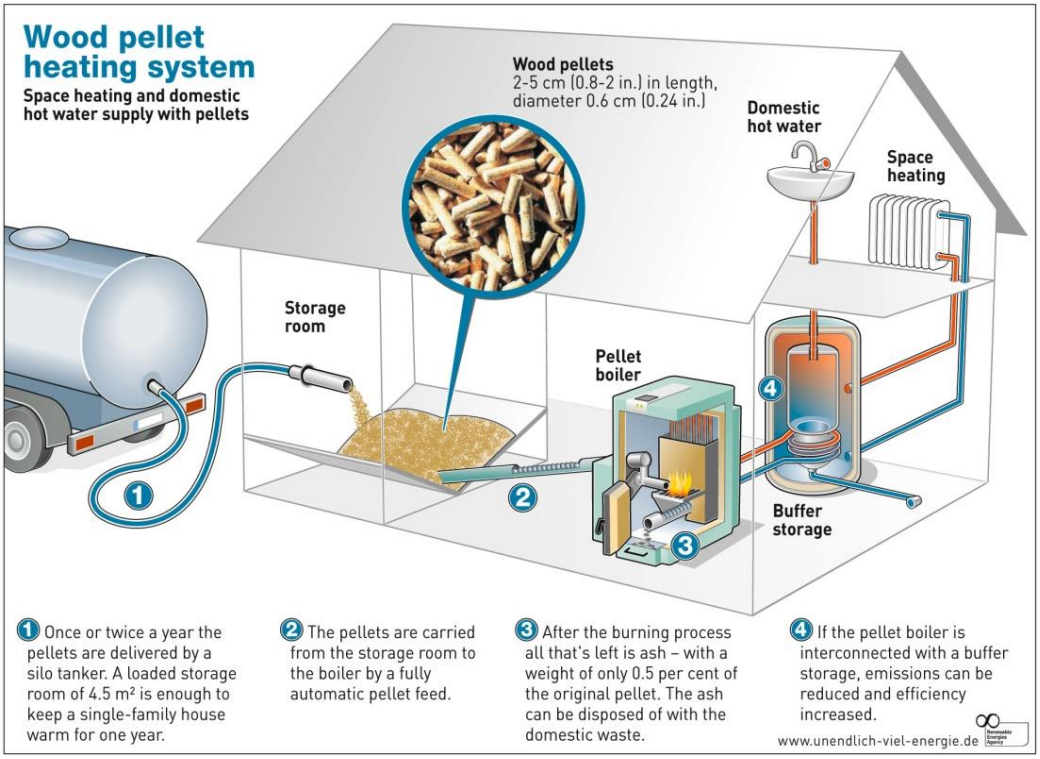

Figure 2 - A typical wood pellet boiler. Source: www.revermont.org

Although biomass appears to be the future of energy production (Figure 1), there is currently an insufficient policy framework set by the European Union on it. For this reason, it has been chosen as the area of focus in this study. The study will focus on the drivers that affect supply and demand of wood biomass in Europe.

Objective

There have been many sources published regarding the use of wood biomass in Europe and some studies have been completed on their future role in energy production. However, RISI has forecasted that there will be a shortage of biomass in Europe for the next decade (RISI, 2013). I am curious about the existing biomass import practises in Europe and how they will have an affect the future of the industry. The purpose of this paper is to present a forecast based on a comparison of market drivers used across the sources I selected. It will investigate the interactions between the drivers and then discuss how they may determine the outlook of the European biomass market.

I chose the sources in this report due to the extensive research presented on both wood pellets and wood biomass. Wood pellets being the most popular from of fuel, can be indicative of the general trend in wood biomass as well. Although these two terms are not interchangeable, I believe that examining both will provide a stronger forecast overall. The market that will be examined is the European wood biomass markets. Pellet imports from North American producers such as the United States will be examined, but the scope will largely focus on interactions within Europe.

This study will aim to discuss:

1. A list of drivers and a description of why they were chosen.
2. An investigation on how these drivers are related to each other.

Methods & Selection of Drivers

In order to create a grounds for comparison, drivers that may affect the demand for wood biomass were examined for in publications. Although some of the specific factors described vary across the literature, they were sorted into the following categories of drivers: Forest Land Availability, Impacts of New Technology & Products, Transportation & Fuel costs, International Trade Dynamics, Subsidies and Carbon Neutrality. These drivers will have varying degrees of impact on the supply and demand of biomass in Europe. I created these categories of drivers as a means to organize my thoughts and information collected from the various sources.

