The biofuel market in the Netherlands in perspective

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Preface and acknowledgements

The concept of biofuels is a very complex topic, it incorporates economic, social and environmental aspects all play a role and it involves Europe and developing countries. Yet, sometimes it seems that everyone know exactly all the ins and outs and has an opinion about it. My goal was to ravel out this “concept of biofuels”. I believe I have ravelled out a small part of the concept, thanks to support and supervision from experts.

I would like to thank my supervisor dr.ir. Peerlings of chair group Agricultural Economics and Rural Policy for guiding me patiently through the work necessary to complete my master thesis. I would also like to thank the persons that I have interviewed, for sharing their knowledge, convictions and thoughts with me. At first, I would like to thank Mr. Boot, for inspiring and assisting me in choosing this research subject. In unspecific order I would like to thank Mrs van der Rest (Shell), Mr Dijkstra (VVD), Mr Backers (Port of Rotterdam), Mr Kager (LTO), Mr Bennekom (Oxfam Novib) and Drs. Weustink (Ministry of Economic Affairs).

Also I would like to thank my parents, brothers, uncle and aunt and my dear friends, in particular Anna and Cate. My appreciation goes to my mother, for her strength and unconditional support. I would like to thank Joer, for stimulating and supporting me during the process. Finally, all my appreciation and gratitude go to my grandparents, for their commitment, trust, wisdom and most importantly for the precious moments I spent with them. Partir, c’est mourir un peu.

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Executive summary

The research objective of this research is: 'to acquire an understanding of the political process behind biofuel policy in the European Union and the Netherlands and to find out which interest groups are influential and what their perspectives are on the biofuel market in the nearby future'. I have used six research questions to offer structure and ensure all relevant information is assessed in meeting my research objective.

The first research question assessed elementary aspects of biofuels. Biofuels are transport fuels made from biomass and can be considered a substitute for fossil fuels. Biofuels are classified by first generation (i.e. food-based) biofuels and advanced biofuels, produced from non-food sources.

In answering the second research question, the political process of biofuel policy was analysed. The outcome showed that the European Parliament has considerable power in making amendments regarding EU biofuel policy. As the number of seats in the European Parliament depends on the population of each country, Germany, France and the United Kingdom have the greatest representation in the European Parliament. The analysis surrounding the political process concludes that Dutch biofuel policy highly depends on the decisions that are made on EU-level.

In answer to the third question, I executed an impact analysis of Dutch state intervention, assessing policy measures and economic incentives. It became clear that the state intervention results in transaction costs of biofuel trade. The high transaction costs are the consequence of reporting obligations for companies dealing in biofuels. This policy measure was introduced in attempt to monitor the environmental and social consequences of biofuels. Another significant issue is the time-inconsistency of the government. The Dutch government has made several changes in Dutch biofuel policy. The social welfare was "distorted", redistributed from the biofuel industry to "the environment". Next, the government introduced an economic incentive for local production of biofuel sources. As the production of biofuel sources i.e. crops is not yet profitable for Dutch farmers, nearly all biofuel sources have been imported. In an attempt to stimulate the local production of biofuel sources, the government counts advanced biofuels double. In 2011, as a consequence, the market share of advanced biofuels i.e. used cooking oil and animal fat was 40%.

Another economic incentive introduced by the government is the bio-ticket market system. It gives companies the opportunity to trade administratively in biofuels as an alternative to supplying their own biofuels. Trading bio-tickets in a perfectly competitive market increases welfare. A firm with lower marginal costs than the market price, gains extra profit by trading in bio-tickets. A firm with higher marginal costs than the market price saves costs by trading in bio-tickets. However, in the empirical analysis it became clear that in reality trade in bio-tickets includes high transaction costs due to lack of information and uncertainty. This reduces the volume of trade in bio-tickets and results in less extra profit. Finally, since there are only a few large sellers of bio-tickets, the market may have an oligopolistic market structure. This also reduces the trade volume and drives up prices. As bio-tickets do not rely on government support, the initiative is a good means of developing the market. However, due to the high transaction costs and potential market power the benefits diminish and it has yet to show its successes.

As a next step, a stakeholder analysis was executed. It showed that the biofuel policy attracts many lobbying interest groups (rent seeking) as much government support is involved. The biofuel industry and the farmers association have a large vested interest in the biofuel market. The biofuel industry and farmers are for a large part from France, Germany, Spain and Italy. These countries have the largest representation in the European Parliament (except for the United Kingdom). Since these countries have the same interest about the future of biofuels, together they have considerable power in the European Parliament. It will be difficult to make amendments that will limit the demand of biofuels. For that reason, it is likely that the recent proposed 5% limit on food-based biofuels will be rejected,

Among Dutch interest groups uncertainties about governmental policy are highly present. Many parties experienced a lock-in due to changes made in the biofuel policy. Besides, the time-inconsistency has most likely affected future social welfare negatively. It has resulted in a fear for inconsistent policies and in a loss of trust in the government.

As long as the EU biofuel policy will not be amended, the demand for food-based biofuels will continue to grow in coming years in parallel with the growing targeted percentages set by the Dutch government. It is expected that further attempts of the government to stimulate the production of advanced biofuels will be made. Much government support will be needed, because without, the marketing of advanced biofuels will, on the short term, fail. In the current situation most advanced biofuels are yet too expensive to market. In the future, the trade in animal fat, used cooking oil, woody chips and straw may grow, provided that government support is present. Several Dutch scholars advocate for advanced biofuels (Bergsma et al., 2010; Bos-Brouwers et al., 2012). However it is questionable whether advanced biofuels can ever be a substitute of fossil fuels on large scale. Next, counting certain types of biofuels double or even quadruple can evoke perverse incentives. In order to be able to supply less biofuels and at the same time save costs, biofuel traders will import palm oil from Indonesia for the use of used cooking oil or corn for the use of biogas. In that case it is questionable whether the double counting system assists in GHG-reduction.

In my research I come to the conclusion that what happens in the Netherlands can be largely derived from actions and decisions made on EU level. All interest groups, except for the Dutch government, are focused on the decisions made on EU level rather than on the political process in the Netherlands.

1. Introduction

In section 1.1 background information on the concept of a biobased economy will be given. Section 1.2 contains the research objective and research questions. In section 1.3 the methodologies that are used in this research will be described. In section 1.5 the content overview will be given.

1.1 Background information

The concept of a biobased economy has generated considerable excitement in Europe and around the world. However, there seems to be some controversies about how to define a biobased economy (Vander Meulen et al., 2011; McCormick, 2010). A biobased economy is an economy in which materials, chemicals and energy are produced from renewable biological sources. Biofuel is one of the main products that can be produced of renewable biological resources (McCormick, 2010). During the past few years the use of biofuels received much attention in policy making (Vander Meulen et al., 2011). In 2003 the European Union started promoting the use of biofuels in the transport sector. The Biofuel Directive requires to blend fossil fuels with biofuels (2003/30/EG). However the biofuel industry, NGOs and scholars have raised concerns regarding the sustainability of biofuels (Eisentraut, 2010). The change of stakeholders' opinions and new information has led to changing policies. The European Union has created another directive promoting not especially biofuels, but renewable energy in general. In 2009 the European Directive Renewable Energy (2009/28/EG) was implemented, consequently the Biofuel Directive was withdrawn from the 1st of January 2012. In September 2012 the European Commission proposed that 5% of the 10% renewable fuel should be from non-foods (2009/28/EG). If the proposal will be accepted, what impacts would this have on the markets of biofuels? Since the biobased economy is a broad concept, it is difficult to conduct a complete analysis. Therefore, in this research I focus on the largest market (biggest volume) namely that of biofuels (Heijne et al., 2011). Much has been written about biofuels, but economic research on biofuels is rather limited (Vander Meulen, 2011). The research performed on the economics of biofuels has largely focused on the United States. Examples are Schneider et al. (2003), Singh et al. (2003) and Carriquiry et al. (2011). For this reason, I will analyse the biofuel market from an economic point of view, with a focus on the European Union and in particular the Netherlands.

1.2 Research objective and questions

The objective of this research is to acquire an understanding of the political process behind biofuel policy in the European Union and the Netherlands. First a descriptive analysis is given, which provides the foundation for the second objective: to find out which interest groups are influential, their viewpoints on current issues and their perspective on the biofuel market in the nearby future.

Research questions

1. What are biofuels?

   To understand the political process regarding biofuel policy, it is essential to have a basic knowledge of biofuels, the technical production process and its applications.
2. How are choices made concerning biofuel policy?

   According to public choice theory, policy processes are based on self-interest. An understanding of the political process behind biofuel policy in the European Union and of the Dutch government is required to determine who are the decision makers. Also, a historical survey of the policy developments will be given.
3. How does state intervention impact the market of biofuels?

   To understand how state intervention impacts the market of biofuels, relevant institutional factors, based on the theory of institutional economics and economic organisation will be analysed. Also, an impact analysis will be done of one economic specific incentive (bio-tickets) set by the Dutch government.
4. What are the viewpoints of the influential interest groups on the market of biofuels?

   According to public choice theory, meeting the needs of influential interest groups is of high importance for policy makers (Wright 1990 cited by extracted from Mueller, 2004). For that reason, it is important to know the most prominent interest groups and their viewpoints.

1.3 Methodology

This research will be conducted through literature reviews and interviews.

Literature reviews

The theories that will be used in this research are:

- Public choice theory: to get an understanding of the political process.
- Institutional economics and economic organization theory: to assess policy measures.
- Stakeholder theory: to identify influential interest groups.
- Neoclassical economic theory: to assess the economic incentive of administratively tradable biofuels.

Interviews

Interviews will be held with the key stakeholders of the Dutch biofuel market in the private and public domain. The interviews are semi-structured and include largely open-ended questions. The objective is to understand the opinions and convictions of stakeholders about topics currently being discussed and the biofuel market in the nearby future. Semi-structured and largely open-ended questions give the respondent the opportunity to show his/her beliefs, thoughts and attitude towards biofuel policy.

1.4 Content overview

In chapter 2 the concept of a biobased economy and of biofuels will be described. Chapter 3 discusses the political process and policy development of biofuels policy in the European Union and in the Netherlands. Chapter 4 and 5 will focus on impacts of state intervention measures on the biofuel market. In chapter 4 the relevant institutional factors based on a market analysis and state intervention measures will be analysed. Subsequently, in chapter 5 an impact analysis will be done of bio-tickets, one of the economic incentives introduced by the Dutch government. Next, chapter 6 will describe influential interest groups in the European Union and in the Netherlands. Finally in chapter 7 I answer the research questions and mention possible shortcomings of my thesis.

2. A biobased economy

The purpose of this chapter is to provide an understanding of biofuels, the technical production process and the applications of biofuels. It gives answer to the question: *What are biofuels?* In section 2.1 the definition of a biobased economy will be given. In section 2.2 the technical processes of transforming biomass into energy will be described. In section 2.3 the biomass sources and products will be given. In section 2.4 the definition of biofuel will be provided.

