CENTRAL EUROPEAN UNIVERSITY

Study of the different strategies implemented by Ethanol Europe Renewable ltd in order to strive in the European fast-changing political framework

A thesis submitted to the Department of Environmental Sciences and Policy of Central European University in part fulfilment of the Degree of Master of Science

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Author's declaration

No portion of the work referred to in this thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Bruno Deremince

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Road transportation is still today largely dependent on fossil fuels, and has grown to become one of the sector releasing the most GHG emissions in the EU. There are only a few alternatives to decarbonise transport, of which biofuels is the only available on the market today. Biofuels production has been stimulated in the EU starting in 2003 with the biofuels directive and minimum quotas. However the political framework rapidly changed and imposed maximum targets for conventional biofuels with the CEP (Climate and Energy Package) amendments in 2012 and the ILUC (Indirect Land Use Change) directive in 2015. These caps include all conventional biofuels in an undifferentiated manner, which is in direct contrast of their extremely variable economic and environmental performances. Conventional biofuels producers have been largely impacted by this political shift. This thesis analyses the impact of EU policies on Ethanol Europe, one of the largest producer of renewable ethanol in Europe. It then identifies and analyses the different strategies implemented by Ethanol Europe and contextualises them within the biofuel debate via interviews of Ethanol Europe's representatives, EU policy-makers and representatives of environmental NGOS active at the EU level.

This work identifies two main strategies implemented by Ethanol Europe: lobbying activities in Brussels, and research & development. Concerning lobbying activities, five arguments in favour of bioethanol are identified and then confronted with the opinions of policy-makers and eNGO. The unknowns and complexities of implementing a more efficient policy framework are then addressed. Concerning research and development, identified activities include the valorisation of existing by-products in ethanol production, the conquest of new sectors other than biofuels (bioplastics, pharmaceutics) as well as the development of advanced biofuels. The strategy adopted by Ethanol Europe is then discussed in relation with different elements of the biofuel debate such as the complexity of science concerning biofuels, public image of the industry, timing of future legislation and predictions, and relation with other industries. This thesis concludes that the current political framework threatens Ethanol Europe and the bioethanol industry, and that this is the result of a shared responsibility between policy-makers (not able to protect biofuels with great environmental performance), NGO (delivering oversimplified messages) and the bioethanol industry (shares interests with the BD industry and is not willing to differentiate itself from it). Other threats identified include the scarcity of diesel in Europe and global competition. Ethanol Europe in particular is threatened by the inherent variability of its technological development, which might prove unsuccessful. This work identifies the carbon intensity approach as a potential fix for the current political framework, but estimates it as unlikely because of the political difficulties it creates, the lack of coordination between bioethanol producers, and the complexity of the biofuel debate.

Keywords: biofuels, bioethanol, renewable fuel, Ethanol Europe, Pannonia Ethanol, policy, lobbying activities, technological patents

Contents

List of Abbreviations

CAP .... Common Agricultural Policy

CEP .... Climate and Energy Package (includes the RED and FQD)

CoEC .... Commission of the European Communities

DDGS .... Distillers Dried Grains with Solubles

DG .... Directorate General (of the EU)

EE .... Ethanol Europe Renewable ltd

EEB .... European Environmental Bureau (eNGO)

eNGO .... Environmental Non-governmental Organization

EU .... European Union

FQD .... Fuel Quality Directive (2009/30/EC)

GHG .... GreenHouse Gas

ILUC .... Indirect Land Use Change

MEP .... Member of the (European) Parliament

PE .... Pannonia Ethanol

RED .... Renewable Energy Directive (2009/28/EC)

T&E .... Transport & Environment (eNGO)

UNEP .... United Nations Environment Programme

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Chapter 1

Introduction

1.1 Background

'Biofuels' is a generic term that refers to 'gas and liquid fuels produced from biomass that can be used in combustion engines' (Demirbas 2008). Biofuels have been considered as a suitable fuel for cars since a long time in Europe: peanut oil for example was used in late XVIII by Rudolf Diesel in order to run his new engine, while Henry Ford used ethanol to run its model T (Ackrill and Kay 2014). However biofuels were abandoned due to the abundance of cheap fossil fuels, starting in the 1960s. Since then, the use of biofuels in Europe has been informally re-introduced in 1992 in a CAP directive (the Council of European Communities 1992), and their production truly started in 2003 after the introduction of the biofuel directive (EU 2003). Biofuels were at that moment considered a prominent mean in order to help Europe to reach its climatic goals in the 2009 Climate and Energy package (EU 2009a; EU 2009b).

Since then however, the political framework rapidly changed: major amendments to the Climate and Energy package emerged in 2012, imposing an undifferentiated cap of 5% on all food-based biofuels (including bioethanol and biodiesel) (EU 2009a). Those amendments were formulated to avoid two potential consequences related to food-based biofuels production: the first one is the influence those biofuels might have on food prices, known as the

'the food vs fuel' debate. Because of the correlation between the start of biofuel production (the Climate and Energy package was formulated in 2009) and the food crisis of 2008-2009 and its rapidly raising food prices, the impact of biofuel on feedstock prices was considered significant by many (Nikos 2008; Alavi Hojjat 2009). Even if now the impact is considered marginal by the EU (a few percent, (EC 2012)), the food crisis made the issue politically sensitive and highly controversial. The second consequence is related to the compensating effect of reallocating arable lands in Europe from food to biofuel production. This phenomenon creates an incentive for farmers to compensate for this lack of food on the global market by using new lands to produce food. This effect is happening mainly in third countries with lower environmental standards, which often results in deforestation (Defossez et al. 2014). This effect is known as 'Indirect Land Use Change', or ILUC.

The influence of biofuel production on food prices and the ILUC effect both lead to the so-called ILUC directive in 2015, which set a cap of 7% on conventional biofuel production within the 10% target of renewable energy in the transportation sector, which Member States are free to restrict even further (EU 2015). In 12 years biofuels have thus gone from a promising tool to decarbonise transport to a technology with huge potential risks that needs to evolve in order to not be phased-out in the near future. Such a quick political shift has had devastating consequences on the European biofuel industries: since 2012 the sector is showing little to no sign of new investments (Sievers 2016). Even though the European Commission is strongly promoting the development of advanced biofuels, which are less prone to influencing food prices and provoke ILUC, it did not introduce mandatory targets for advanced biofuels as a share in the energy used for transportation in Europe yet. The European biofuel industry is thus paralysed by the uncertainty about whether or not there will be a market for biofuels and advanced biofuels after 2020 (Reng 2016).

1.2 Aims and objectives

This thesis focuses on Ethanol Europe Renewable ltd, a major bioethanol industry based in Hungary. It aims to answer the following question:

> *How does the bioethanol-producer Ethanol Europe Renewable ltd (referred to later as 'Ethanol Europe') adapt to the quickly changing regulatory framework in Europe in order to strive in the future?*

This research question involves many objectives, listed below:

- a thorough review of the political evolution in Europe concerning biofuels, starting in 1985;
- the identification of the main drivers of the political change in Europe concerning conventional biofuels and advanced biofuels;
- an analysis of the impact of the political change on Ethanol Europe and its development;
- the identification and analysis of the different strategies implemented by Ethanol Europe in reaction to the new legislative framework;
- the contextualisation of Ethanol Europe's strategies within the biofuel debate.

Many studies and books analysed the European political evolution concerning biofuels, some of them are used in this thesis such as (Ackrill and Kay 2014; Domingos Padula et al. 2014; Demirbas 2008; Kutas et al. 2007). However there is little research on the practical incidence that such a quick political change has had on specific industries. Furthermore no academic study concerning Ethanol Europe and its adaptations strategies has been conducted yet. This thesis aims to fill that gap.

The study of practical consequences of political changes is crucial in the European biofuels market. Indeed transportation in Europe is the only sector which saw its GHG emissions rise during last years: GHG emissions increased by 36% between 1990 and 2007, while GHG emissions from other sectors decreased by 15% during the same period (EC 2016). Given that biofuels and especially bioethanol can provide significant GHG emissions reduction compared to their fossil equivalent, biofuels could therefore bioethanol a suitable option to decarbonise transport in the short and mid-term. This is especially true since biofuels can be used in internal combustion engines, which are by far predominant today compared to the alternatives such as electric engines (Domingos Padula et al. 2014). Failing to seriously consider options such as bioethanol to decrease emissions originating from transport might threaten the EU's ability to reach its climatic objectives. A thorough understanding of the practical consequences of past political actions on specific industry such as Ethanol Europe is thus crucial to improve our understanding and create a more efficient political framework in the future. This is especially true today, as the revision of the Renewable Energy Directive (RED) is expected later this year (2016). This revision is expected to clarify the EU opinion towards conventional and advanced biofuels, via the creation or the absence of mandatory goals for advanced and conventional biofuels for the horizon 2030.