Forest Land Availability

According to the report on global potential of biomass published by the Swedish University of Agricultural Sciences, one of the major determining factors for biomass energy source's feasibility is land availability (Ladlanai & Vinterbäck, 2009). Land availability is an important factor to consider as it is a major constraint on countries trying to create a self-sustaining system. According to RISI report on biomass plantations, Europe was overall a net importer of biomass for pellet production (Figure 3).The European Union's total land size is currently 4.3 million km² and has a population of over 500 million. The majority of the population shifting to a wood biomass focused energy production will require imports from neighboring countries or overseas sources.

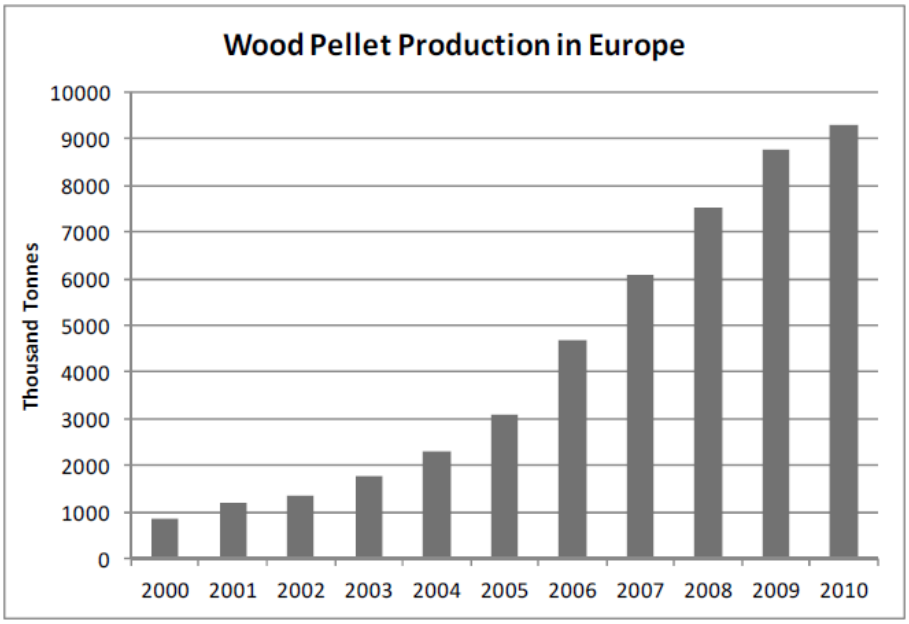

Figure 3 - European wood pellet production trend, growth exhibited to 10 million tonnes in 2010. Source: RISI, 2013

Impacts of New Technology and Products

The introduction of new products and technology will bring significant changes to the outlook of the bio economy. In Hänninen and Mutanen's article on forest bioenergy outlook, the authors argue that the evolution of traditional wood processing facilities can create either an increase or decrease in demand for wood products. For example, many sawmills are

implementing retrofitting to evolve their current facilities into superefficient bio-refineries (Hänninen & Mutanen, 2014). The installation of these new bio refineries may either cause an increase in demand for wood biomass to supply energy production or because of their efficiency, result in a decrease in demand of biomass to produce the same output.

Transportation & Fuel Costs

As mentioned afore, the largest restricting factor on Europe's production of forest energy crop is its land availability. This constraint forces many power producers to source their biomass fuel from places outside of the European Union. One of the biggest exporters is North America, especially the southern United States. According to the United States Department of Agriculture, American pellet producers will expect an increase in demand from Europe over a 10 year period (K.L. Abt, R.C. Abt, Galik, & Skog, 2014). The rate of increase will be controlled largely by the transportation costs and fuel prices. Figure 4 below shows the most recent costs of transporting biomass internationally.

Table 5: International transportation costs of biomass

	(USD/GJ)	Route
Africa	3.6 – 5.3	Nigeria to South Africa
Asia	1.2 – 1.3	South East Asia to China/Japan
Europe	-0.6	Russia to Europe
N. America	1.1 – 4.2	USA to Europe
OECD Pacific	0.9 – 3.6	Australia to Japan
L. America	0.9 – 3.6	Brazil to USA

Figure 4 - International transportation costs of biomass. Units are given in USD per gigajoule. Source: IRENA, 2014

International Trade Dynamics

In Think Forest's report on the future of the European forest-based bioeconomy, they argue that current outlook studies are outdated and require re-examination of certain trends that will affect demand (Hetemäki, Hoen & Schwarzbauer, 2014). One of the important trends highlighted by Think Forest was the impacts of international trade. China is growing to be a major importer

of biomass and will therefore affect the availability of biomass from North America (IRENA, 2012). This may lead to more pressure from consumers on producers within Europe.