2.1 Definition

In the dictionary the term “biobased products” is defined as follows: Biobased products refer to non-food products (energy or industrial materials) derived from biomass (plants, algae, crops, trees, marine organisms and biological waste from households, food/feed production, etcetera). Biobased products may range from high value added fine chemicals such as pharmaceuticals, cosmetics, food/feed additives, to high volume materials such as biopolymers, biofuel and fibers. It may include existing biobased products, such as paper and pulp, detergents, lubricants, construction materials, or new ones, such as vaccines made from plants or second-generation bio-fuels (Van Dale, 2003). This definition is in line with Nowicki et al. (2008): The biobased economy is an orientation towards the substitution of biologically derived materials and processes for the production of goods that seeks to reduce the use of extracted minerals and petro-chemistry. Also Jenkins (2008) defines the biobased products as a substitute of products from mineral oil: In the bioeconomy, biorefineries will process biomass into a range of value-added bioproducts. The definition that I will apply in this research is the one of Nowicki et al. (2008) where in the analysis the main focus will be on biofuels. The biological resources in this research are mainly crops and wood materials. Algae and other third generation products are left out, unless it is mentioned differently.

2.2 The technical production process

There are several methods of converting biomass into energy. The most common techniques are burning (combustion) and chemical conversion.

Burning

Examples of processes that require burning are:

- Thermal conversion. The thermal conversion process converts biomass into a different chemical through chemical reactions and interaction with oxygen. An example is the gasification process where both heat and gas are produced. Biomass or biofuels are converted, by using high temperatures and oxygen and steam, into hydrogen and carbon monoxide and can be further converted into methanol and hydrogen and synthetic fuel.

- Pyrolysis. Pyrolysis is a process where the biomass is heated without interaction with oxygen. Fast pyrolysis of biomass is one of the most recent renewable energy processes introduced in the market. Products of pyrolysis are carbon monoxide, methane, hydrogen and carbon dioxide (Czernik et al., 2004).
- Torrefaction. During torrefaction the properties of biomass are changed to obtain higher quality fuel. The final product of torrefaction is bio-coal, made into pellets and burned for heating in homes and fuel for industries (Patrick et al., 2005).

Chemical conversion

Chemical conversion is a method of processing where burning is not required. This non-combustion method breaks down the chemical structure of plants such as soy, sugar canes and corn. After breaking down the chemical structure and processing, it is converted into solid (e.g. charcoal), liquid (e.g. bio-oils, methanol and ethanol) or gas (e.g. methane and hydrogen). Some of these chemicals are used directly, as biofuel for example, while others need to be broken down further through other refining methods (Zhang et al., 2010).

2.3 The sources and products

Another word for biological resources is biomass. Traditionally, biomass is used as food and feed. In developing countries, wood is also often used for heating. In Europe, in the last twenty years, we came to the conclusion that we can use biological resources as a substitute for fossil fuels such as oil, coals and gas. Nowadays biomass is applied in different markets for the production of electricity and gas, as fuel in transport, in chemistry, or for heating. In table 2.1 (see next page) the different sources, raw materials and products are schematically presented. In the table there is a distinction made between crops and raw materials. Within the group of crops, there is a distinction made between food and food waste. Food that is used for energy is for example soybeans, sugar canes and corn. The leftovers of the plants are food waste: leaves, stumps etc. The products that are derived from the crops are for example oil and starch. These raw materials can be converted into fuel but can also be used as input in the production of plastics, cosmetics, chemicals and inks.

The second groups of biomass sources are timber materials, for example natural fibres and wood. Natural fibers are converted into cotton and jute, which is among others used for clothing and paper. Wood is used for heating and electricity.

Table 2.1 Biobased economy: Categorized by source, raw material and product

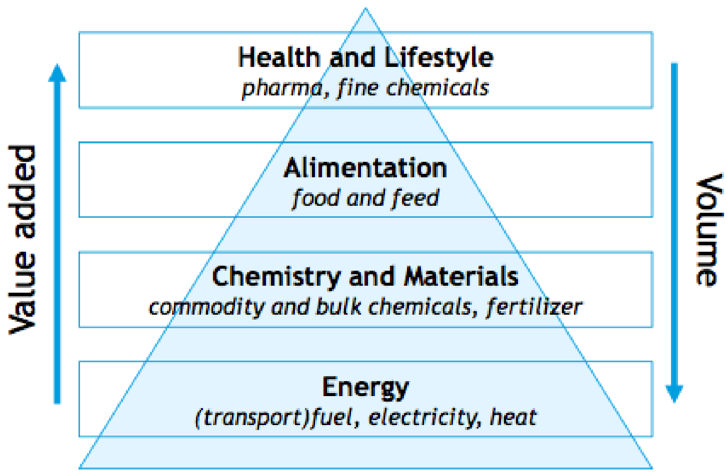
	Source	Raw material	Product
Crops	Food such as soybean, sugarcane, corn Residues such as leaves and stumps	Oil, starch, alcohol	Plastics, fuel, cosmetics, chemicals
Timber materials	Natural fibers	Cotton, jute	Clothing, paper
	Wood	Wood, acids	Heating, electricity

Source: Self-constructed

Value pyramid

An alternative for table 2.1 is the so-called biomass cascading pyramid. *Cascading of biomass* means that biomass is used for the application with the highest added value. To optimally use biomass, all available components within biomass should be utilized, first for the application where it has the highest value. The remaining biomass should be used for other applications. In general the order of added value is: medicines and fine chemicals, food and feed, bulk chemicals and fertilizers and finally fuel, electricity and heat. Figure 2.1. shows this pyramid. It is a pyramid of the social value and the volume of the different markets and is often used by interest groups that advocate using biomass for “high-valued” products. At the top of the pyramid are the health and lifestyle products: a small market (with respect to the volume) but a high added value (Bergsma et al., 2010). The biomass pyramid is a tool to show the different applications of biomass and the involving added values (Weustink, 2013; Boot, 2013, van der Rest, 2013, Kager, 2013). It is argued that biomass applied for the top-layers (refined chemistry and food) has most added value.

Figure 2.1 Biomass cascading pyramid based on Ministerie van LNV, 2007



Source: Odegard, 2012

2.4 Biofuels

Biofuels are fuels produced from biomass for the use of transport. Biofuels are primarily used to fuel vehicles, but can also fuel engines in stationary applications. Biofuel can be made from different sorts of resources and can be refined into different types of fuel. In section 2.4.1 the biofuel types are explained, making a distinction between ethanol and biodiesel. In 2.4.2 the technical production process of these types of biofuels is described. In 2.4.3 the terms “traditional and advanced biofuels” are explained.

2.4.1 Types of biofuels

A variety of fuels can be produced from biomass resources including liquid fuels, such as ethanol, methanol, biodiesel, biodiesel and gasoline, and gaseous fuels, such as hydrogen and methane. The two most common types of biofuels are ethanol and biodiesel. Ethanol can be used as a replacement for gasoline. Traditionally, ethanol is made from starches and sugars, such as sugarcane, corn and maize. Biodiesel can replace diesel as the fuel in diesel engines. Biodiesel is produced from oilseeds such as palm, soybeans, sunflower, rapeseed (canola) and jatropha. Jatropha is a toxic bush and its seed can produce biofuel. The advantage of this bush compared to other products is that it has the ability to grow well on poor and infertile soil (Sarin et al., 2010).

Table 2.2 Sources, products, substitutes and end use of biofuels

Sources	Products	Substitute	End use
Biological resources such as plant-based oil	Ethanol	Fossil fuels such as:	Biofuel for the use of transport
	Methanol	Oil	
	Biodiesel	Coal	
	Gasoline	Gas	

Source: Self-constructed

2.4.2 The technical production process of biofuels

The technical processes converting biomass into ethanol and into biodiesel are explained next.

From biomass to ethanol

The fermentation of sugar is the main type of ethanol processing. Cellulose-based plants are broken down and turned into sugars such as glucose. Then the fermentation takes place where the sugar turns into ethanol. After the fermentation, the distillation separates the ethanol from the water and the ethanol is ready to be used as fuel.

From biomass to biodiesel

Biodiesel is made from transesterification of vegetable oil with alcohol. During the transesterification the methanol, catalyst, oil and fats are mixed. The chemical reaction results in two products: biodiesel and glycerin. The crude biodiesel is separated from the glycerine. Once separated from the glycerin, the biodiesel goes through a purification process; removing all remaining alcohol and catalyst. It is then dried and stored (Sarin et al., 2007).

2.4.3 Traditional and advanced biofuels

There have been a variety of terms used to classify biofuels. Nowadays, the most common terms to classify biofuels used by the government, Shell and NGOs are *traditional and advanced biofuels*. Traditional biofuels, also called first generation or conventional biofuels, are generally made from food crops and encompass starch based ethanol and oil crop based biofuels. Examples are sugar, wheat, corn (ethanol) and palm oil, rapeseed oil and soy oil (biodiesel). A different term to define these biofuels is food-based biofuels. In this research the terms “traditional biofuels” and “food-based” biofuels will be used. Advanced biofuels, also defined as second-generation biofuels, are biofuels produced from non-food sources, such as wood and straw. These biofuels do not cause extra greenhouse gas emissions (GHG-emissions) due to indirect land use change (explained in chapter 3). Other examples of advanced biofuels are biofuels produced from waste, residues or materials of cello-lignose. In table 2.3 an overview of traditional and advanced biofuels is given. Sometimes the name ‘third generation biofuels’ is used for (future) fuels derived from feed produced in aquatic environments (algae) or from bushes (Jatropha) (Scott et al., 2010; Solecki et al., 2012).

Table 2.3 Examples of traditional and advanced biofuels

Traditional biofuels	Advanced biofuels
Produced from:	
Corn	Waste
Rapeseed	Residues
Sugarcane	Cello-lignose
Wheat	Algae’s
Soybean	Woody chips
Palm oil	Used cooking oil

Source: Self-constructed

3. Biofuel policy development

In order to determine who the decision makers are of EU and Dutch biofuel policy, an understanding of the political process behind biofuel policy is required. This chapter will answer the question: *How are choices made concerning biofuel policy?* In section 3.1 the political process and the developments of the biofuel policy will be described. In section 3.2 the EU policy measures will be explained. Section 3.3 will describe Dutch biofuel policy.

3.1 The political process

According to public choice theory, political processes are dominated by self-interest. Decision makers, just as all other people are predominantly self-interested creatures (Heckelman, 2004). Who are the decision makers with respect to biofuel policy? In the European Union's political system the main decision makers are: The European Commission, the Council and the European Parliament. The Commission consists of a president and commissioners; one from each Member State. The Commission makes proposals for new legislation, which the Parliament may accept, reject or amend by a simple majority vote. If accepted by the Parliament, the proposal goes to the Council. If the Council accepts the proposal it becomes law (Meuller, 2003).