1.3 Structure outline

In order to achieve the aim of this thesis as well as its different objectives, this work is structured in the following way.

A literature review is conducted in chapter two. The literature review starts with a short review of the technical specificities between the different types of biofuels, crucial to understand the thesis development (a special focus on bioethanol is also provided). In order to contextualise and understand the reaction of Ethanol Europe towards the changing political framework, the chapter continues with a thorough review of the political evolution concerning biofuels, including the concerns expressed about incidence on industries if any. A summary of the political evolution in Europe concerning biofuels policy and a description of the current state of the policy framework are included at the end of the chapter to facilitate reading and understanding.

Based on the literature review, the chapter three outlines the methods used during this work to gather data and carry out the analysis. Connections to the literature review and the thesis' aim and objectives are drawn in order to highlight how the latter will bioethanol reached. The chapter also highlights the study's limitations.

The results section (chapter four) is based on data gathered in the field (see the methodology section for more details). It aims to analyse the data and link it to the literature review, in order to achieve the thesis' aim and objectives. It starts with a short background section about Ethanol Europe's situation, and then continues with the story of Ethanol Europe and its reaction towards the political changes. It then identifies and analyses the strategies implemented by Ethanol Europe in order to adapt for the future. The analysis is based on a thorough literature review as well as on the confrontation between Ethanol Europe's opinion with EU policy-makers and eNGOs' opinion. Those points of view external from the firm help to analyse the influence of Ethanol Europe on the European policy evolution and help to get practical insights about the bigger forces at play in the biofuel sector.

Based on both the literature review and the results section, the discussion (chapter five) section aims to discuss the current position of Ethanol Europe, as well as its potential future. In order to achieve that goal, the chapter discusses different major elements of the biofuel debate, their interactions with Ethanol Europe and the bioethanol industry in general. The final chapter (chapter six) identifies key findings and draws conclusions of the work, in relation to the thesis' aim and objectives.

Chapter 2

Literature review

In order to understand the different strategies put in place by Ethanol Europe to adapt to the rapidly changing EU political framework, it is crucial to understand the evolution of the political framework first. This literature review starts with identifying the three main political drivers of biofuel policies (and their relative importance within the EU), and then focuses on the political framework evolution when it comes to biofuels in the EU, starting in 1986 until today. As this thesis focuses practical consequences from political change on a single company (Ethanol Europe), concerns about potential economic incidence formulated by the policy-makers in the different documents are included if any.

As the issues concerning biofuels include technical specificities which are crucial to understand the political evolution, a short introduction about biofuels and the technical differences existing between the different kinds and generations of biofuels is provided. An extensive review of specific environmental issues such indirect land use change (ILUC) and the food vs fuel debate, central in the biofuel political debate (as highlighted in the introduction), is provided as well.

2.1 What are biofuels

Biofuels can be defined as 'fuels extracted or fermented from organic matter' (Ackrill and Kay 2014), or 'liquid or gaseous fuel for transport produced from biomass' (EU 2003). Biofuels include a large range of products, from biodiesel to bioalcohol, biochar, synthetic oils, biohydrogen and biogas (Liew, Hassim, and Ng 2014). While biofuels include a wide range of different products, the two dominant ones today are bioethanol and biodiesel.

Ethanol and biodiesel have similar chemical properties, but ethanol is derived from sugars, while biodiesel originates from oil (Fazal, Haseeb, and Masjuki 2011). Ethanol production in the world is dominated by the US and Brazil, produced respectively from corn and sugarcane. In comparison Europe is a rather small market for ethanol, where it is produced from corn and beetroot (see figure 2.1). Ethanol is typically blended with petrol and sold as such: a mix 10% ethanol with 90% petrol for example is called 'E10', and is already widely available in France, Germany, and some Nordic countries (Ethanol Nu 2016).

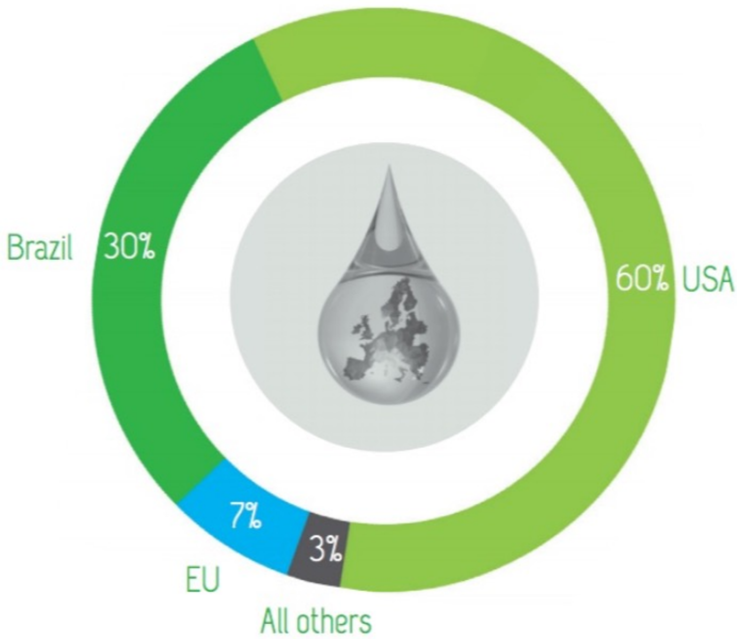

Figure 2.1: Share of global renewable ethanol production in 2014 (ePURE 2015)

Biofuels are usually divided into first generation and advanced biofuels. The differences explaining this classification is the feedstocks used in the process (whether it is suitable for human or animal food or not) as well as the process itself.

First generation biofuels are commonly referred to as 'conventional biofuels'. In Europe conventional biofuels are derived from feedstocks such as corn or sugarbeet which can be consumed directly by human (sugar from the beets, corn syrup) or indirectly through animal feed. The key feature here is that all those feedstocks need to be cultivated on lands (Domingos Padula et al. 2014; Demirbas 2008).

Advanced biofuels are also split into different generation, namely the second and the third. Second generation biofuels are derived from lignocellulosic biomass like for example non-edible part of plants (leaves or the husks of corn) or forestry wastes (Domingos Padula et al. 2014). Those feedstocks are cheap and largely available compared to food crops (Koçar and Civaş 2013). Such biofuels also don't directly compete with food production. Second generation biofuels are thus not part of the controversial food vs fuel issue (see below) (Liew, Hassim, and Ng 2014). However those feedstocks display very different physical and chemical composition and are relatively hard to break down compared to feedstocks for conventional biofuels and need to be pre-treated (Liew, Hassim, and Ng 2014; Agbor et al. 2011). This additional step increases the production costs. An exception in second generation biofuels is the use of certain type of grasses, which compete for lands with food production.

Defining third generation biofuels is more difficult, as it includes many different kinds of processes and end-products. Much has been written about algae which can convert solar energy to chemical energy (in the form of oil) in a very efficient way using the photosynthesis process (Kasturi Dutta 2014; Naik et al. 2010). A major difference with second generation biofuels is that third generation biofuels don't require the bioconversion of conventional feedstock to biofuels (Kasturi Dutta 2014). Third generation biofuels are derived from altered feedstocks which have been adapted to improve bioconversion, namely energy crops.

A fourth generation of biofuels can also sometimes be considered by some studies. Such technologies are based on ideal feedstocks able to produce a negative carbon balance. The technology developments aim to produce crops with a high carbon storage capacity, and to capture and store the carbon released during the process (Carbon Capture and Storage technology, aka CCS) (Ackrill and Kay 2014). CCS is a key feature for delivering negative carbon balance. It is however important to notice that such technologies hardly exist on paper for now. Fourth generation biofuels are thus not considered in this work.

2.1.1 Renewable Ethanol

Ethanol, or ethyl-alcohol (C_2H_5OH), is a colourless, volatile and flammable liquid with an alcoholic content ranging from 80 to 99.9% (ePURE 2016). Ethanol can be qualified as renewable when it is issued from processed crops and organic material (ePURE 2016). Ethanol is a commodity, so an economic good with no qualitative differentiation on a given market. The main indicator to evaluate its value on a daily basis is the Platts index (the evolution of ethanol's price can be observed in Appendix C).