Subsidies

A driver that will affect the outlook of biomass energy will be subsidies granted by the government. Subsidies can come in a variety of forms such as land allowances and tax breaks. These subsidies are provided to companies looking to introduce new technology in biomass energy. In order to compete with the heavily subsidized oil industry (Barnes & Halpern, 2000), new companies will naturally apply for subsidies as well. In 2012, the biomass renewable energy sector received a total of €8 billion in assistance from the European Union (Alberici *et al.* 2014). As the pressure of the EU 2020 targets approach, there will likely be a greater increase in subsidy applications (2014).

Carbon Neutrality

The perception of the carbon neutrality of forest biomass will undoubtedly affect both the supply and demand in Europe. There is a large debate surrounding how to accurately account for this. Organizations such as the World Biomass Association maintains that forest biomass energy is a renewable source of energy and is also carbon neutral. Conversely, environmental groups are arguing that some of the loose regulations around biomass harvesting that is not carbon neutral. With both sides weighing in on the debate, there will be a shift in demand and supply present.

Results

The following table includes all the drivers listed. The forecasted affect that they will have on supply and demand are based on the research I have done. For the majority of the drivers, it is quite clear which direction they will go whereas a select few, it is either not applicable or can go in either way. Reasoning behind the predicted directions will be discussed in the following section.

Table 1 - A list of drivers and the affects that they will have on the supply and demand of wood biomass within the EU.

DRIVERS	SUPPLY	DEMAND
Forest Land Availability	Decrease	---
Impacts of new technology	Increase	Increase
Transportation & Fuel Costs	Increase/Decrease	Decrease
International trade dynamic	Increase	Increase
Subsidies	Increase	Decrease
Carbon Neutrality	Decrease	Increase

Discussion/ Analysis

In this section, I would like to discuss the impacts on supply and demand that the drivers listed in the previous sections will have. Some of the drivers have stronger relationships with each other

Forest Land Availability, International Trade Dynamics & Transportation Costs

One of the European Union's greatest limiting factor in domestic biomass production is insufficient forests and land availability. As a result of this, an emergence of mass wood pellet imports from countries outside the EU are increasing. Countries such as the United States, where plantation forestry is more prevalent, benefit from shipping wood biomass to the European Union to meet the demand. Using wood pellets as a specific focus, Figure 3 illustrates the trend of European consumption and a projected trend. It is quite clear, according to the data, that the current capacity of domestic production is insufficient and that the deficit must be filled with imports form producers outside of the European Union.