The power of the Parliament has increased in recent decades. The power of the Parliament increased in recent decades. Parliament has legislative power over various domains; It is responsible for the EU budget and co-decides concerning Common Agricultural Policy (CAP). Parliament can exert influence by putting pressure on Commission and Council to take measures on certain subjects (Hix, 2007). The European Parliament has representatives elected by the people of each Member State. As the number of seats in the European Parliament depends on the size of the population of each country, Germany, France and the United Kingdom have the greatest representation in the European Parliament (Mueller, 2003; European Parliament Resolution, 2013).

Biofuel policy development

When were biofuels first included in EU policy and why? In table 3.1 it is shown how policy on biofuels has developed over the last years up till now. The reasons for the introduction or change of biofuel legislation, the legislation and the concerning target are schematically shown.

Table 3.1 EU biofuel policy developments, 2003 - 2013

Year	Reason	Rule/law	Target
2003	To improve energy security, support agriculture and reduce greenhouse gas emissions	Biofuel Directive	To mix 2% of the energy content of fossil fuels with biofuels in 2005
2009	To reduce the most important emissions during biofuel production	The Renewable Energy Directive and the Fuel Quality Directive	Reach a 10% share of renewable energy in the transport sector and reduce CO_2- intensity by 10% in 2020
2013	To limit global land conversion for biofuel production	The Renewable Energy Directive and the Fuel Quality Directive (Amendment)	To produce biofuels that doesn't originate from land with a high biodiversity value or with high carbon stocks

Source: Self-constructed

2003: In 2003 biofuels were first mentioned in EU policy, namely in the Biofuel Directive created by the European Parliament and Council. The reasons for introductions were: to improve energy security, support agriculture and reduce greenhouse gas emissions. Member States were not obligated to incorporate the Directive in their national legislation. The target was to mix 2% of the energy-content of fossil fuels with biofuels in 2005 (Biofuel Directive (2003/30/EG). The next initiative with respect to the use of biofuels was the Biomass Action Plan. The plan set out a series of Community actions and responded to a threefold objective: further promotion of biofuels in the EU and in developing countries, preparation for the large-scale use of biofuels and increased cooperation with developing countries in the sustainable production of biofuels (Biofuel Action Plan, 2005). As a follow up, the next year the European Commission introduced "An EU strategy for Biofuels" in which the Commission brought forward a report on the implementation of the Biofuels Directive and the possible revision of the Directive.

2009: Three years later, in 2009, the European Commission incorporated measures with respect to biofuels in two mandatory Directives: The Renewable Energy Directive (RED) and the Fuel Quality Directive (FQD). At the same moment the Biofuel Directive (2003/30/EG) was withdrawn. The Renewable Energy Directive set a compulsory goal: Reaching a 10% share of renewable energy in the transport sector in every Member State by 2020. The Fuel Quality Directive (2009/30/EC) introduced the mandatory target of achieving a 6% reduction in the greenhouse gas intensity of fuels used in road transport by 2020.

2013: Currently there are two proposals of the European Commission published respectively in October 2012 and January 2013. The aim of the proposals is to reduce greenhouse gas emissions associated with biofuel production and further stimulate advanced biofuels while protecting existing investments (2012/0288 (COD)). Under current legislation sustainability criteria to minimize greenhouse gas emissions are taken into account. However, the greenhouse gas emissions associated with land conversion and deforestation due to indirect land use changes are not yet taken into account. The proposals advocate for limiting the amount of food food-based biofuels to a maximum of 5% without modifying the 10% renewable energy target in 2020. In the next section the proposed measures are further elaborated on (2012/0288 (COD)).

3.2 EU policy measures

As mentioned before, the Renewable Energy Directive and the Fuel Quality Directive are the directives that cover the biofuel targets. A directive is a legislative act of the European Union, which requires Member States to achieve a particular result without dictating the means of achieving that result (Folsom et al., 1996) The two directives cover two main targets with respect to the use of biofuels: reduction of greenhouse gas-emissions (GHG-emissions) and a sustainable use of biofuels. In this section the targets and the measures to reach the targets will be described.

Blending mandates

As mentioned before, according to the RED 10% of the transport fuels should consist of renewable energy. Renewable energy for transport includes biofuels such as biodiesel and bioethanol, renewable electricity, wind- and water energy and hydrogen. The EU uses a score system to count the quantity of biofuels and other renewable energies used by Member States. With respect to the use of biofuels there are three blending options: Mix the fuel with biofuel (low blends), use bioethanol (high blends) or use pure bioethanol (RED).

Greenhouse gas-intensity

In 2020 the greenhouse gas-intensity (also CO_2-intensity) should be reduced by 10%. CO_2-intensity is defined by the quantity of CO_2-emissions throughout the complete lifecycle of the biofuel, per energy-unit. The greenhouse gas-intensity is calculated on a life-cycle basis. This includes all relevant stages from extraction or cultivation, including land-use changes, transport and distribution, processing and combustion. According to the Fuel Quality Directive the “life cycle greenhouse gas emissions” means all net emissions of CO_2, CH_4 and N_2O that can be assigned to the fuel (including any blended components) or energy supplied (FQD (2009/30/EC); Agentschap NL, 2011).

Sustainability requirements

Biofuels, whether locally produced or imported, have to comply with sustainability criteria. These criteria aim at preventing the conversion of areas of high biodiversity and high carbon stock for the production of raw materials for biofuels.

- Biomass cannot originate from land with a high biodiversity value such as primeval, protected nature reserves and grasslands with a high value of biodiversity.
- The biomass cannot be produced on land with high carbon stocks, such as wetlands and continuously forested areas. This is also applicable to peat land, unless it is shown that the biomass production does not lead to drainage of formerly non-dewatered soil (2009/28/EC).

Indirect land use change (ILUC)

Due to the introduction of the blending mandate, it happens that agricultural land, originally used for food production, changes of purpose, namely for biofuel production. In order for the farmers to continue food production, non-agricultural land (such as forests) is converted into new cropland. As a result, greenhouse gasses are emitted and biodiversity may be decreased (Peters et al., 2013). The policy instruments that are suggested in the two proposals to reduce these effects are the following:

- Limit food food-based biofuels (first generation) to a maximum of 5 (also called a 5% CAP) of the targeted 10% in 2020 stated in the RED;
- Additional support for advanced biofuels by weighting differently their contribution to the 10% target (Double and quadruple counting);
- Obliging Member States and fuel suppliers to report the estimated indirect land-use change emissions of biofuels;
- Strengthening the sustainability criteria: 60% of Greenhouse Gas savings for all new plants

(EU Proposals 2012/0288 and (2013)17, EC).

5% CAP

One of the proposed measures to minimize indirect greenhouse gas emissions is to limit food-based biofuels to a maximum of 5% in 2020. The European Commission proposed the following addition to the Renewable Energy Directive:

> *“(d) for the calculation of biofuels in the numerator, the share of energy from biofuels produced from cereal and other starch rich crops, sugars and oil crops shall be no more than 5% (..) of the final consumption of energy in transport in 2020.”*

The proposal states that the Member States are free to decide their own percentage CAP adapted to the existing investments, so that such installations are not affected by the measure (2012/0288/(COD)).

3.3 Dutch biofuel policy

Member States should meet the targets of the RED and the FQD, however Member States are free to design their own strategies on how to reach these targets. In 2007 the Netherlands introduced a blending mandate, introducing a target of 5.57% blending of biofuels in 2010. In 2008, Minister Cramer (Infrastructure and Environment) reduced the 2010- target from 5.57 to 4%. In 2009 the Netherlands delivered an action plan to the European Commission. The Dutch legislation has adopted the CO_2-reduction and renewable energy production targets and has set goals up to 2020 (Nationaal Actieplan voor Energie uit Hernieuwbare bronnen, 2009/28/EG) (Agentschap NL, 2012).

4. Impact analysis

Market failure is a concept within economic theory that applies to imperfect markets. When market failures exist government intervention can be justified (Heckelman, 2004; Slangen et al., 2009). In Europe, support for biofuels from the government is necessary, without this support production costs are too high to compete with fossil fuels (van der Rest, 2013). This chapter answers the question: *How does state intervention impact the market of biofuels?* To understand how state intervention impacts the market of biofuels, relevant institutional factors will be analysed. In section 4.1 the recent market developments in the European Union and in the Netherlands will be described. Section 4.2 describes the economic incentives introduced by the government. Section 4.3 analyzes relevant institutional factors (Slangen et al., 2009).

4.1 Market developments

Member States

The biofuel market in Europe is 75% covered by biodiesel and 15% by bioethanol, the remaining biofuels include e.g. biogas, syngas and bio-hydrogen. The largest players in the EU production of biodiesel are France and Germany. Spain, Italy, Belgium and Poland have experienced an exponential growth over the last few years (European Biodiesel Board, 2011). Important biofuel sources are rapeseed, soybeans and corn. The production rate of rapeseed has increased rapidly in previous years covering 70% of the EU biodiesel production in 2009. The main producers of rapeseed (oil) are France, Spain and Italy. The demand is expected to further grow in coming years both for biofuel production and for human consumption (Product Board MVO, 2009).

The Netherlands

In 2006 fuel companies began supplying biofuels on the Dutch market**,** primarily due to the introduction of fiscal incentives in that year. Since then the supply of biofuel in the Netherlands has grown steadily (European Biodiesel Board, 2011), in line with the blending mandate. In 2010 the growth of supplied biofuels fell by 1.5%. Reasons for this might be the introduction of the double-counting system or the introduction of the trade in administratively biofuels (both further discussed in section 4.2). In 2011 the market share of renewable energy in the market of transport fuel was 4.31% of which 40% consisted of advanced biofuels. Almost all biofuels that are supplied on the Dutch market are imported. The production of sources for food-based biofuels is not yet profitable for Dutch farmers. However, after implementation of the double counting system, Dutch parties have been dealing in local animal fat and used cooking oil (Agentschap NL, 2012).

4.2 Economic incentives

The government gives economic incentives to stimulate the production of (sustainable) biofuels. The biofuel industry benefits from high levels of financial support in almost all Member States (Charles et al., 2013). The total expenditure of the European Union in 2011 on biofuels was approximately 8.4 billion euros, according to the International Energy Agency (IEA, 2012, p. 235 cited by Charles et al., 2013). Next to subsidies and tax exemption, the Dutch government has introduced other economic incentives that will be discussed next.

Double counting system

In 2009 the government introduced the Double Counting System. The system counts advanced biofuels double in the calculation of the required production of biofuels (RED 2009, Dutch Emission Authority, 2009). For example, when a company has to produce 10 units of biofuels, it can, instead of producing 10 food-based units of biofuels, produce 5 units of advanced biofuels. The aim of this system is to stimulate trade in biofuels that do not emit GHG due to ILUC. Since the introduction of the system, the share of advanced biofuels in the biofuel market has increased considerably. In 2011 the market consisted for 40% of advanced biofuels (Agentschap NL, 2011). An additional effect of the system is that it reduces the real quantity of biofuels that is supplied on the market. Besides, it may evoke perverse incentives. To save costs US corn is imported for the use of biogas or palm oil is imported from Indonesia for the use of used cooking oil, both applicable for the double counting system (Boot, 2013). At the end, the question is whether advanced biofuels indeed diminish GHG-emissions, compared with food-based biofuels.