The process for producing bioethanol is complex and include many different steps: in the case of Ethanol Europe, bioethanol is produced from corn exclusively grown in Hungary (PE 2015c). When the crops are harvested, the maize is brought to the biorefinery, then corn grains are separated from the rest of the plant: they are then cooked and liquefied in order to be fermented (PE 2015b). The yeast used in the fermentation process releases pure CO_2, and the solution obtained after fermentation is distilled to obtain a solution highly rich in ethanol. The industrial process is then separated in two sections: part of the solution will go through a molecular sieve, in order to produce ethanol at the purity needed for to export for the market. The other part of the solution is centrifuged in order to separate the solids lefts in the solution, which will become the Distiller's dried grains with solubles (DDGS). The liquid will be concentrated in an evaporator to create distillers corn oil (DCO) (PE 2015b). The input and outputs of the process are schematised in figure 2.2. The ethanol production process of Pannonia Ethanol is ISO 9001 and 14001 certified. It is also part of the voluntary biofuels sustainability certification scheme (Bühg) and the GMP+ feed safety assurance scheme (PE 2016b).

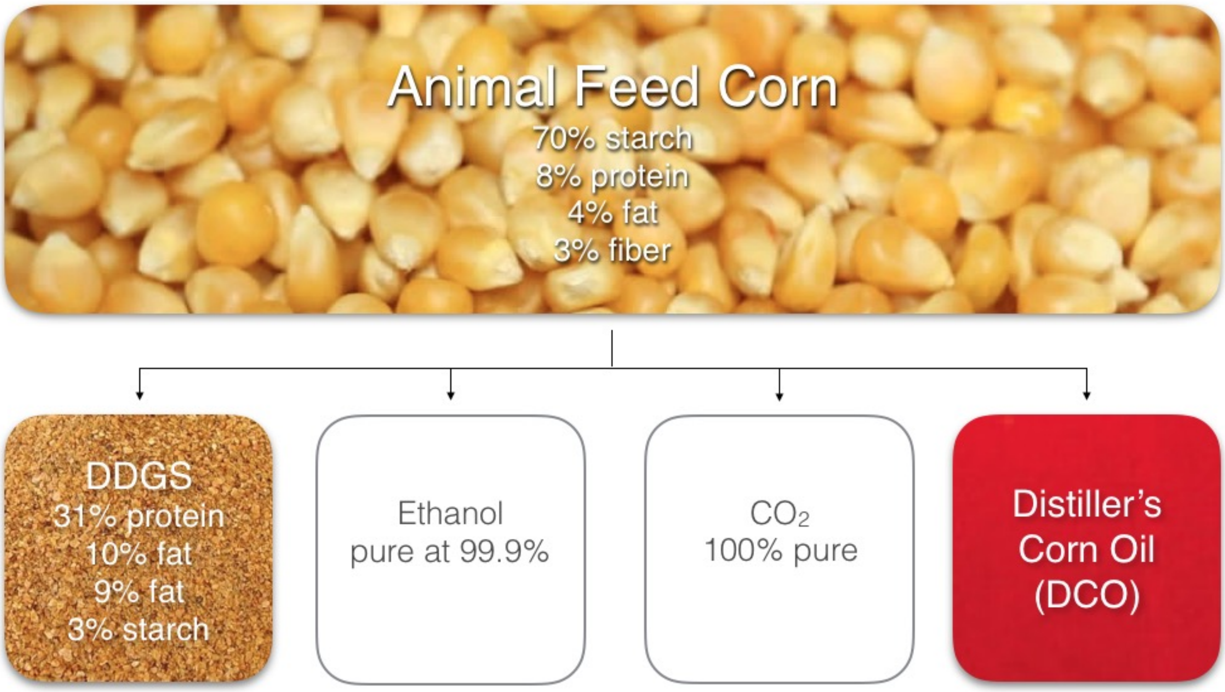

Figure 2.2: Illustration of the industrial process of Pannonia Ethanol (data from (Sievers 2016; PE 2016b))

Ethanol can be used in a multitude of way such as in the beverages and industrial sector. In the transportation sector, it can be used as a renewable fuel. It is then usually blended with gasoline: E5 for example is a mixture of 5% of ethanol and 95% of petrol. This is the option mainly considered in this work and largely preferred on the market (see figure 2.3).

2.2 The policy background

2.2.1 The main policy drivers

Before exploring the lobbying activities and commercial strategies of Ethanol Europe, it is important to understand the different drivers that stimulated the political evolution in Europe concerning biofuel production. Three main factors are widely recognised in the literature as the drivers for the development of biofuel policies in the world: energy security, rural development and environmental preservation (Ackrill and Kay 2014; FAO 2008; Kutas

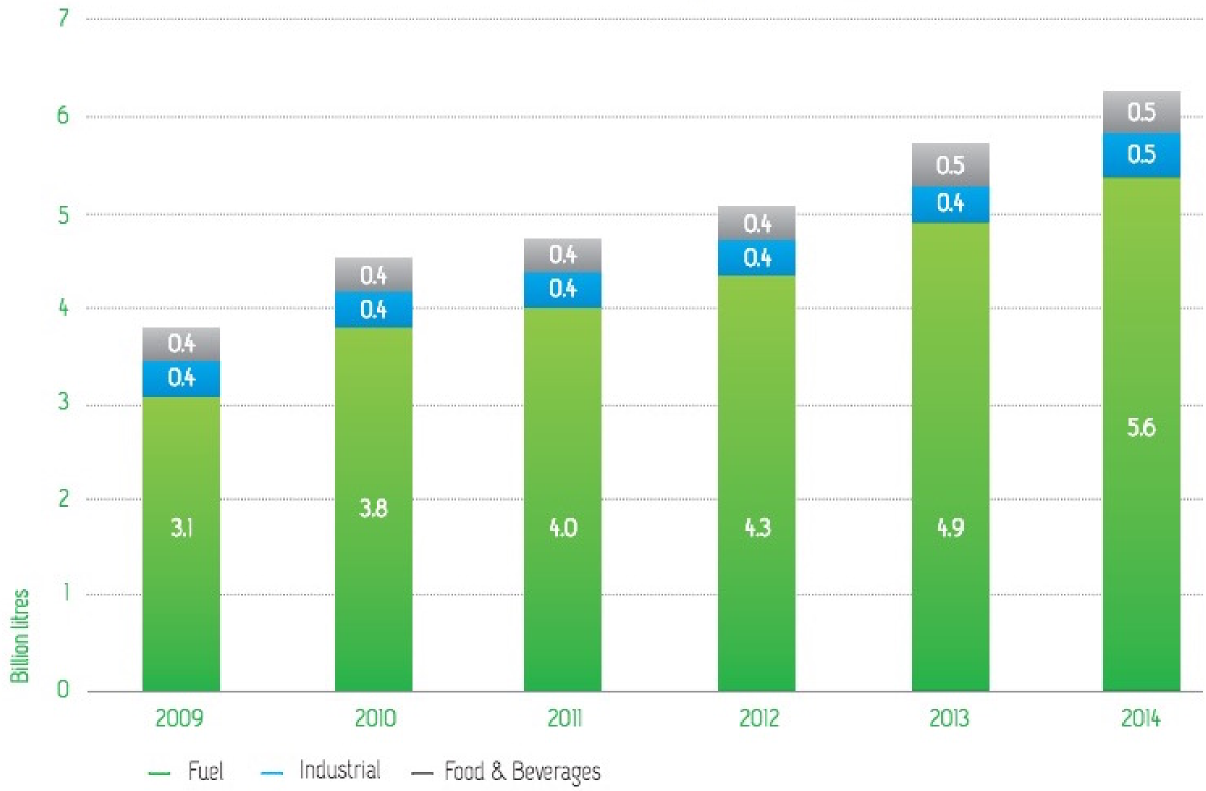

Figure 2.3: EU renewable ethanol production by end-use (ePURE 2015)

et al. 2007). Other minor drivers can also be distinguished such as agricultural development (distinct from the rural development), technological progress and other economic concerns such as the unknowns around the interactions between food and biofuel prices (the famous food vs fuel debate) and biofuel competitiveness (IEA 2010).

2.2.1.1 Energy security

Road transport in Europe still depends today on fossil fuels for 96% of its energy need today (EU 2016; EEA 2016), making the transportation field one of the major GHG emitter sector of the European Union (see figure 2.4). However fossil fuels such as diesel need to be imported in the EU, decreasing the energy security of supply. Given that biofuels are produced and consumed locally, developing biofuels in order to substitute for oil in the transportation sector (as illustrated on figure 2.3) might thus fix the situation. In Europe, officials also stress the diversification of type of transport fuel, as it provokes a diversification of source countries as well and thus entail the security of supply (Ackrill and Kay 2014). Please notice that while Europe imports diesel, it is also a net exporter of petrol, a situation known as the 'EU diesel deficit'. The EU diesel deficit is a crucial element in the analysis of the bioethanol situation in Europe, as developed in the results and discussion section.