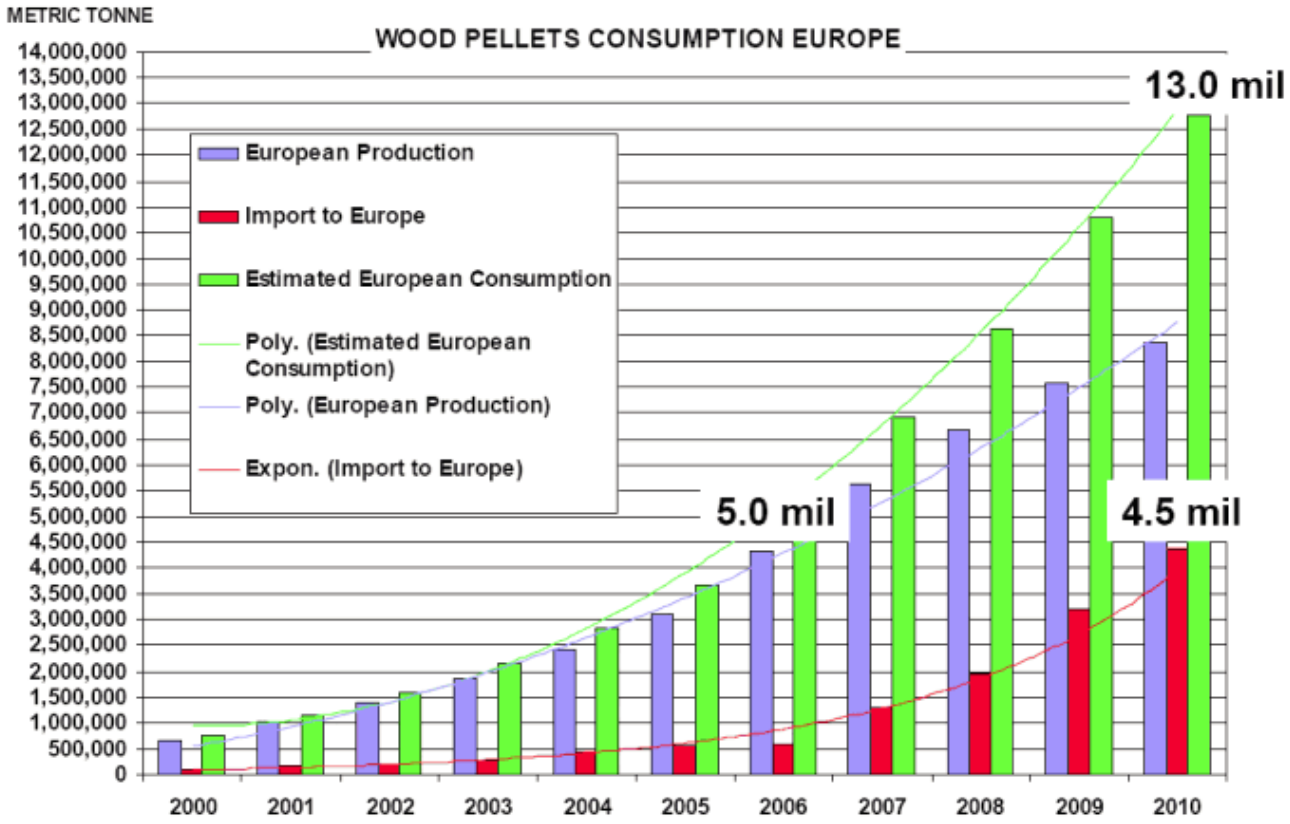

Figure 5 - Pellet consumption, domestic production and import in Europe. Source: Canadian Northern Timber, 2009

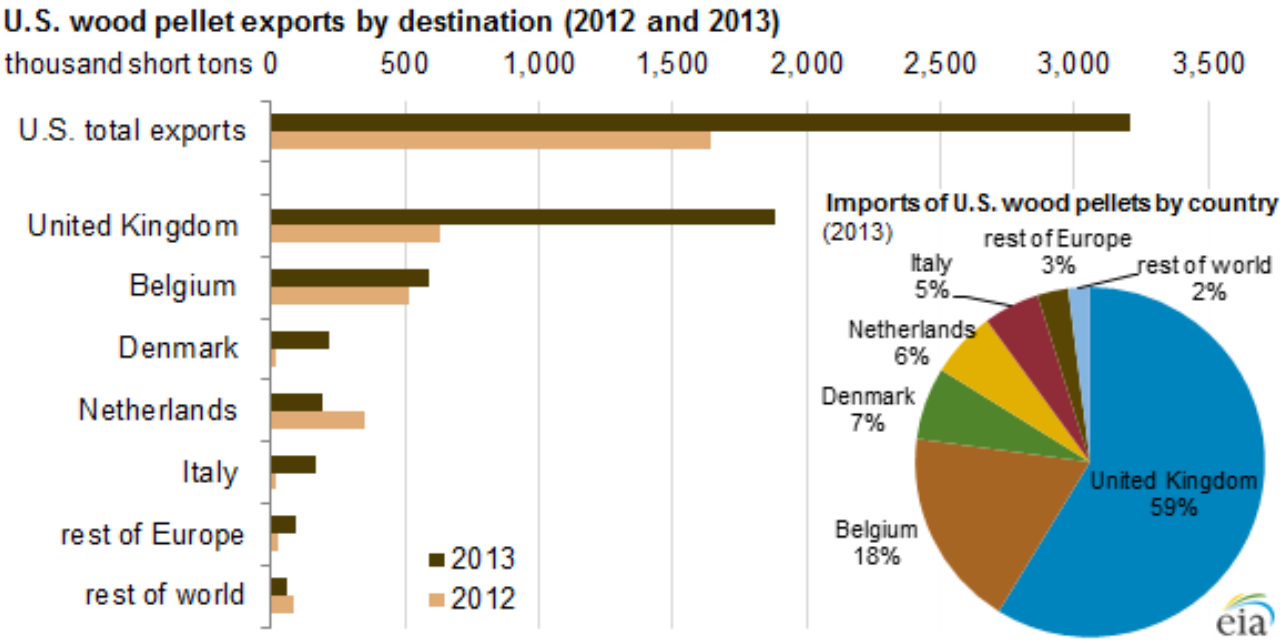

Figure 6 - US wood pellet exports from 2012-2013 compared to the rest of Europe. Source: US Energy Information Administration, 2015