Bio-ticket analysis

The government has introduced the bio-ticket system in 2011. It is in economic incentive that gives companies the opportunity to trade administratively biofuels as an alternative from supplying biofuels. The efficiency of the bio-ticket market is assessed in the next chapter.

4.3 Institutional factors

What impact has state intervention on the market of biofuels? What environment or ‘level of playing field’ has the government created for players on the biofuel market?

Bounded rationality

According to institutional economics and economic organisation theory, humans have a limited mental capacity to process information (Slangen et al., 2008). A cause can be a lack of information. For the government, to have perfect information on the emitted GHGs due to the production of biofuels is impossible. Monitoring is a solution for a lack of information. The government has introduced a reporting-measure. To assure that companies fulfil the obligation of blending biofuels, companies have to report their “biofuel-balance” to the Dutch Emission Authority. The “biofuel-balance” shows the quantitative use of renewable energy per company. If companies do not meet the required percentage it is seen as an economic offence, with a penalty as result (Dutch Emission Authority, 2012).

To assure that during the biofuel production process, GHG-emissions are reduced without damaging biodiversity, the GHG-emissions should be reported and biofuels should contain a certification that proves the EU sustainability requirements are met. The certification is provided by a third party and costs a couple of thousand euros.

The reporting-measure and certification obligation are tools for the government to increase their information. However, it increases the transaction costs for the companies that have to fulfil these measures. Recently the European Commission has proposed a reporting obligation with respect to the GHG-emissions due to ILUC. This will further increase the transaction costs. The “ILUC-factor” (GHG emissions due to indirect land use change) is difficult to precisely know because the ILUC-factor depends on crop type, type of land converted, amount of land conversion and region. The ILUC-factors predicted by agro-economic models still vary greatly (Broch et al., 2013; Gawel et al., 2011) (2012/0288(COD)). Obliging reporting on ILUC will be very costly for companies and the government. Besides, the more precise the reporting has to be, the more susceptible it is to fraud (van der Rest, 2013).

Time-inconsistency

Time-inconsistency is the case when the party that has decided the policy or rules changes the rules of the game. Changing policies results in lock-ins and leads to redistribution of social welfare. The lock-in can prevent people from making investment in the future, because of fear of being held-up again (Slangen et al., 2008). In 2008, one year after introducing the biofuel blending mandate, the Dutch government changed the policy by decreasing the blending mandate. Many investors were hit by the change. Argos Oil, who had invested 45 million euros in a biodiesel plant, has lost millions of euros (Deijbel, 2011). Currently many plants have excess capacity (van der Rest, 2013). The social welfare was “distorted”, redistributed from the biofuel industry to “the environment”. However, the change in policy does not only affect social welfare at the concerning moment, it has also affected social welfare in the future: it has resulted in a fear for inconsistent policies and in a loss of trust in the government (van der Rest, 2013; Kager, 2013).

Rent seeking

Rent seeking is the phenomenon of redistribution of previously created wealth (i.e. a certain income, employment) rather than applying resources to the creation of wealth (Heckelman, 2004). For example, when the government gets involved in protecting the environment by imposing a 5% limit on food-based biofuels, farmers and the biofuel industry will invest more resources into lobbying and making efforts to shape policies to their advantages. The resources that normally would be used to generate income are now “invested” in lobbying, i.e. rent seeking. The more government transfers exist (subsidies, tax exemptions), the more rent seeking occurs. Since the biofuel production is greatly dependent on subsidies, tax exemptions and other support measures, it may not be surprising that there are many interest group actively rent seeking.

5. The market of bio-tickets

This chapter focuses on one particular economic incentive, namely the tradable administratively biofuel system (bio-tickets) introduced in 2012 (Dutch Emission Authority, 2012). An impact analysis will be executed, which will assist in answering the question: *How does state intervention impact the market of biofuels?* Section 5.1 contains background information on the concept of bio-tickets. Section 5.2 describes the analytical framework. In section 5.3 an empirical and descriptive analysis will be done.

5.1 Background information

There is a market of bio-tickets with suppliers and buyers. Suppliers of the bio-tickets are companies that have delivered a higher quantity of renewable energy on the market than required. When biofuel suppliers have supplied a higher quantity of renewable energy than required, they receive a bio-ticket; the administratively tradable biofuels. The bio-tickets can be traded with fuel suppliers that have not met the target i.e. not have produced enough renewable energy. Those companies did for example produce pure fossil fuels without blending.

The companies that sell bio-tickets are the companies that can blend biofuels or produce renewable energy at the lowest cost. The companies that usually buy bio-tickets are the companies for which producing renewable energy involves higher cost than not producing renewable energy and buying bio-tickets. The suppliers of bio-tickets are mostly big companies. This is among others because big companies have economies of scale, for example regarding the costs of certification systems. When companies produce renewable energy, they have to obtain a sustainability certification that proves that the renewable energy has met the EU sustainability requirements. The certification is provided by a third party and costs a couple of thousand euros. The more biofuel is produced, the larger the economies of scale, and therefore, the lower the costs e.g. for obtaining the certification. Often big companies have a surplus of renewable energy while small companies often choose not to blend fossil fuel with renewable energy and to buy bio-tickets (Dutch Emission Authority, 2012; Ecorys, 2012). There are three ways of buying bio-tickets:

1. The company buys both biofuel and bio-tickets and agrees with the other party on the price.
2. The company buys only the required amount of bio-tickets and agrees with the other party on the price.
3. The company buys bio-tickets through a broker on a market place where the price is not negotiable. In the Netherlands there is one single broker, STX services (Hanschke et al., 2010).

5.2 Analytical framework

According to economic theory a market is efficient or "optimal" when it fulfils the conditions of perfect competition. When a market is perfect, its outcome is called Pareto-efficient. In that case there is no way to make a company better off, without making another company worse off. A market is distorted or not Pareto-efficient when these conditions are not fulfilled e.g. when there are one or a few players that have market power. The conditions for perfect competition are strict. In reality perfectly competitive markets are non existent or very rare. In this case perfect competition serves as a benchmark against which to analyse the bio-ticket market. In economic theory, perfect competition requires the following conditions (Varian, 2010):

1. Large number of sellers and buyers: In a perfectly competitive market there is a large number of sellers and buyers where an individual effort of a buyer or seller may influence the price (due to change in supply or demand), but buyers and sellers do not take that into account in their optimizing behaviour.
2. Perfect information: Sellers and buyers should have complete access to information e.g. on the price of the product.

3. Homogeneous goods: The products of the sellers are homogeneous and perfect substitutes for one another. The commodities are perfectly similar in quality, quantity, size and shape.
4. No entry barriers: Under perfect competition there are no entry or exit barriers. Buyers and sellers are free to enter and leave the market.
5. Zero transaction costs: In a perfectly competitive market there is one single unit price. The price is not affected by the cost of transportation of goods or other costs in the exchange of goods.
6. Profit maximization firms: Sellers aim to maximize their profit. Sellers will keep selling as many products as long as they can cover their marginal costs. Any profit-maximizing producer faces a market price equal to its marginal cost (P=MC). This implies that a commodity price equals its marginal revenue (Becker, 2007).

Imperfect market

An imperfect market occurs when one of the above-mentioned conditions are not met. The imperfect market is often expressed in two general forms: monopoly and oligopoly. A monopoly exists when one single seller can control the market price. An oligopoly exists when there are only a few sellers and many buyers in the market. This reduces competition and allows the sellers to influence the price. A monopolistic or oligopolistic market situation results in increased costs for other market actors. Also a monopolistic or an oligopolistic situation results in greater profits for the seller(s). This causes an inefficient use of resources. If there is market power on the demand side we have a monopsony or oligopsony.

5.3 Economic analyses

5.3.1 Empirical analysis

The aim of tradable bio-tickets is to reduce CO_2 emissions at lowest costs, in other words to create an efficient market for CO_2-emission reduction. The question is if the market of bio-tickets is Pareto-efficient. First, a table with the perfect-market requirements is shown and explained. Subsequently a mathematical example is given to show whether there are cost savings or welfare creation for firms that have to fulfil the biofuel-blending mandate of 5%. In table 5.1 it is analysed whether the bio-ticket market is an optimal market. The perfect competition case is used as benchmark.

Table 5.1 Bio-ticket market versus perfect competitive market

Perfect competition	Bio-ticket market
Large number of sellers and buyers	A few large sellers (14)
Perfect information: Price information is available	No perfect information. Price information is not available
Homogeneous product: same quality, shape and size	Bio-tickets have the same quality, shape and size
No entry or exit barriers	For sellers and buyers there are no or little entry or exit barriers
No transaction costs	Due to lack of transparency, time and costs are involved for obtaining price information

Source: Self-constructed

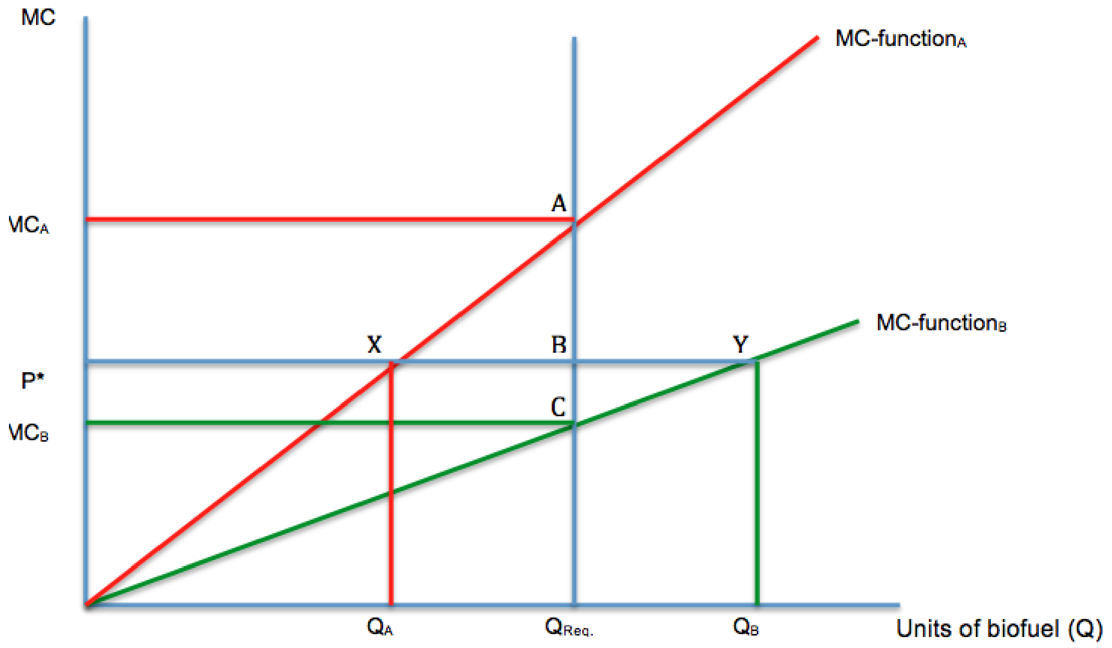
Large number of sellers and buyers: It is known that the amount of sellers and buyers is not equal: There are fourteen big suppliers and many more demanders; the exact number of demanders is unknown. This implies an oligopolistic market structure. However, there does not seem to be excessive market power of one single party (Ecorys, 2012).
Perfect information: There is little information available about the market of bio-tickets. The amount of transactions and the prices of bio-tickets are unknown (van Santen, STXservices). A firm can sell its bio-ticket to a broker who has knowledge on the market. This saves time but increases costs. **Homogeneous product:** In the market of bio-tickets the product is homogeneous: one bio-ticket is substitutable by another bio-ticket. The difference in price points to the existence of transaction costs.