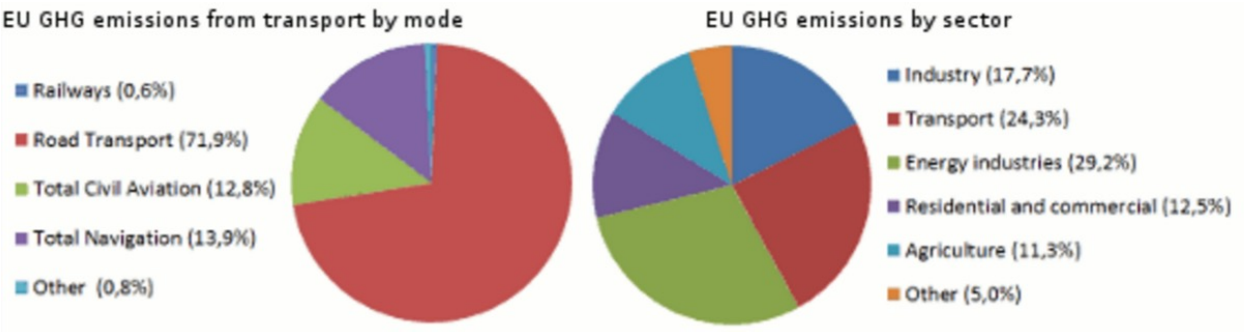

Figure 2.4: EU28 greenhouse gas emissions by sector and mode of transport in 2012 (EC 2016)

2.2.1.2 Rural development

As a renewable energy, biofuel production is a part of the development of a new and decentralised way of energy production. Biofuel crops such as first and second generation biofuels are land-based and needed all year long for biofuel production, constituting guaranteed outcomes for farmers in the form of cash crops'. In addition, biorefineries are created where biofuels crops are grown, creating jobs in those rural areas. It was indeed estimated that for the same energy output, the biofuel industry requires 100 times more labour than the fossil fuel industry, more capital-intensive (Domingos Padula et al. 2014). This is mainly related to the variety of jobs needed in the biofuel industry. Biofuel production is thus a major incentive for rural development. Notice that according to the Organisation for Economic Cooperation and Development (OECD) Nomenclature of Territorial Units for Statistics (NUTS), a region is predominantly rural if the share of population living in a zone with a density below 150 inhabitants per km^2 is above 50% (Eurostat 2015).

2.2.1.3 Environmental preservation

Biofuels are thought to substitute fossil fuels, cut GHG emissions and tackle climate change. But surprisingly not all biofuels produce less GHG than their fossil fuel equivalent, and those who do might see their emissions vary in time. From all three biofuel policy drivers, the environmental one is thus considered as the more ambiguous and controversial in the literature (Ackrill and Kay 2014; Domingos Padula et al. 2014).

There are three main reasons explaining why GHG emissions from biofuels are so hard to accurately define. The first one is due to the large variety of technological pathways, potential feedstocks and type of biofuels (as illustrated above). The second one is the constant enhancement of the industrial processes used. The third one is different environmental consequences biofuel production can provoke, such as land-use change. Land-use change is a very controversial aspect of biofuel. It comes in two aspects: direct and indirect, the latter being the most controversial. Direct land-use change, or DLUC, is defined by the European Commission as a change of land-use according to the IPCC classification (grassland, wetlands, forest-land, cropland, other) plus a category for perennial crops (Ackrill and Kay 2014). Notice that land-use change doesn't include crop-use change, meaning that if a European farmer growing wheat for food decides to switch and grow wheat for biofuels, it is not considered a DLUC in the European classification.

2.2.1.3.1 indirect land use change indirect land use change, or ILUC, is a thorny subject for academics and policy-makers especially in Europe, where its controversial aspect was so strong that it influenced policy makers (Ackrill and Kay 2014). Indeed ILUC is not specifically addressed in the US or Brazil. ILUC is best described as an example: if a significant group of European farmers decide to switch from food to energy crop production, it might create a shortage of food on the market, increasing the food prices. Farmers somewhere else in Europe might thus be tempted to clear new areas like forest or pastures to produce food, following this new economic incentive. In this case EU biofuels policy would have a direct effect on land-use change, but also an indirect land use change somewhere else in Europe. As food markets are globalised, ILUC might even be provoked anywhere in the world due to economic incentives originating form Europe. Biofuels production might thus create economic incentives for deforestation in countries with more flexible environmental legislation like Indonesia or Malaysia, antagonising de facto green political parties and environmental NGOs across Europe as illustrated in 'the little book of Biofuels' (Defossez et al. 2014).

ILUC is thus challenging in many ways: indeed establishing a clear and direct causality between an economic incentive and its practical consequences is more than challenging, let alone the potential distance between the two occurrences. Many external factors like droughts, flooding or wars in foreign countries can strongly influence the prices of the food market as well, making any causality link unprovable. However, ILUC is crucial in the sense that if the newly cleared areas were storing carbon (like forest or peatlands), then the release of carbon from the soil has to be accounted in order to reduce the carbon intensity of fuels used in Europe effectively.

Given that ILUC is an economic phenomenon, it is quantified through economic models focusing on price transmission effects between food, biofuels and land markets. But there is no established methodology to quantify ILUC, contrary to DLUC (as explained above). As a result the study of ILUC is based on assumptions on key economic linkages, and thus always up for debate as no scientific certainty can be reached. This difficulty crystallised the opposition to biofuels and thus provoked a strong polarisation of the debate between pro and opponents to biofuels (Ackrill and Kay 2014).

For the different reasons outlined above, the results of the different studies about biofuels GHG emissions greatly vary in the literature. In the European framework, ILUC was formalised by the European Union in order to amend the Renewable Energy Directive (see below) three years after it was filed. One of the figure of the impact assessment backing up the amendment can be seen below (figure 2.5). As seen on the figure, the European Commission estimated the GHG savings of for example corn bioethanol above 50% in 2012. UNEP estimated them between -5% (more pollutant than its fossil equivalent) and 60% in 2009 (UNEP's figure can be seen in appendix A). GHG savings from sugarcane bioethanol, widely produced in Brazil, is estimated around 60% by the European Commission in 2012,

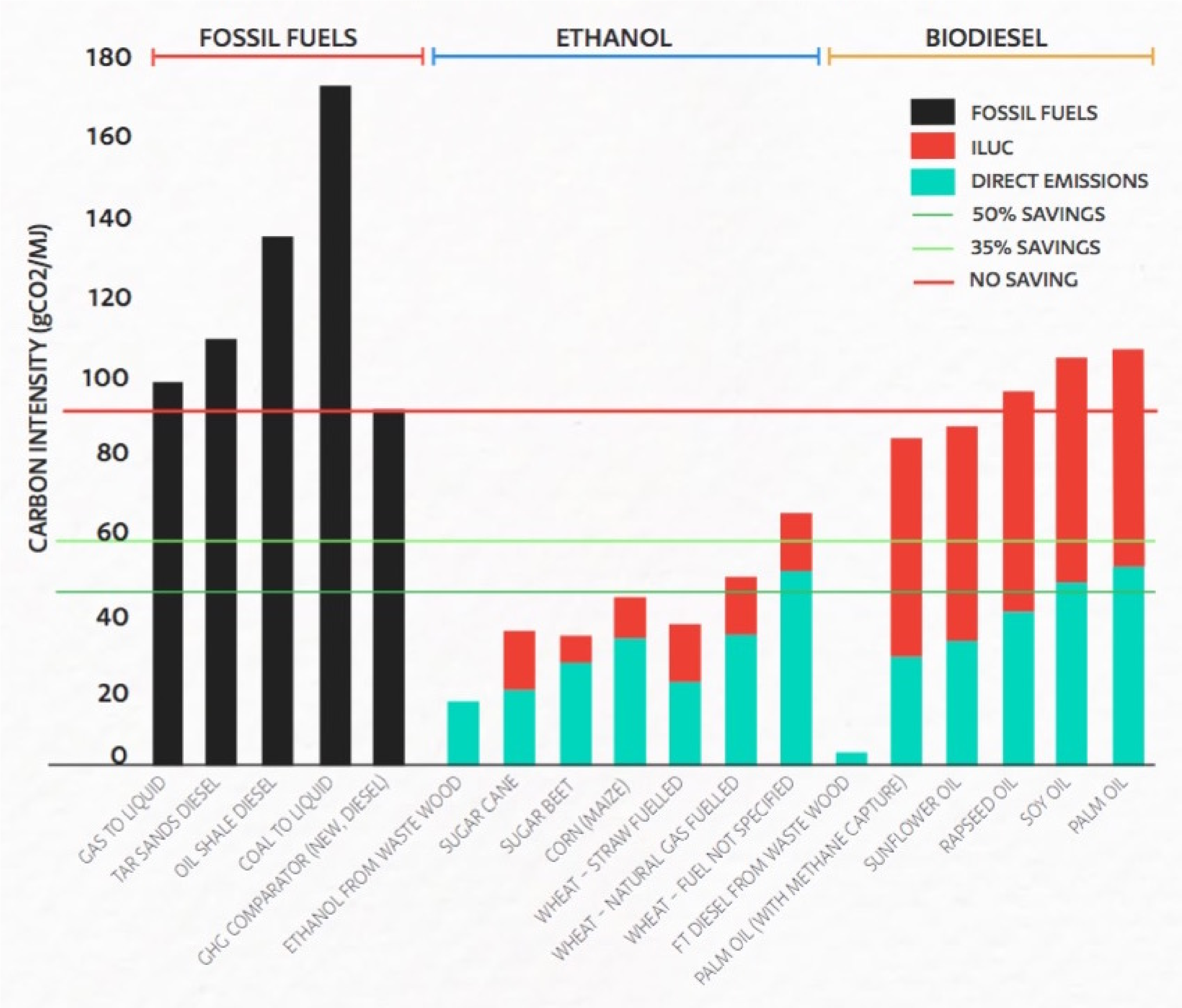

Figure 2.5: Impact Assessment accompanying the ILUC proposal (Defossez et al. 2014)