As illustrated in Figure 4, the United States nearly doubled their exports in 2013 to Europe from the previous year. The EIA attributes this to not only an increase in residential installations of biomass burners but also large scale conversions of industrial power producers (EIA, 2015). A notable example of a power producer converting to biomass is the DRAX Power Station in North Yorkshire, England. The giant power station was historically the largest coal burning power producer in the United Kingdom. Since the late 1980s, the DRAX Power Station's boilers were retrofitted to burn woody biomass instead of coal. In order to maintain an energy output that contributes 8 percent towards the National Grid, DRAX needs to burn over 7 million tons of biomass a year in the place of coal. Unable to obtain such a vast amount of biomass within the UK, DRAX imports nearly all its biomass from countries such as the United States.

The DRAX Power Station is not unique to this arrangement. Many power producers throughout Europe are experiencing a similar situation where the countries cannot supply sufficient biomass for power production. The top two producing countries of wood biomass in Europe during 2014 were Germany and Sweden at 2,350 MT and 1350 MT respectively (Huang, 2015). Despite these impressive figures, the European Union still reported a net import of

biomass totalling at 11,420 ktoe that same year (IEA, 2014). This shipping of mass quantities of wood pellets will continue to increase as a shortage of pellets are present. One of the main drivers within the shipping of wood pellets will be the price of fuel. High fuel prices will make it unprofitable to ship the wood pellets from overseas and therefore may put further strain on the availability of pellets.

In Table 1 of the results section, forest land availability will be responsible for the decrease in supply of biomass within Europe. I believe that the decrease will come as Europe's endemic biomass production reaches its carrying capacity. Land availability will not have an effect on the demand as it is more applicable to the production aspect. International trade dynamics, especially with the North America, will be responsible for the majority of wood biomass supplies. It is important to note that trade with countries outside of the EU is determined by transportation costs and fuel prices. If the costs remain high with fuel prices, then supply and demand will decrease as it becomes too expensive to invest in.

Carbon Neutrality & Impacts of New Technology

As aforementioned, land availability is highly determinant of Europe's ability to supply the demand of biomass for energy. With many municipal boilers in Europe converting from coal to wood pellets as the choice for heat and electricity production, there is an increased stress on the capacity of Europe's native forests. Consequently, other affordable sources of wood are being imported in large quantities from overseas in order to sustain the growing demand. The carbon neutrality of these large quantities of biomass being burned are being questioned by environmental groups.

According to United States Energy Information Administration, 4.4 million tons of wood pellets from the US are imported a year to Europe for energy production for industry (EIA, 2015). Environmental groups such as Natural Resource Defense Council are heavily criticizing this practice. Many of these organizations have raised criticisms regarding the harvesting practices by mass exporting countries such as the United States. In the US, environmental groups are concerned by the carbon neutrality of biomass power, especially with the harvesting of old-growth stands and emissions emitted from the involved operations (Brack, 2015). Environmentalists state that biomass harvesting also does not account for the changes in carbon stock of forests. When a forest is cleared the carbon reservoir no longer exists and the

sequestration rate is greatly reduced. The harvesting of mature forests releases carbon stored in the trees and pools sequestered in the ground as well (NRDC, 2015). The carbon neutrality of wood biomass energy is challenged by large carbon debts and the extensive payback periods. Furthermore, there are factors that contribute to the carbon debt that are immensely difficult to account for accurately (Brack, 2015). Carbon emissions from harvesting operations and shipping to Europe are both examples of contributors that are hard to track (2015). Environmental groups have a strong influence on the public perception of biomass energy. If the critics are not satisfied, it can damage any chances of success biomass will have Europe.