Other conditions that influence the efficiency of the market are:
High liquidity/transaction rate: The liquidity (transaction rate) is quite low since companies tend to buy bio-tickets only once a year. According to the head of biofuels of bio-ticket trading company STXservices van Santen 25% of the bio-tickets can be used or sold in the next year (Dutch Emission Authority, 2010). This increases the liquidity of the market. However, bio-tickets are not internationally tradable, due to differences in national legislations. If the bio-tickets were internationally tradable, the liquidity would be higher.
No externalities: In the market of bio-tickets there are no factors that decrease the welfare without companies paying for it. The costs of the carbon dioxide emitted during the fuel production process are included in the price of bio-tickets.
No uncertainty: The market of bio-tickets is quite depended on the blending mandate set by the Dutch government. The sellers have to deal with time inconsistency because of the policy changes of the Dutch government. Often policy is made for the long term, but changed on the short term. For example, the blending mandate percentage, the inputs used to produce biofuels or the goods that may be produced to fulfil the mandate.

5.3.2 Descriptive analysis

In the descriptive analysis an example is given of two biofuel suppliers functioning in a perfectly competitive market. The market price and welfare in the situation where trade is possible are analysed. The descriptive analysis is based on the graph 5.1.

Graph 5.1: Bio-ticket market in a perfectly competitive market



Source: Self-constructed

Table 5.2 Explanation of terms used in graph 5.1

Term	Explanation
X-axis	Quantity of units of biofuel
Y-axis	Costs, price
MC firm A and firm B	Marginal cost functions of firm A and 2
Required Q	The quantity biofuel production required according to Dutch legislation
Q_A and Q_2	Quantity produced after trade
MC_1 and MC_2	Marginal costs of firm A and 2: costs for producing one extra unit of biofuels
P*	Market price
A and C	Market equilibriums before trade
X and Y	Market equilibriums after trade

Source: Self-constructed

Graph 5.1 displays a situation of two biofuel companies in a perfectly competitive market. The two companies have to produce a certain amount of biofuels to meet the blending mandate set by the Dutch government (Qreq.). The two linear lines show the marginal costs of the two firms i.e. the change of their total cost as the quantity supplied changes by one unit. The vertical line is the demand curve of biofuels. The line is totally inelastic due to a blending mandate of the Dutch government. So, the price has no impact on demand. Fossil fuel, the main substitute, is currently more attractive in terms of costs (van der Rest, 2013). The market equilibriums of the two companies before trade are the points where the demand curve crosses the supply curves (A, C). The level of the points A and C shows the marginal costs (MC) of the two firms. Marginal costs are the costs of producing one extra unit. Firm A has higher marginal costs than firm B.

Price and welfare after trade

When trade is possible the market price will be P*. As seen in the previous section, a profit-maximizing producer faces a market price equal to its marginal cost (P=MC). Trade results in different outputs for both firms. Under perfect competitive conditions, the firm chooses to produce a quantity biofuels such that the marginal cost of biofuels is equal to the price of a bio-ticket. This means that the firm will buy bio-tickets if its marginal cost is higher than the price of a bio-ticket and will sell bio-tickets if the marginal cost of biofuel is lower than the price of a bio-ticket. Under perfect competitive conditions, firms trade until the point that the marginal value and the price become equalized (Gangadharan, 2000). P* lies between the MCs of firm A and B. Firm's A MC is larger than P^*, which makes it more attractive to buy bio-tickets.

For firm A, it is cheaper to produce biofuels from 0 to Q_A, than to buy bio-tickets, as P* lies above the marginal costs for all biofuel produced from 0 to Q_A. Firm A saves costs Q_AQreqA. However, to meet the blending mandate (Qreq), the firm has to buy bio-tickets from Q_A to Qreq. This is the same quantity that firm B sells. The firm has to pay firm B Q_AQBX. The extra profit after trade is the saved costs minus the expenditure on the biofuel tickets, which is XBA.
Film B sells (Qb-Qreq), the same quantity that firm A buys. Firm B's marginal revenue (what it receives from A) is QreqBYQb and the costs of production are QreqCYQb. The revenue minus the costs is the extra profit firm gains after trade. In the graph, this is CYB.
To conclude, in the perfectly competitive market of bio-tickets, it is advantageous to trade biofuels administratively. The firms with initial lower marginal costs gain extra profit by selling bio-tickets. The firms with initial marginal costs higher than the market price increase profit by saving on costs by buying bio-tickets.

5.3.3 Numerical example

Next a numerical example is presented that illustrates the possible welfare gains after trade. The figures in table 5.3 are arbitrarily chosen by the researcher.

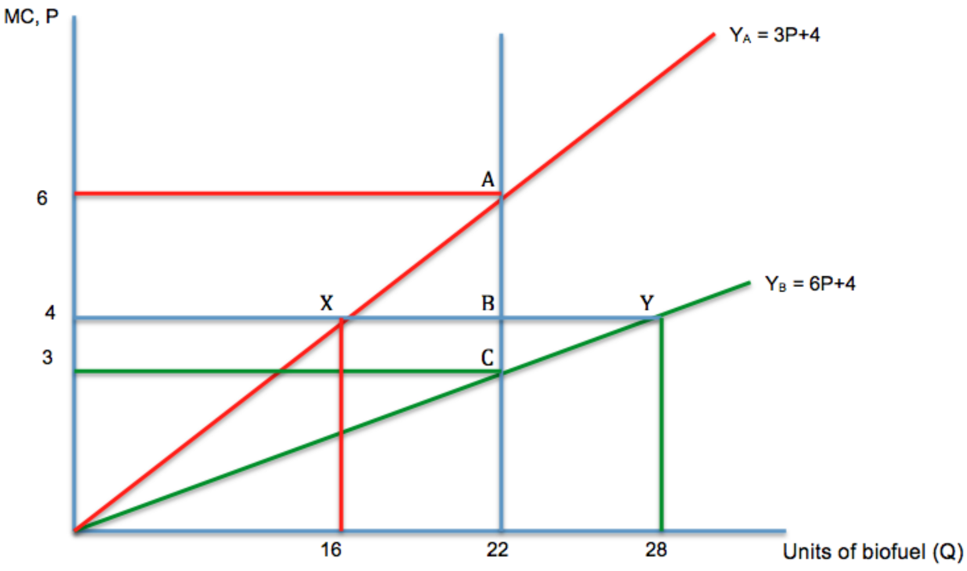
Table 5.3 Marginal cost functions of firm A and B

The two marginal cost functions:	Q_A = 3P+4 Q_B = 6P+4
The required quantity of units of biofuel	22
MC of firm A (P=MC)	22=3P+4 → 18/3 = 6 = P = MC → MC=6
MC of firm B (P=MC)	22=6P+4 → 18/6 = 3 = P = MC → MC=3

Source: Self-constructed

The marginal cost (MC) function shows the change in total cost as quantity supplied changes by one unit (Becker, 2007). As seen in the previous section, a profit-maximizing producer faces a market price equal to its marginal cost (P=MC). Graph 5.2 shows the numbers graphically.

Graph 5.2: Bio-ticket market in a perfectly competitive market



Source: Self-constructed

Price and welfare after trade

The market price in a situation of trade can be derived from the two marginal cost functions. The output of both companies is fixed (22), due to the blending mandate set by the Dutch government.

$$Q_A + Q_B = 44 = 3 \cdot P + 4 + 6 \cdot P + 4$$
$$44 = 9 \cdot P + 8$$
$$P = 4$$

Extra profit after trade for firm A: The new output after trade is calculated by including P=4 in the MC-function: $Q_A = 3 \cdot 4 + 4 = 16$. The difference in output: $22 - 16 = 6$. The new quantity biofuel produced by firm A is 16, however the firm is obligated to fulfil the blending mandate of 22 units of biofuel. Firm A will buy the remaining 6 units, against market price (4). The extra profit after trade is the total saved costs minus the costs of buying bio-tickets:

The total saved costs for not producing quantity $Q_{req.} - Q_A$:

$$\left(Q_{req.} - Q_A\right) \cdot P + \frac{\left(Q_{req.} - Q_A\right) \cdot (MC - P)}{2}$$

$$(22 - 16) \cdot 4 + \frac{(22 - 16) \cdot (6 - 4)}{2} = 30$$

Minus the costs for buying bio-tickets to fulfil the blending mandate:

$$\left(Q_{req.} - \ Q_A\right) \cdot P$$

$$(22 - 16) \cdot 4 = 24$$

The extra profit after trade for firm A = 30 – 24 = 6

Extra profit after trade for firm B: The new output after trade is calculated by including P=4 in the MC-function: $Q_B = 6 \cdot 4 + 4 = 28$. The difference in output is: 28 - 6= 22. The new quantity biofuel produced by firm B is 28, which are 6 more than required. The 6 units will be sold against market price (4). The extra profit after trade equals the revenue after trade minus the marginal costs for production of the extra units of biofuels.