and from 70 to 143% by UNEP in 2009. It is also interesting to notice that ILUC is very variable within a group of biofuel (for example first generation biofuels, which includes bioethanol and biodiesel), in addition of being variable between the different studies and models, such as illustrated on figure 2.5. This high variability makes drawing conclusions difficult, and fosters oversimplification.

2.2.1.4 the food vs fuel debate

The food vs fuel debate is hard to classify: it is intrinsically economic, but it also has strong environmental and political implications. As we saw, biofuel production (and especially conventional biofuels) involves land use and thus directly competes with food production.

This triggers DLUC and ILUC, the latter being especially controversial in terms of negative externalities for the environment.

However, it is challenging to directly link biofuel production to food prices evolution (Ackrill and Kay 2014; Domingos Padula et al. 2014). Indeed the food and energy sector were already tied long before biofuels were produced through for example fertilisers and mechanical traction. As the energy market is much larger than the agricultural one, a small change in energy prices usually involves a large change in agricultural feedstocks demand (FAO 2008). Increasing crude oil prices will thus drive up food prices, whether biofuels are involved or not. The rise of biofuels only ties the energy and food sector more closely together.

Still, the link between food and biofuel prices is not always as straightforward as explained above. The biofuels production process usually creates different by-products as well, which can be transformed to bioethanol used as animal feed. Leftover from ethanol production such as corn residues for example can be dried and sold as Distillers Dried Grains with Solubles (DDGS) (Stein 2007). This massive by-products of ethanol production decreases significantly the prices of animal feed on the market, undermining the relevance of the food vs fuel argument.

But in the same way that the considerable variation within biofuels production (technological pathways, potential feedstocks) and biofuels themselves obstructs an accurate description of their GHG emissions, those variations also harden an assessment of their economic competitiveness. The economic sector in itself is very variable: fossil fuel prices have been very volatile in the last decade, as a result of geopolitical instabilities and other economic factors. A comparison between biofuels prices and their fossil equivalent in order to evaluate biofuels competitiveness will thus need to be constantly updated to keep its relevance.

2.2.2 The European political evolution concerning biofuels

The EU was created in 1986 with the Single European Act and the creation of a unified market with a strong identity, even if the common market for coal and steel (ECSC) and the European Economic Community (EEC) existed already respectively in 1951 and 1958. The European Union is rapidly growing and seen by many as a major actor on the global stage. The development of Green Parties in the nineties (Green Parties were part of 11 out of 15 national parliaments in the late nineties) and environmental policy in different State led Europe to take the lead for environment preservation and climate change tackling (Kelemen 2010).

The first major environmental discussion to which the European Union took part as a whole was the United Nations Conference on Environment and Development, more widely known as the Rio summit, in 1992 (Kelemen 2010). The summit led to the creation of the United Nations Framework Convention on Climate Change (UNFCCC) as well as to the Kyoto protocol (enforced in 2005), for which the European Union made the most ambitious plea of GHG emissions cutting of all developed countries. Ambitions climatic targets were also renewed during the Paris agreement in 2015 (EC 2015a).

The political drivers identified above can be identified for every major biofuel producer (Europe, the US and Brazil), but their relative importance may vary over time. In Europe, the environmental driver and the desire to tackle climate change was the strongest influence explaining the development of biofuels policies, far ahead energy security and rural development (Ackrill and Kay 2014).

2.2.2.1 The emergence of biofuels policy in Europe

As explained in the introduction, biofuels were widely used in the XIXth century but were abandoned due to the abundance of cheap fossil fuels starting in the 1960s (Ackrill and Kay 2014). The first European policy concerning biofuels (without citing them) was filed in 1985 by the Council of European Communities (CEC). Indeed the directive 85/536/EEC specifically addresses the need for 'crude-oil savings through the use of substitute fuel components in petrol' in order to reach 'a continuous and balanced expansion and an increase in stability'. Those substitute should be produced from 'raw materials other than crude oil' that can be blended with petrol with 'only minor modifications to existing (...) systems'. This directive thus directly aims for energy security ('broadening the raw materials base for the production of fuels') without expressing any concerns about rural and environmental issues (the Council of European Communities 1985).

However, biofuels production really began in the nineties, with an emphasis on biodiesel (a substitute for diesel) given that the EU imported diesel and exported gasoline (which can be substituted by ethanol), which is known as the EU diesel deficit. The first legislation in favour of biofuel at the European level was filed by the Common Agricultural Policy (CAP), and were not biodiesel-specific (Kutas et al. 2007). Indeed in 1992 the CAP introduced the obligation to set aside at least 15% of the areas dedicated to conventional agricultural commodities (oilseeds and cereals) to avoid agricultural surpluses that were hard to export. However on those lands farmers could grow non-food crops such as oilseed rape, which can easily be used to produce biodiesel (Kutas et al. 2007). In 1992 a new directive (92/81/EEC) allowed Member States to 'apply total or partial exemptions or (fiscal) reductions' in the field of 'more environmentally-friendly products and in particular in relation to fuels from renewable resources' (the Council of European Communities 1992).

A proposal about motor fuels from agricultural sources is passed in 1994. The main focus is to limit 'harmful emissions' when 'fuels produced from renewable agricultural sources have been identified in general as beneficial to the environment'. The directive also identifies the ability of biofuels to 'create new demand for agricultural products' and 'reduce unemployment' (the Council of European Communities 1994). The focus of the directive has thus shifted from energy security to environmental and rural development issues.

The White Paper called 'An Energy Policy for the European Union' identifies in 1995 all three political drivers: it is considered that 'an increased share of renewables in the

Community's energy balance would make a contribution to both its security of supply and environmental protection'. The Commission also estimates that renewables could 'play a role in reinforcing economic and social cohesion in the Community', and also that 'Rural areas could also play an important role in the production of energy based on biofuels and could thereby make an important contribution not only to the achievement of energy objectives, but also to their own economic viability', hence highlighting the potential rural development associated with biofuels (CoEC 1995). During the same year the introduction of two countries with strong environmental legislation (Finland and Sweden) in the European Union tilted the European politics even more in favour of environmental issues. During the nineties the development of biodiesel standards by the industry also helped to secure the supply and stabilise the market (Kutas et al. 2007).

The European Commission discussed in 1997 the different options available to progress towards the target that would be proposed during the Kyoto climate negotiations via a key report called 'Energy for the Future: Renewable Sources of Energy'. It is indicated that a 'significant increase of biofuel in transport fuel use by 2010' is an important element for 'achieving the overall Union objective'. It is noted that this objective should be accomplished 'whatever the precise outcome of the Kyoto Conference' (EC 1997). Given that the paper was drafted before the Kyoto negotiations, environmental and climatic concerns are the key drivers of this text. However references are made to rural development and energy security as well. The European Union ended proposing a cut of 8% of its GHG emissions in Kyoto, the most ambitious savings within developed countries.

Prior to the Gothenburg summit in May 2001, the Commission of the European Communities acknowledges in a proposal that in order to achieve sustainable development, 'economic growth, social cohesion and environmental protection must go hand in hand'. More specifically to biofuels, the document states that 'Alternative fuels, including biofuels, should account for at least 7% of fuel consumption of cars and trucks by 2010, and at least 20% by 2020'. It is also specified in the same paragraph that 'The Commission will make a proposal in 2001 for adoption in 2002' (CoEC 2001b).