Despite the criticisms presented by environmental organizations, there is also a widespread support for biomass. Groups such as World Bioenergy Association (WBA) maintain that wood biomass is a carbon neutral source of energy. They argue that biomass energy falls within the natural carbon cycle of forests (WBA, 2012). In brief, the carbon that is captured by trees through photosynthesis will eventually be released into the atmosphere after they die and decompose (2012). The WBA claim that burning biomass is releasing only the amount of carbon that was already sequestered from the atmosphere by the tree (2012).

While I agree with the majority of the WBA's claim, I believe that mass wasteful burning of wood biomass such as the DRAX power plant, release more carbon into the atmosphere than what is realistic to be sequestered by replanting trees. The introduction of newer and more efficient technology makes it possible to be closer to carbon neutrality. IRENA published a report in 2012 comparing the costs of various types of boiler technologies available on an industrial scale. The two most significant types of boilers were Stoker boilers and Digesters were found to be the most cost efficient in terms of wood biomass input and energy obtained (IRENA, 2012).

In terms of supply and demand, the criticisms by environmentalists that shape the public perception of biomass will reduce the demand from consumers in the long term. Power producers that invest in new forms technology that require less input will also help bring down the demand. The WBA does highlight that this may encounter some barriers in development due to high initial investment costs (WBA, 2014). Suppliers of biomass may see both an immediate decrease from consumers but an increase in the long term. An immediate decrease due to

pressures of environmentalists and emergence of efficient technology. However, in the long term, an increase as industrial power producers install more energy efficient pellet boilers.

Subsidies

Subsidies are a complex topic in forest biomass energy. It is a combination of both political and economics aspect of biomass energy. For this purposes of this study, the role of subsidies will be discussed in brief.

Forest biomass is widely viewed as a means to curb carbon emission levels during energy production and will therefore invoke a demand from a growing number of environmentally conscious consumers and producers. In addition, there have been many policies surrounding biomass in the EU that can further influence companies to switch to biomass energy. Because technology in forest biomass energy production is still relatively young, there is a lot of potential for the industry to expand further in the market. The current barrier to expansion are initial investments in the conversion of biomass into energy. These conversions are typically much more costly than compared to conventional methods (WBA, 2014). Furthermore, altering conventional oil and gas installations to biomass boiler requires a period of time. In order to maintain a competitive price in the market, there needs to be a reduction in the cost of production. These expansions will require intense competition directly with the already heavily subsidized oil and gas industry. Subsidies will likely have a greater effect on the producers (supply) of biomass and energy.

While subsidies are an effective way to incentivize businesses and individuals to switch to biomass, there are many criticisms of existing schemes. In fact, The Department of Energy and Climate Change in the United Kingdom released a report in 2014 that studied the reality of subsidy schemes. It was found that most of the payments made by governments to businesses and individuals converting to boilers was in fact higher than predicted originally (DECC, 2014). These unforeseen costs are due to payment schemes that were set in place for a number of years (2014). Furthermore, many of the installations failed to meet efficiency standards that were set in place to meet the European Union’s 20-20-20 goals (2014).

If the government were to continue running existing subsidy schemes, I believe that the supply and demand for biomass will increase. Producers will be able to continue supplying fuel

at a very low cost. Consumers that will also benefit from subsidy schemes will increase the demand. If subsidies were withdrawn from the market then many people would not be able to afford the costs of conversion.

Conclusion

I strongly believe that wood biomass has a future in the European Union power production. However, I find that the current state of the industry will require further development particularly on both the technological and policy front.

In order to create an adequate framework for sustainability, the certification of biomass power requires a discussion between policy makers, scientists and industry. There were a few policy recommendations I came across during my research that I believe would be beneficial to adopt.

1. Funding by government in biomass initiatives ought to be refocused towards researching and developing less wasteful boilers instead of subsidizing the costs of businesses and individuals converting (Hetemäki *et. al*, 2014). New types of technology needs to be introduced in order to promote carbon neutrality. If the status quo continues with wasteful practises such as those used by the DRAX power production facility, then I do not believe that this industry will survive.
2. Creating some standards for which biomass crops can be sourced from would also be beneficial. Examples of acceptable sources from which biomass could be derived from are wood waste and excess from forest thinnings (Southern Environmental Law Center, 2015). Setting these standards would protect old growth forests and biodiversity.
3. Policies developed in the future should include a carbon pricing system. A pricing system will be an incentive to minimize wasteful use of wood biomass. Standards for emissions and pricing should include more than just carbon stored by forests and also the release of carbon from them that result of production operations and the use of biomass (EEA, 2011).

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