The change in revenue after trade: $(28 - 22) \cdot 4 = 24$. The change in costs after trade:

$$\left(Q_B - Q_{req.}\right) \cdot 3 + \frac{\left(Q_B - Q_{req.}\right) \cdot (P - MC)}{2} \Rightarrow (28 - 22) \cdot 3 + \frac{(28 - 22) \cdot (4 - 3)}{2} = 21$$

The extra profit after trade for firm B is: 24 – 21 = 3

Trade in a market with transaction costs

As mentioned before, the bio-ticket market is characterized by high transaction costs. The lack of transparency causes inefficiencies. Different allocation mechanisms will have different levels of transaction costs. Transaction costs lower the quantity traded and welfare from trade. Below a numerical example is given. It is exact the same market, with the same figures as in the previous example. The new price; the quantity traded bio-tickets and the deadweight losses are calculated. Transaction costs = 1; firm A (the demander) pays the transaction costs (P_D = P_s + t). The new equilibrium price after trade in a market with transaction costs will be derived from: $Q_A + Q_B = 44$

$$44 = 6 \cdot (\mathrm{P} + 1) + 4 + 3 \cdot \mathrm{P} + 4$$

Price of producer ($\mathrm{P_S}$):	$\mathrm{P_S} = 3\tfrac{2}{3}$
Price of firm A (demander):	$\mathrm{P_d} = 3\tfrac{2}{3} + 1 = 4\tfrac{2}{3}$
Quantity of firm A (demander):	$Q_A = 3 \cdot 4\tfrac{2}{3} + 4 = 18$
Quantity of firm B (supplier):	$Q_B = 6 \cdot 3\tfrac{2}{3} + 4 = 26$
Extra profit after trade for firm A:	
Change in saved costs:	$(22 - 18) \cdot 4\tfrac{2}{3} + \frac{(22-18)\cdot\left(6-4\frac{2}{3}\right)}{2} = 21\tfrac{1}{3}$
Change in extra costs:	$(22 - 18) \cdot 4\tfrac{2}{3} = 18\tfrac{2}{3}$
Extra profit:	$\left(21\tfrac{1}{3} - 18\tfrac{2}{3}\right) = 2\tfrac{2}{3}$
Loss in profit due to transaction costs:	$6 - 2\tfrac{2}{3} = 3\tfrac{1}{3}$
Change in total revenue:	$(26 - 22) \cdot 3\tfrac{2}{3} = 14\tfrac{2}{3}$
Change in costs:	$(26 - 22) \cdot 3 + \frac{(26-22)\cdot\left(3\frac{2}{3}-3\right)}{2} = 13\tfrac{1}{3}$

Extra profit: $14\frac{2}{3} - 13\frac{1}{3} = 1\frac{2}{3}$

Loss in profit due to transaction costs: $3 - 1\frac{1}{3} = 1\frac{2}{3}$

The total loss in profit after trade in a market with transaction costs is:

$3\frac{1}{3} + 1\frac{2}{3} = 5$

Monopoly

The empirical analysis showed that there are a few suppliers and many demanders. This could imply an oligopoly. Here I will give a numerical example. For simplicity I will assume a monopoly. In a monopoly the market includes one supplier that determines the quantity of biofuels traded in the market. The supplier bases its production quantity on the behaviour of the demanders, which he is assumed to know given that he is only the only supplier. Trade decreases due to a monopoly. The monopolist benefits as he produces less (lower costs) at a higher price.

Gain for the monopolist and deadweight loss for society

Price in a monopolistic market = P_m
Marginal cost of the monopolist = MC_m
Equilibrium quantity in a monopolist market = Q_m
Price in a market with perfect competition = P_p
Equilibrium quantity in a market with perfect competition = Q_p
The demand function is: $P = 20 - Q$
The total cost function: $TC = 8Q + Q^2$
The marginal cost function is the derivative of the total cost function: $MC = 8 + 2Q$
The marginal revenue curve is twice as steep as the demand curve: $MR = 20 - 2Q$

The equilibrium quantity and price:

$$MR = MC \Rightarrow 20 - 2Q = 8 + 2Q \Rightarrow -4Q = -12 \Rightarrow Q = \frac{12}{4} = 3 \Rightarrow Q_m = 3$$

$$P_m = 20 - Q \Rightarrow P = 20 - 3 = 17 \Rightarrow P_m = 17$$

$$MC_m = 8 + 2Q \Rightarrow MC_m = 8 + 2 \cdot 3 = 14 \Rightarrow MC_m = 14$$

The equilibrium quantity and price in perfect competition is:

$MC = Demand\ function$

$$Q_p = 8 + 2Q = 20 - Q \Rightarrow 3Q = 12 \Rightarrow Q = \frac{12}{3} = 4 \Rightarrow Q_p = 4$$

$$P_p = 20 - Q \Rightarrow 20 - 4 = 16 \Rightarrow P_p = MC_P = 16$$

The extra profit for the monopolist equals:

$$(P_m - P_p) \cdot Q_m - \frac{(P_p - MC_m) \cdot (Q_p - Q_m)}{2} \Rightarrow (17 - 16) \cdot 3 - \frac{(16 - 14) \cdot (4 - 3)}{2} = 2$$

The deadweight loss for society equals:

$$\frac{(P_m - MC_m) * (Q_p - Q_m)}{2} \Rightarrow \frac{(17 - 14) * (4 - 3)}{2} = 1.5$$

The decrease in trade and increase in price in a monopolistic market structure compared with perfect competition equals:

$\Delta Q: 3-4=-1$ and $\Delta P: 17-16=+1$

Oligopoly

The empirical analysis showed that there are a few suppliers and many demanders. This could imply an oligopoly. A characteristic of an oligopolistic market is that independent suppliers can control the supply, and thus the price, thereby creating a seller's market. In an oligopolistic market structure each firm takes the other firm's choice of output level as fixed and then sets its own production quantities. I will give a numerical example of a Cournot oligopoly with two players, also called a duopoly. The equilibrium will be found by solving the so-called reaction-curves. Reaction curves are found by equating marginal revenues and marginal costs. A reaction curve for Firm A is a function that takes as input the quantity produced by Firm B and returns the optimal output for Firm A given firms B's production decisions. In other words, Q_A (Q_B) is Firm A's best response to Firm B's choice of Q_B.

Gain for the oligopolist and deadweight loss for society

Price in an oligopolistic market = P_o
Marginal cost of the oligopolist = $MC_a \; or \; MC_b$
Equilibrium quantity in an oligopolistic market = Q_o
Price in a market with perfect competition = P_p
Equilibrium quantity in a market with perfect competition = Q_p
The inverse demand equation: $P = p(Q_A + Q_B) = 60 - (Q_A + Q_B)$
Marginal cost_A: $Q_A - 10$
Marginal cost_B: $4Q_B - 20$
The revenues and marginal revenues of firm A and B are:
Revenue_A: $(60 - (Q_A + Q_B)) \cdot Q_A$ Marginal Revenue_A: $60 - Q_B - 2Q_A$
Revenue_B: $(60 - (Q_A + Q_B)) \cdot Q_B$ Marginal Revenue_B: $60 - Q_A - 2Q_B$

By equalising marginal revenue to marginal cost the following reaction curves are obtained:
$MR_A = MC_A \Rightarrow 60 - Q_B - 2Q_A = Q_A - 10 \Rightarrow$Reaction curve $Q_A = \frac{70}{3} - \frac{1}{3} \cdot Q_B$
$MR_A = MC_A \Rightarrow 60 - Q_A - 2Q_B = 4Q_B - 20 \Rightarrow$Reaction curve $Q_B = \frac{80}{6} - \frac{1}{6} \cdot Q_A$

The Cournot equilibrium is now found by solving the system of two reaction curves.

$$Q_A = \frac{70}{3} - \frac{1}{3}\left(\frac{80}{6} - \frac{1}{6} \cdot Q_A\right) \Rightarrow Q_A = 20$$

$$Q_B = \frac{80}{6} - \frac{1}{6}\left(\frac{70}{3} - \frac{1}{3} \cdot Q_B\right) \Rightarrow Q_B = 10$$

Substituting the equilibrium quantity in the marginal cost functions, gives $MC_A = 10$ and $MC_B = 20$.
Substituting both quantities supplied in the demand function gives the price:
$P_O = 60 - (20 + 10) \Rightarrow P_O = 30$

The equilibrium quantity and price in perfect competition will be derived from equalising the demand function to the supply function.
$Q^D = 60 - P \; (P = MC)$
$Q^s = Q_A + Q_B$

$$MC_A = Q_A - 10 \Rightarrow Q_A = MC_A + 10 \;\&\; MC_B = 4Q_B - 20 \Rightarrow Q_B = \frac{1}{4}MC_B + 5$$

$Q_A + Q_B = \frac{5}{4}MC + 15 \Rightarrow 60 - P = \frac{5}{4}P + 15 \Rightarrow 45 = \frac{45}{\frac{4}{5}}P \Rightarrow P = 20$

Substituting the price in the marginal cost function gives the equilibrium quantities:

$Q_A = P + 10 \Rightarrow 20 + 10 \Rightarrow Q_A = 30$

$Q_B = \frac{1}{4}P + 5 \Rightarrow 5 + 5 - \Rightarrow Q_B = 10$

The extra profit for firm A in an oligopolistic market structure:

$$(P_o - P_p) \cdot Q_a - \frac{(P_p - MC_O) \cdot (Q_p - Q_a)}{2} \Rightarrow (30 - 20) \cdot 20 - \frac{(20 - 10) \cdot (30 - 20)}{2} = 150$$

The extra profit for firm B in an oligopolistic market structure:

$$(P_o - P_p) \cdot Q_b \Rightarrow (30 - 20) \cdot 10 = 100$$

The consumer surplus equals:

$$-(\,(P_o - P_p) \cdot (Q_a + Q_b) + \frac{(P_o - P_p) \cdot (Q_p - Q_o)}{2}) \Rightarrow$$

$$-((30 - 20) \cdot 30 + \frac{(30 - 20) \cdot (40 - 30)}{2}) = -350$$

The deadweight loss for society equals:

Consumer surplus + producer surplus ⇒ $-350 + (150 + 100) = -100$

The decrease in trade and increase in price in an oligopolistic market structure compared with perfect competition equals:

ΔQ: $30 - 40 = -10$ and ΔP: $30 - 20 = +10$

The numerical example shows that a monopolistic and oligopolistic market structure result in less trade in bio-tickets and drive up the prices.

6. Interest groups

According to public choice theory, it is of significant importance for policy makers to meet the needs of influential interest groups in maintaining their political legitimacy (Rainy 1997, p. 30 cited by Bryson, 2004). The purpose of this chapter is to analyse influential interest groups on EU and Dutch level. It answers the following question: *What are the viewpoints of the influential interest groups on the biofuel policy?* Section 6.1 provides background information about the introduction of biofuel policy and about the involved interest groups. Section 6.2 describes the influence of EU interest groups and their viewpoint towards topics currently discussed. Section 6.3 will give a description of Dutch key stakeholders and will glance at the Dutch biofuel market in 2030.

6.1 Background information

In 2003 more than 50% of the energies supply in the EU was imported (Eurostat, 2012). This strong dependence on energies supply from non-EU countries was a growing concern in the European Union (Dijkstra, 2013). In the meantime, the EU had become increasingly aware of the seriousness of global warming. In 2001 the Intergovernmental Panel on Climate Change (IPCC), the leading international scientific body for the assessment of climate change, published its third assessment on global warming (TAC). The Panel stated that the emissions of greenhouse gases and aerosols due to human activities would continue to alter the atmosphere in ways that would affect the climate. Also they found stronger evidence that most global warming observed over the last fifty years was attributable to human activities (McCarthy et al., 2001). Furthermore, another discussion point in European politics was the depopulation of rural areas. Abundance of agricultural areas due to depopulation was a growing concern, particularly in France. Countering depopulation is of high importance: It is a stated objective of many EU agri-environmental schemes (Primdahl et al., 2003). To conclude, in 2003 concerns in the EU were among others 1) the large dependence on energies supply, 2) climate change and 3) depopulation of rural areas.