The next proposal was made by the Commission the same year in November. In the introduction it is mentioned that 'the objective of 20% substitution by alternative fuels in the road transport sector by the year 2020 (has) the dual purpose of improving security of supply and reducing greenhouse gas emissions'. Rural development is assessed as well: 'the production of raw materials for biofuels would help to create new sources of income and to maintain employment in rural areas'. Three alternative fuels are identified, namely biofuels, natural gas and hydrogen (in this order). Within biofuels, biodiesel and bioethanol are firstly identified. Cooking oils and other alternatives such as biomethanol are also mentioned (CoEC 2001a).

2.2.2.2 The biofuels directive (2003/30/EC)

The first legislation targeting specifically biofuels was reached in 2003 with the so-called Biofuels Directive (2003/30/EC). This directive can be considered as the formal starting point of biofuels policy at the European level, even if biofuels policy were already formalised at the national level by some Member States like Germany or the UK prior to 2003 (Ackrill and Kay 2014). In a general manner, as we have seen, biofuels have been considered for a long time within broader agendas like the environment.

All three pillars that stimulated biofuel policies in the past can be found in the Biofuels Directive. Indeed the article 1 of the directive 'aims at promoting the use of biofuels or other renewable fuels to replace diesel or petrol for transport purposes in each Member State, with a view to contributing to objectives such as meeting climate change commitments, environmentally friendly security of supply and promoting renewable energy sources' (EU 2003).

Environmental concerns is the most assessed pillar: it is thought by the European Commission that 'CO_2 emissions from transport (will) rise by 50% between 1990 and 2010'. Therefore, a 'greater use of biofuels for transport forms a part of the package of measures needed to comply with the Kyoto Protocol' given that 'most vehicles currently in circulation in the European Union are capable of using a low biofuel blend without any problem'. The European Union also acknowledges the 'wide range of biomass that could be used to produce biofuels, deriving from agricultural and forestry products, as well as from residues and waste from forestry and the forestry and agrifoodstuffs industry', highlighting the environmental benefits of second generation biofuels without naming them (EU 2003).

The energy security issues are also addressed: the European Commission acknowledges that the 'increased use of biofuels for transport (...) is one of the tools by which the Community can reduce its dependence on imported energy and (...) influence the security of energy supply in the medium and long term'. Rural development is only assessed once in the directive. The directive explicitly says that 'promoting the use of biofuels (...) could create new opportunities for sustainable rural development in a more market-orientated common agriculture policy' (EU 2003).

The European Union also expresses doubts about the economic viability of biofuels compared to environmental and security benefits. The article 3 explicitly states that 'Member States should (...) give priority to the promotion of those fuels showing a very good cost-effective environmental balance, while also taking into account competitiveness and security of supply'. It is also noted in the directive that 'Alternative fuels will only be able to achieve market penetration if they are widely available and competitive' (EU 2003).

It is interesting to compare the biofuels directive with the amended proposal that led to its creation. The concerns expressed a few months before the proposal were mainly focusing on environmental concerns around biofuels. Additions that found their way to the directive includes paragraph 24, which states that 'Research and technological development in the field of the sustainability of biofuels should be promoted'. Paragraph 25 was also added, stating that 'An increase in the use of biofuels should be accompanied by a detailed analysis of the environmental, economic and social impact in order to decide whether it is advisable to increase the proportion of biofuels in relation to conventional fuels' (EU 2003). More importantly, some paragraphs of text from the amended proposal didn't find their way to the directive. One of them was trying to enforce 'a set of clear environmental criteria for the production of liquid biofuels' in order to 'to ensure sustainable farming practices' (EU 2003). Thus even the growing environmental concerns didn't allow the premise of the sustainability criteria (see below) to be accepted in 2003.

The Commission thus proposed indicative (non binding) targets of 2% in 2005 and e. Moreover Member States are obliged to report annually on 'the measures taken to promote the use of biofuels (...) for transport purposes', 'the national resources allocated to the production of biomass for energy uses other than transport' and 'the total sales of transport fuel and the share of biofuels (...) placed on the market' (EU 2003).

2.2.2.3 The evolution of the biofuel directive

During the period 2004-2006, biofuels are mainly considered by the European Union through the larger issue of renewable energy promotion. Little progress has been recorded for biofuels development during this period time. In December 2005, two years after the Biofuels Directive, the Biomass Action Plan acknowledges that biofuels share at the European level will be at best of 1.4% for 2005 given the 'substantial variation in Member States' efforts'. It is also stated that between 2003 and 2005 a number of Member States switched from fuel tax exemptions to biofuels obligations enforced via an obligatory biofuel blending percentage in the fossil fuels on the market, mainly to achieve the desired targets more 'cost-effectively'. Second generation biofuels are explicitly mentioned by the Commission which estimates that they should get 'favourable treatment' in the future (CoEC 2005).

In 2006 the 'EU Strategy for Biofuels' summarises the work already achieved and highlights the unchanged EU goals for biofuels, mainly 'reducing greenhouse gas emissions, boosting the decarbonisation of transport fuels, diversifying fuel supply sources and developing long-term replacements for fossil oil' (CoEC 2006). Biofuels are also expected to 'offer new opportunities to diversify income and employment in rural areas'. The EU Strategy for biofuel sets three aims: 'to further promote biofuels in the EU and developing countries', 'to prepare for the large-scale use of biofuels by improving their cost-competitiveness through the optimised cultivation of dedicated feedstocks, research into 'second generation' biofuels' and 'to explore the opportunities for developing countries' including those affected by the reform of the EU sugar regime 'for the production of biofuel feedstocks and biofuels' (CoEC 2006).

In January 2007 the 'Biofuels Progress Report' updates the progress made in the use of biofuels in the European Union. The Commission estimates that biofuels have 'proved themselves a credible alternative to oil', and that since 'energy diversity is rather low' in the transportation field, there is 'a pressing need for the Union to send a clear signal of its determination to reduce its dependence on oil use in transport' (see figure 2.6) (CoEC 2007a). However the Commission estimates that the targets set by the Biofuel Directive for 2010 will not be achieved, and that the reasons for that are not 'justified' or 'related to new scientific evidence' (CoEC 2007a).

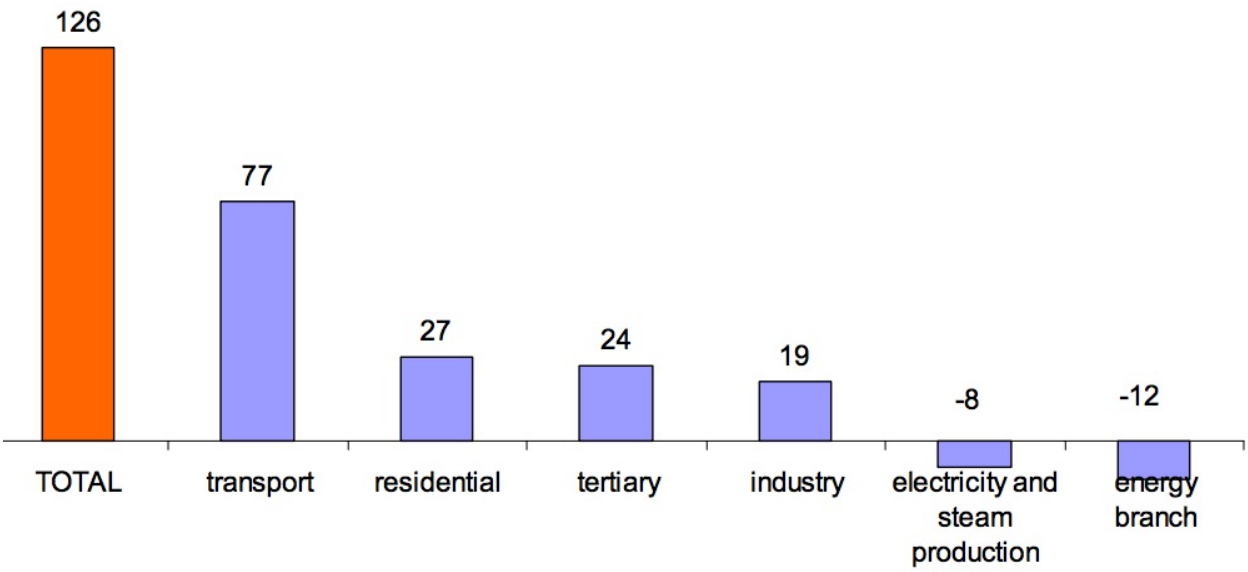

Figure 2.6: Forecast change in greenhouse gas emissions for EU25, period 2005-2020 (Mt per year, CO_2 only) (CoEC 2007a)

More importantly, the Commission filed also in 2007 a 'Renewable Energy Road Map' aiming to increase 'security of energy supply' and reduce 'greenhouse gas emissions' by making a 'better use (...) of renewables' (CoEC 2007b). In order to achieve those ambitious objectives, the Commission proposes 'a mandatory target of 20% for renewable energy's share of energy consumption in the EU by 2020' as well as a new and ambitions objective of a 'mandatory minimum target of 10% for biofuels'. The target of 10% of biofuels will need to be achieved through the Directive 98/70/EC on fuel quality, those new objectives will thus need the creation of a 'new legislative framework to enhance the promotion and use of renewable energy' (CoEC 2007b).

2.2.2.4 The Climate and Energy package

All the work achieved between 2003 and 2007 by the European Commission led to a game-changer in the EU renewable energy policy: the Climate and Energy package (CEP). The package includes a revised Fuel Quality Directive (FQD) and the Renewable Energy Directive (RED), as well as ideas introduced previously in order to promote biofuels in the European Union. Overall the package introduces the so-called 20-20-20 targets: a 20% reduction of GHG emissions, a 20% share of renewable in final energy consumption and a 20% improvement in energy efficiency by 2020 in the European Union.

2.2.2.4.1 The renewable energy directive (2009/28/EC) The Renewable Energy Directive (RED) has multiple goals. Generally, it aims to promote 'the security of energy supply and (...) technological development and innovation' as well as providing 'opportunities for employment and regional development, especially in rural and isolated areas' (EU 2009a). More specifically it formalises a target of 20% 'for the overall share of energy from renewable source' and of 10% for energy from renewable sources in transport, two goal first raised in 2007 in the Renewable Energy Road Map (see above).

The 20% target will vary at the national level, according to the 'starting point, potential (...) and GDP' of the different countries (EU 2009a). However the 10% target in the transport sector will be the same in every country in order to 'ensure consistency in transport fuel specifications and availability'. Member States struggling to meet their targets always have the opportunity to import renewable energy from neighbouring countries. Member States will have to notify the Commission of their achievement in that matters annually (EU 2009a).

Environmental concerns

The Commission fears that the growing global demand for agricultural commodities 'will be met through an increase in the amount of land devoted to agriculture' (EU 2009a). The Commission expresses thus concerns about the potential environmental impact of increased biofuels production, even if the 10% target has to be achieved 'from renewable sources as a whole, and not from biofuels alone' (EU 2009a). In order to avoid any potential environmental impact provoked by biofuels, the Commission created sustainability criteria.

Sustainability criteria were designed to avoid 'encouraging the destruction of biodiverse lands' via an an increased demand of biofuels (EU 2009a). Biodiverse areas have been defined by the Food and Agriculture Organisation (FAO) in the Global Forest Resource Assessment since 1946 (FAO 2015). Such areas include primary forests, as well as certain types of 'grasslands, steppes, scrublands and prairies' (FAO 2015). The conversion of lands with 'high stocks of carbon in its soil or vegetation' such as wetlands should also be avoided for biofuel production (EU 2009a). If such an area is considered, the carbon released in the atmosphere during the clearance has to be accounted in the total GHG emissions of the biofuel. As a rule of thumb, 'land should not be converted for the production of biofuels if its carbon stock loss upon conversion could not, within a reasonable period, (...) be compensated by the greenhouse gas emission saving resulting from the production of biofuels or bioliquids' (EU 2009a). In order to avoid increasing the pressure on European lands, the Commission estimates 'both likely and desirable that the (biofuel) target will in fact be met through a combination of domestic production and imports' (EU 2009a).

The Commission also expresses concerns about how the rise of biofuels production in third countries 'might not respect minimum environmental or social requirements', and encourages the 'development of multilateral and bilateral agreements and voluntary international or national schemes that cover key environmental and social considerations' (EU 2009a). To avoid such potential effects of biofuels, the Commission considers 'the inclusion of a factor for indirect land use changes in the calculation of greenhouse gas emissions' in the near future (EU 2009a).

Sustainability criteria impose a target of GHG savings for biofuels of at least 35% starting in 2013 (EU 2009a). This target will be 50% by 2017 and 60% by 2018. The 'biofuels and bioliquids that do not fulfil sustainability criteria (...) shall not be taken into account' in the targets. The data used in calculation should be 'obtained from independent, scientifically expert sources and to be updated as appropriate as those sources progress their work' (EU 2009a).

Economic concerns

The Commission expresses concerns about the industrial sector. To guarantee industrial stimulation and thriving, the Commission created a framework with mandatory targets at the European level in order to 'provide the business community with the long-term stability it needs to make rational, sustainable investments in the renewable energy sector' (EU 2009a). Mandatory targets are also introduced at the national level, to 'provide certainty for investors and to encourage continuous development of technologies which generate energy from all types of renewable sources' (EU 2009a). Second generation biofuels, which were 'becoming commercially available' at that time, and 'adequate levels of blending' were available to industries in order to reach the new goals. By aligning the industrial interests with its own, the Commission probably hopes to achieve its goals in a win-win situation (EU 2009a).

Indeed the Commission assumes that 'innovation and a sustainable competitive energy policy' will create economic growth, or the so-called green growth (EU 2009a). It is also assumed that this new green growth will create a switch from centralised to decentralised energy production, a switch favoured by the Commission since it increases energy security at the local level. However promising the green growth concept is, the Commission warns that it is 'desirable that energy prices reflect external costs of energy production and consumption, including, as appropriate, environmental, social and healthcare costs' (EU 2009a). Energy companies will thus have to face the challenge of internalising environmental and social costs.

Calculation of biofuels greenhouse gas impact

The total GHG emissions of a biofuel has to be accounted following the formula below, as explained in the annex V of the RED (EU 2009a). The term E equals the total emissions from the use of the fuel. The different terms are expressed in gCO_2eq/MJ, i.e. grams of carbon dioxide per MegaJoule of fuel.

$$E = e_{ec} + e_l + e_p + e_{td} + e_u - e_{sca} - e_{ccs} - e_{ccr} - e_{ee}$$

Table 2.1: The different factors included in the calculation of biofuels GHG emissions (EU 2009a)

Emissions released from	**Emissions saved through**
The extraction or cultivation of raw materials (e_{ec})	Soil carbon accumulation via improved agricultural management (e_{sca})
annualised carbon stock changes caused by land-use change (e_l)	Carbon capture and geological storage (e_{ccs})
Processing (e_p)	Carbon capture and replacement (e_{ccr})
Transport and distribution (e_{td})	Excess electricity from cogeneration (e_{ee})
Fuel in use (e_u)	

The formula to calculate the term e_l can be found in the Appendix B. Notice that Member States base their typical greenhouse gas emissions from cultivation of agricultural raw materials on the nomenclature of territorial units for statistics (NUTS), as explained above. The calculations also include Nitrous oxide (N_2O) and methane (CH_4) emissions, after being transformed as CO_2 equivalent via a factor of respectively 296:1 and 23:1.

The resulting savings are normalised via the use of a fossil fuel equivalent calculated according to the formula below:

$$Savings = \frac{E_F - E_B}{E_F}$$

Where:

- E_B = total emissions from the biofuel or bioliquid; and
- E_F = total emissions from the fossil fuel comparator.

2.2.2.4.2 The fuel quality directive (2009/30/EC) The Fuel Quality Directive (FQD) relies heavily on the RED. In this directive the Commission focuses on the transportation sector, responsible for 'around 20% of Community greenhouse gas emissions' in 2009. In order to reach the 20-20-20 targets, a gradual 'decarbonisation of transport fuel' is needed (EU 2009b). The Commission estimates that the transportation sector specifically should 'reduce life cycle greenhouse gas emissions by up to 10% per unit of energy from fuel and energy supplied' by end 2020 (EU 2009b). The Commission is giving multiple to the industrial sector means to achieve this ambitious goal: by 2020 only 6% of actual GHG reduction has to be achieved 'compared to the EU-average level of life cycle greenhouse gas emissions per unit of energy from fossil fuels in 2010' via the use of 'biofuels, alternative fuels and reductions in flaring and venting at production sites' (EU 2009b). Within those 6%, 2% has to be achieved by end 2014 and 4% by end 2017. The last 4% reduction is divided in two: 2% can be 'obtained through the use of environmentally friendly carbon capture and storage technologies and electric vehicles' and the last 2% can be obtained 'through the purchase of credits under the Clean Development Mechanism of the Kyoto Protocol'. The two additional targets, accounting for 4%, are not legally binding (EU 2009b).

The Commission expresses the same environmental concerns as the one in the RED. In this directive biofuels are subject to the same sustainability criteria, explained above as part of the RED. The methodology estimates that the GHG impact of biofuels is similar to the one included in the RED as well. Notice that the Commission expresses specific concerns about the blending of ethanol in petrol, which 'increases the vapour pressure of the resulting fuel' in a non-linear manner (EU 2009b).