In an attempt to solve the above mentioned concerns, NGOs and farmers unions gathered and strongly lobbied for the introduction of biofuels. They argued that substituting fossil fuels with biofuels would reduce greenhouse gas emissions and it would decrease EU energy dependence on non-EU countries. Moreover, the introduction of biofuels would create employment in rural areas, which would therefore tackle the problems of depopulation.

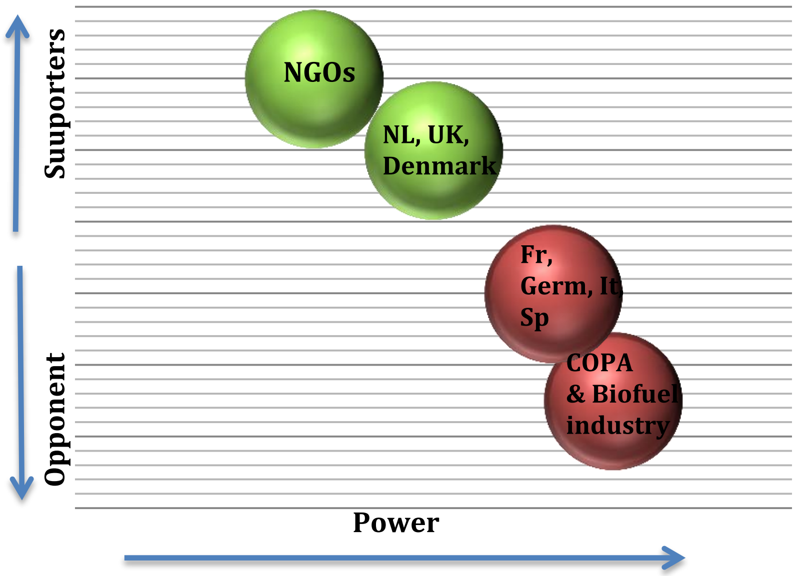
6.2 Interest groups in the European Union

According to Bryson (2004), the importance of stakeholder analysis has increased. This is primarily due to globalism. In problems that are of economic, environmental and social importance many parties are involved and not one entity is fully in charge (Kettle, 2004 cited by Bryson 2004). The biofuel discussion is a good example of an economic, environmental and social issue in which many parties play an important role. Furthermore, chapter 4 has shown that the biofuel discussion within politics attracts many (lobbying) interest groups.

In this section the "stakeholder-mapping technique" is applied (Anderson et al., 1999 cited by Bryson, 2004). This technique helps to identify the influence of interest groups and their interest on a particular issue. I will analyse the viewpoints of interest groups regarding the proposed policy measure of limiting food-based biofuels to 5% in 2020. As this is a current topic of discussion within the European Parliament, there will be a focus on the most influential Member States. A distinction is made between supporters (green bulbs) and opponents (red bulbs).

- : France, Germany, Spain; the European farmers association (COPA) and the biofuel industry.
- : The Netherlands, United Kingdom, Denmark and NGOs.

Figure 6.1 Influential interest groups divided in supporters and opponents of the 5% CAP-proposal



Source: Self-constructed, based on the model of Anderson et al. (1999)

Member States: The Member States that are opposed to limiting food-based biofuels to 5% are: France, Germany, Italy and Spain. As Germany, France, the United Kingdom and Italy have the greatest representation in the European Parliament, they have considerable influence on EU policy. Besides, France and Germany are the largest EU countries and belong to the Union's six founding countries. France, Germany, Italy and Spain each have a large vested interest in the EU biofuel market (European Biodiesel Board, 2011). The 5% CAP would limit the demand for (food-based) biofuels and these countries have therefore shown resistance and would likely vote against the 5% CAP. The Netherlands, UK and Denmark are the only countries supporting the proposed 5% CAP (Euractive, 2013). These countries have smaller or no economic interest in producing food-based biofuels.

COPA: Another strong opponent is the European Farmers Association COPA. COPA played an important role in introducing biofuels to EU policy (Boot, 2013, van der Rest, 2013). In 2011 almost 45% of the EU budget was assigned to the Common Agricultural Policy. Farmers, as producers of biofuels, have a large vested interest in biofuels. The 5% CAP limits the demand for crops for the use of biofuels and would negatively affect farming incomes and therefore employment within agriculture.

The Industrial Trade Union of Biofuels: Since 2003 various parties have made large investments in the supply chain development of biofuels. Investors expected a growth in demand for biofuels based on the EU target of 10% biofuels in 2020. This has resulted in a biofuel industry worth €10bn that is now of great importance for the European Union (Knoop, 2012). The European Commission has stated that its intention is to not allow changes in biofuel policy to affect such investments.

NGOs: NGOs are strongly supporting the 5% limit on food-based biofuels. NGOs provide the government information on the social and environmental impact of biofuels. The environmental and social concerns raised by NGOs provoke public opinion and discussion in the European Parliament. According to NGOs, the production of biofuels causes a rise in food prices, threatens food access in developing countries, increases GHG-emissions and damages biodiversity.

6.3 Interest groups in the Netherlands

Dutch biofuel policy highly depends on the decision made in the European Parliament and Council. The targets that are stated in the Renewable Energy Directive and Biofuel Quality Directive should achieved by every Member State. However Member States are free to design their own strategies and introduce measures to reach the targets. The key interest groups contribute to the development of these strategies and to the development of policy measures. In this section a short description of the key stakeholders will be given. Next, the influence of these interest groups and their viewpoints on the proposed measure of limiting food-based biofuels to 5% in 2020 will be given (Anderson et al., 1999 cited by Bryson, 2004).

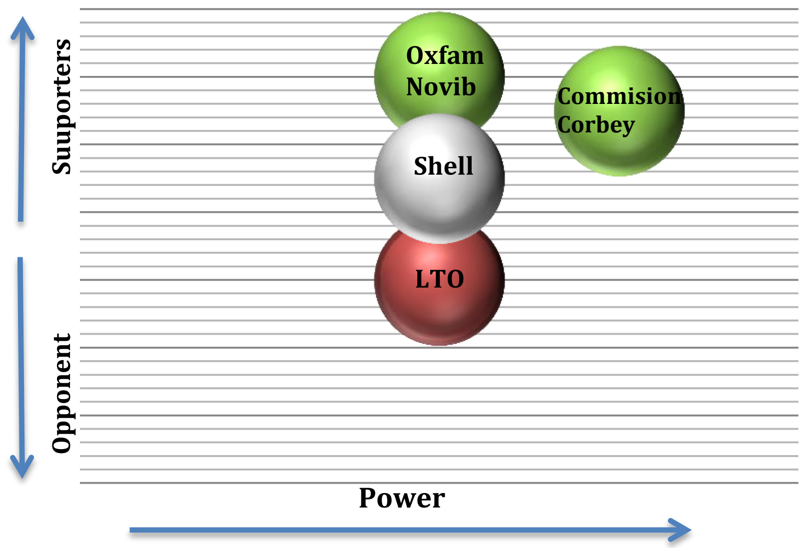
Commission Corbey: The project group Sustainable Production of Biomass, also known as the Commission Corbey recommends policy measures regarding sustainable biofuels. The commission consists of experts from the public and private domain. The commission has determined sustainability criteria for the Dutch biofuel policy. Besides, they have recommended policy measures concerning the blending mandate, the double counting of advanced biofuels and, currently in discussion, measures against ILUC (Grinsven, 2009; Boot, 2013, Mansveld, 2013).

LTO: LTO is the Dutch Agriculture and Horticulture Organization that represents the interests of the Dutch farmers. Furthermore, LTO advocates the interests of food processing companies. Processing companies are important buyers of the crops of farmers

Oxfam Novib: Oxfam Novib is a non-profit development organization in the Netherlands. Oxfam Novib provides the government information about the negative effects of the current biofuel policy on the environment and the local population in developing countries. Oxfam Novib has started discussion about the possible effects that biofuels have on food prices ('Voedsel in je tank?', 'Hunger grains').

Shell: Royal Dutch Shell (Shell) is a Dutch-British petrochemical company. Shell is one of the petroleum industries that has to comply with the targets and meet the measures set by the Dutch government.

Figure 6.2 Influential interest groups divided in supporters and opponents of the 5% CAP-proposal



Source: self-constructed, based on the model of Anderson et al. (1999)

Commission Corbey: Commission Corbey is in favour of the 5% limit. As long as there is no consensus on the effects of indirect land use change (and therefore no possibility to directly tackle ILUC), the 5% limit of food-based biofuels is a good alternative to limit GHG-emissions and loss of biodiversity due to the indirect land use change (Commission Corbey, 2012).

LTO: LTO is opposed to the 5% limit on food-based biofuels. The introduction of the cap would hold-up farmers that have invested in food-based biofuels. Another reason for LTO to be against the cap might be their interest to preserve good relations within COPA. In COPA the majority of countries is against the cap. LTO is an outsider because it is in favour of monitoring ILUC-factors, according to themselves (Kager, 2013).

Oxfam Novib: Oxfam Novib advocates a 3% cap on food-based biofuels. Limiting food-based biofuels is a measure that tackles the problems concerning indirect land use change i.e. farmers who are driven away from their land, higher prices for locally produced food which threatens food access for the poor, the extra GHG-emissions and loss of biodiversity.

Shell: Shell is not opposed to this policy measure provided that the percentage limit of food-based biofuels applies to all Member State.

6.4 The Dutch biofuel market in 2030

In 2010 the Netherlands has submitted an action plan in accordance with the biofuel directive-targets. The government has set out annual blending mandate-targets, they have defined the trajectory they would like to follow and the measures they would like take to overcome barriers. Examples of measures the Dutch government has taken are subsidies, tax exemption, double counting of advanced biofuels and the possibility of administratively trade in biofuels. As seen in chapter 4 the economic incentives result in a growth in trade of advanced biofuels (double counting system). However, the economic incentives do not stimulate a growth in the volume of traded biofuels. The system authorizes companies to supply a lower volume than required according to the blending mandate. Assuming that the double counting system will continue to exist, the trade in advanced biofuels will grow but the growth of biofuels will decrease.

Transaction costs

In the current situation, the transaction costs of biofuel trade are high: There is a lack of information about the negative environmental effects of biofuels. The tool that the government has introduced to tackle this problem, is a monitoring obligation: supplied biofuels have to have a certification that proves that the stated sustainability requirements are met. The costs to obtain the certification are seen as transaction costs. It is assumed that these transaction costs will also exist in the future and may grow even further. When the European Parliament decides to oblige companies to report on ILUC, transaction costs will increase: it will cost much time and money, especially because it is difficult to know the indirect land use changes that companies affect.

5% CAP

Regarding the policy of ILUC, The Netherlands will wait and see what the European Union will decide and what targets it will set before taking measures. It is likely that the proposed 5% limit on food-based biofuels will not be implemented in EU biofuel policy. Currently there is too little support from the European Parliament to implement the CAP-measure. The question now is how biofuel policy and the market of biofuels will further develop.

Advanced biofuels

In the current situation there is nearly no production of biofuels in the Netherlands. Food-based biofuels is at the moment not yet profitable (Kager, 2013). The government and all interest groups are in favour of stimulation of advanced biofuels. Advanced biofuels tackle indirect land use change. Market figures of 2011 have shown that the production of biofuels that are counted double has increased. If specific biofuels will continue to be counted double it is expected that the trade and possibly the production, of these biofuels will grow. A current topic of discussion is whether the government should introduce a quadruple counting system. In that case, particular products would be counted quadruple. Currently parties can propose products to be counted quadruple. LTO sees opportunities in biogas and advocates for manure for the use of biogas (Kager, 2013). Currently there are only a few types of advanced biofuels that are traded on the Dutch market. Examples are used cooking oil and animal fat. There has been done much research and trials to produce advanced biofuels. However, in the past many experiments have failed. In an attempt to market advanced biofuels, Shell has executed many research projects. Most of these projects have for some reason failed. Their on-going research projects are in woody chips and straw.
Another complication of advanced biofuels is the investment in time it requires. From the start of a project to a plant in progress that supplies the biofuel takes at least twenty years. To conclude, for a further growth of advanced biofuels, time and money is required.

Cascading of biomass

Several parties, such as LTO, the project group Biobased Economy of the ministry of Economic Affairs and scholars aim for the development of other bio-market rather than the biofuel market. They argue that there are better applications for the use of biomass, such as bio-plastics and biochemistry. According to the biomass cascading pyramid (Chapter 2), biofuels is an application with low added value. The problem of using biomass for bio-plastics or biochemistry is the involving high costs. The production process is complicated and requires much time, specific knowledge and investments for the development of the supply chain (Heijne et al., 2011) . If the government will support the interest groups to develop other bio-supply chains, Dutch farmers will not only sell to food companies, but also to producers of bio-plastics, biochemical companies and electricity companies (Kager, 2013).

Alternative paths

Along the way, Shell has taken up another path in an attempt to find solutions for energy dependence and reduction of GHG-emissions. Shell currently participates in consortia with Volkswagen, Toyota and Mitsubishi to find opportunities for more economic motors (van der Rest, 2013). When a motor consumes fewer fuels per kilometre, GHG-emissions in transport will reduce. In EU policy, sustainability requirements regarding economical motors are still lacking. The development of economical motors in EU is much hindered by the resistance of Germany. Germany has a large car industry. The key selling points of German car companies are the safety and luxury, rather than the economy, of cars.

Long-term policy

Finally, a common interest of the Dutch interest groups is a long-term policy. Many parties are economically hit by the time-inconsistency of the government. This has held-up companies and resulted in a waiting and distrustful attitude towards the Dutch government. To LTO and Shell clarity about long-term policy is of great importance, even if the policy is against the interests of the parties.

7. Conclusion and discussion

7.1 Conclusions

The research objective of this research is: ‘to acquire an understanding of the political process behind biofuel policy in the European Union and the Netherlands and to find out which interest groups are influential and what their perspectives are on the biofuel market in the nearby future’. I have used six research questions to offer structure and ensure all relevant information is assessed in meeting my research objective. In this section I will evaluate whether the research objectives have been realised.

The first research question assessed elementary aspects of biofuels. Biofuels are transport fuels made from biomass and can be considered a substitute for fossil fuels. Biofuels are classified by first generation (i.e. food-based) biofuels and advanced biofuels, produced from non-food sources.

In answering the second research question, the political process of biofuel policy was analysed. The outcome showed that the European Parliament has considerable power in making amendments regarding EU biofuel policy. As the number of seats in the European Parliament depends on the population of each country, Germany, France and the United Kingdom have the greatest representation in the European Parliament. The analysis surrounding the political process concludes that Dutch biofuel policy highly depends on the decisions that are made on EU-level.

In answer to the third question, I executed an impact analysis of Dutch state intervention, assessing policy measures and economic incentives. It became clear that the state intervention results in transaction costs of biofuel trade. The high transaction costs are the consequence of reporting obligations for companies dealing in biofuels. This policy measure was introduced in attempt to monitor the environmental and social consequences of biofuels. Another significant issue is the time-inconsistency of the government. The Dutch government has made several changes in Dutch biofuel policy. The social welfare was “distorted”, redistributed from the biofuel industry to “the environment”. Next, the government introduced an economic incentive for local production of biofuels. As the production of biofuel sources is not yet profitable for Dutch farmers, nearly all biofuel sources have been imported. In an attempt to stimulate the local production of biofuels, the government counts advanced biofuels double. In 2011, as a consequence, the market share of advanced biofuels i.e. used cooking oil and animal fat was 40%.

Another economic incentive introduced by the government is the bio-ticket market system. It gives companies the opportunity to trade administratively in biofuels as an alternative to supplying their own biofuels. Trading bio-tickets in a perfectly competitive market increases welfare. A firm with lower marginal costs than the market price, gains extra profit by trading in bio-tickets. A firm with higher marginal costs than the market price saves costs by trading in bio-tickets. However, in the empirical analysis it became clear that in reality trade in bio-tickets includes high transaction costs due to lack of information and uncertainty. This reduces the volume of trade in bio-tickets and results in less extra profit. Finally, since there are only a few large sellers of bio-tickets, the market may have an oligopolistic market structure. This also reduces the trade volume and drives up prices. As bio-tickets do not rely on government support, the initiative is a good means of developing the market. However, due to the high transaction costs and potential market power the benefits diminish and it has yet to show its successes.

As a next step, a stakeholder analysis was executed. It showed that the biofuel policy attracts many lobbying interest groups (rent seeking) as much government support is involved. The biofuel industry and the farmers association have a large vested interest in the biofuel market. The biofuel industry and farmers are for a large part from France, Germany, Spain and Italy. These countries have the largest representation in the European Parliament (except for the United Kingdom). Since these countries have the same interest about the future of biofuels, together they have considerable power in the European Parliament. It will be difficult to make amendments that will limit the demand of biofuels. For that reason, it is likely that the recent proposed 5% limit on food-based biofuels will be rejected,

The outcome of the Dutch stakeholder analysis shows that, in line with the conclusions of Bos-Brouwers et al. (2012) and van Thuijl (2006), the time-inconsistency of the government has resulted in a fear for inconsistent policies and in a loss of trust in the government. Among Dutch interest groups uncertainties about governmental policy are highly present. Many parties experienced a lock-in due to changes made in the biofuel policy. The time-inconsistency has most likely affected future social welfare negatively.

As long as the EU biofuel policy will not be amended, the demand for food-based biofuels will continue to grow in coming years in parallel with the growing targeted percentages set by the Dutch government. It is expected that further attempts of the government to stimulate the production of advanced biofuels will be made. Much government support will be needed, because without, the marketing of advanced biofuels will, on the short term, fail. In the current situation most advanced biofuels are yet too expensive to market. In the future, the trade in animal fat, used cooking oil, woody chips and straw may grow, provided that government support is present. Several Dutch scholars advocate for advanced biofuels. However it is questionable whether advanced biofuels can ever be a substitute of fossil fuels on large scale. Next, counting certain types of biofuels double or even quadruple can evoke perverse incentives. In order to be able to supply less biofuels and at the same time save costs, biofuel traders will import palm oil from Indonesia for the use of used cooking oil or corn for the use of biogas. In that case it is questionable whether the double counting system assists in GHG-reduction.
There are many articles and reports that assess the use of specific advanced biofuels (algae, woody chips, biogas). In my opinion it is more relevant to assess how Dutch biofuel policy and market have developed, in order to be able what to expect in the future and anticipate on that.

In line with Bos-Brouwers et al. (2012), in my research I come to the conclusion that what happens in the Netherlands can be largely derived from actions and decisions made on EU level. All interest groups, with the exception of the Dutch government, are focused on the decisions made on EU level rather than on the political process in the Netherlands. Much Dutch research is only focused on Dutch biofuel policy and the Dutch market. I did not discover research that investigated the EU political process, influential interest groups on EU level nor research on the influence of farmers on EU biofuel policy. I recommend to further explore the political process of the EU policy and relevant interest groups.

Finally, scholars argue that biomass should be used for applications with higher added values such as biochemistry products or bio-plastics (Bos-Brouwers et al., 2012, Bergsma et al., 2010). I raise the question whether the added value of, for example, biochemistry is indeed higher than the added value of biofuels. There exists a well-developed and well-functioning supply chain for biofuels. To be able to trade biochemistry a supply chain has to be developed. This involves high costs. Moreover, the production process of biochemistry products is more expensive than that of biofuels.

7.2 Discussion

I have executed a descriptive and empirical analysis of bio-tickets set by the Dutch government. I have given three numerical examples to illustrate the possible welfare gains; in a perfect competitive market, a market with transaction costs and in case of a monopoly. As the figures have been arbitrarily chosen, they do not represent reality. However, for doing that there is too little information available about prices and players in the bio-ticket market. The reasons may be because most deals are bilaterally made and because it was not until 2011 that the system has been in existence. There are no data concerning 2011 and 2012. There is a trading company, STX services, trading in biofuels, however they do not publish market figures.

In order to truly assess the bio-ticket system, an analysis of real market figures will have to be made. It is recommended that in coming years, when the system has developed and more market figures have become available, an analysis with real market figures will be carried out.

In order to acquire an understanding of Dutch stakeholders, I have interviewed six main key stakeholders. The interviews were semi-structured and the questions were open-ended. I asked the questions I needed to know. However, the focus relied on the situation and on what the interviewees wanted to discuss. The outcome has been assessed and interpreted by me. A well-structured and quantitative method was lacking. However, I have noticed that the most significant, and possibly relevant, information is derived from informal exchange of thoughts we had around the formulation of the prepared question. Also I believe that convictions and opinions are based on emotions. Therefore it is important to give the interviewee enough opportunity to share his of her thoughts.

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Appendix

Interviews

As part of my research, I have held several interviews with representatives of key interest groups in the Dutch biofuel market. The information shared by the interviewees has been included in the research and the interviewees are used as reference. In table A.1 an overview is given of the interviewees and the interest group they represent.

Table A.1 Overview of interviewed interest groups of Dutch biofuel policy

Company or organization	Interviewee	Responsibilities
Shell	Mrs van der Rest	Safety, health and environmental management
Port of Rotterdam	Mr Backers	Business Developer Liquid Bulk Cargo
LTO	Mr Kager	Policy Advisor “Biobased Economy and Biofuels”
Oxfam Novib	Mr Bennekom	Policy Advisor “Biofuels”
Commission Corbey	Mr Boot	Member of Commission Corbey
VVD – Governmental Party	Mr Dijkstra	Member of the Second Chamber – “Dossier Klimaat en Milieu”
Ministry of Economic Affairs	Mrs Weustink	Director of project group “Biobased economy”

Source: Self-constructed