2.2.2.5 The evolution of the Climate and Energy package

Reaching a 10% share from renewable sources in the transportation sector transport is one of the many ambitious goals set by the CEP, and the Commission expects the private sector to reach this target by using biofuels massively (EU 2009a; EU 2009b). However the CEP doesn't include any binding targets for biofuels specifically, let alone specific objectives for the different generations of biofuels. Although this is a clear policy incentive in favour of biofuels because 'the contribution of biofuels towards these targets is expected to be significant' (EU 2009a), it is only a weak one since it doesn't stimulate innovation in the field by establishing clear production goals for more advanced types of biofuels (second and third generation). The message can thus be considered ambiguous by the private sector and might deteriorate the secured environment needed for long-term investment.

Another issue is the way the European Commission is handling the potential environmental issues of biofuels. About ILUC for example, in the RED the Commission estimates that it should 'develop a concrete methodology to minimise greenhouse gas emissions caused by indirect land use changes', but doesn't elaborate on how it's supposed to be done. As we already saw ILUC can't be observed directly. Its quantification is thus based on assumptions that need to assess how far and how indirect the quantification should be. Such questions are by nature uncertain, and are strongly expected to divide the opinion. Any miscommunication could also rapidly polarise the public debate revolving around biofuels.

In 2010 the ILUC issue was becoming a symbol for the opponents to biofuels, allowing them to group behind the problematic (Ackrill and Kay 2014). The Commission assessed the ILUC issue and created a method to quantify it in a report about 'indirect land use change related to biofuels and bioliquids' (EC 2010). In the report the Commission acknowledges that 'estimating the greenhouse gas impact due to indirect land use change requires projecting impacts into the future, which is inherently uncertain' and that estimated ILUC 'can never be validated, as indirect land use change is a phenomenon that is impossible to directly observe or measure'.

Land-use change in g/MJ[21]	**Maize ethanol**	**Soya biodiesel**
Searchinger et.al. (2008)	156	165-270
CARB (2009)	45	63
EPA (2010)	47	54
Hertel et.al. (2010)	40	-
Tyner et.al (2010)	21	-
IFPRI MIRAGE (2010)	54	75

Figure 2.7: GHG emissions related to land-use change for maize bioethanol and soya biodiesel (EU 2010)

The document is based on many different reports from Europe and the US, as well as an extensive literature review. Two of those reports also included modelling exercises: the first one is the AGLINK-COSIMO model, developed by the Institute for Prospective Technological Studies (IPTS). Under an assumption of 7% of conventional biofuels and 1.5% of advanced biofuels (double-counted) to reach the 10% target of renewable energy, the model estimated the additional demand would result in a release of 21 Mtoe which would result in 'an increase of the total land area required for crops of 5.2 million hectares globally, one quarter of which is in the EU'. This model didn't include a calculation of GHG impact (EC 2010).

The second model is the MIRAGE, developed by the International Food Policy Research Institute (IFPRI). Under an assumption of 5,6% of conventional biofuels and 1.5% of advanced biofuels (the rest of the 10% being filled by other means), the model predicts that an output of 8 Mtoe, which would result in ‘an increase of total land area required for crops of 0.8 and 1 million hectares globally’ (EC 2010). In a 45/55 ratio of bioethanol/biodiesel, this would result in a GHG release of 18gCO_2eq per MegaJoule for land-use emissions. In the case of a 8,6% share of conventional biofuels, the model predicts a GHG release of 30g/MJ. Notice that the ratio of bioethanol/biodiesel has a strong influence on the land-use emissions: as explained a ratio 45/55 will release 18g/MJ of GHG, where a ratio of 25/75 would theoretically release 45g/MJ.

The results of the report are thus very variable, as the models are based on different assumptions such as ‘the treatment of co-products, existing and marginal yields, food and feed consumption, classification of land, elasticities, carbon stock values, type of land converted, modelling of pasture and the drivers of deforestation’ (EC 2010). Figure 2.7 represents the different GHG release that would theoretically be provoked by land-use change for soya biodiesel and corn bioethanol. For the latter, the estimations vary on a scale from 21 to 156 g/MJ, making any conclusion difficult. The variability in the models are ‘based on economic principles, where decision making on e.g. land-use change, is reduced to a least-cost optimization problem’, neglecting any ‘several non-economic factors (...) like political choices (land-use and agricultural policy, land rights, etc.)’ that might influence land-use change but are hardly quantifiable (EC 2010). The Commission also acknowledges that ‘the geographical origin of the feedstock could also be a significant variable in estimating the (indirect) land-use change impact of a specific biofuel’, but that ‘none of the modelling done so far has explored this variability’ (EC 2010).

2.2.2.6 The amendments of the RED and FQD

In order to address the environmental concerns underlined above and specifically ILUC, the European Commission amended the RED and the FQD in 2012. In the introduction of the proposal the Commission acknowledges that ‘emissions from indirect land use change (...) can negate some or all of the greenhouse gas savings of individual biofuels relative to the fossil fuels they replace’ (EC 2012). The proposal has multiple aims, the principal being the 'introduction of a limit to the contribution made from biofuels (...) produced from food crops (...) to current consumption levels', aka 5% (EC 2012). New refineries will have to achieve greater GHG savings more quickly (60% by 2014 compared to 2017 in the original directive). Refineries in operation before 2014 will have until 2018 (an additional extra year) to reach 50% of GHG savings, but they will have to include 'estimated emissions from carbon stock changes caused by indirect land use change' (EC 2012).

The Commission explicitly aims to 'protect existing investments until 2020', but estimates that 'biofuels which do not lead to substantial greenhouse gas savings (when emissions from indirect land use change are included) (...) and are produced from crops used for food and feed should not be subsidised' (EC 2012). The Commission thus wish to encourage greater production of 'advanced biofuels (...) (that) provide high greenhouse gas savings with low risk of causing indirect land use change and do not compete directly for agricultural land for the food and feed markets' (EC 2012). It estimates as well that those kind of fuels are not yet commercially available due to 'competition for public subsidies with established food crop based biofuel technologies'. To stimulate the production of advanced biofuels production, the Commission wishes to adopt a new accounting system based on the feedstocks used in the process: biofuels produced from algae (as well as from non-biological origin) would be accounted for four times their energy content, biofuels made from mixed municipal waste would be accounted for two times their energy content (EC 2012).

Stormy debates about ILUC quantification and a potential cap on conventional biofuels took place between 2012 and 2014, creating a climate of uncertainty around the future of biofuels. In the 'Renewable energy progress report' of 2013 the Commission acknowledges some deviations from national and European targets in the transportation field for 22 Member States which 'failed to achieve their indicative 2010 target of 5.75%' (EC 2013). The Commission estimates that the 4.7% share of biofuels in the European transportation sector generated 25.5 Mt CO_2eq, but that when ILUC or agricultural intensification effects are considered those 'estimated savings are significantly reduced' (EC 2013). The Commission thus suggests that a new amendment should 'include (a limit of) the contribution that food-based biofuels can make towards the 10% target to 5%, enhanced incentives to encourage the development of second generation biofuels from non-food feedstock' to clarify EU biofuels policy (EC 2013).

About the biofuels sustainability criteria, the Commission acknowledges its lack of enforcement in some Member States, and has started 'legal proceedings (...) to ensure that effective sustainability regimes are in place in all Member States' (EC 2013). Key countries involved in deforestation issue and exporting biofuels to Europe like Indonesia, Brazil, Argentina and Malaysia have also recently improved their environmental practices related to biofuels production. Indeed respectively 80% and 83% of bioethanol and biodiesel consumed in Europe are produced domestically, the rest being imported from countries like Argentina, the US and Brazil (see figure 2.8). Notice that the import shares from Brazil, internationally famous for the intense deforestation of the Amazonian forest, has 'almost halved (in 2013) in comparison to 2008' and only reached 8.4% in 2013 (EC 2013).

The Commission also assesses the controversial 'food vs fuel' argument in the 2013 report. The Commission estimates that the use of agricultural commodities like grains for ethanol production was only amounted to 3% of the total cereal use in the period 2010-2011, with a minor impact on price effect on international markets (between 1 and 2%). The Commission estimated the impact of EU biodiesel consumption on food prices around a few percents as well (4%) (EC 2013). The Commission notices that 'biofuel demand is more price sensitive than the food market and so demand declines more in response to rising prices'. The interactions between biofuels production and other economic sectors still need to be assessed (EC 2013).

According to the Commission, this situation is mainly due to the economic crisis of 2008-2009 that strongly affects the renewable energy sector and 'particularly its cost of capital' (EC 2013). The Commission fears that this 'increase the regulatory risk faced by investors and barriers that should, but have not yet been addressed', thus deterring any potential

	Biodiesel		Bioethanol		
	Volume (ktoe)	Share		Volume (ktoe)	Share
EU	8,270	83.2%	EU	2,243	80.1%
Argentina	1,003	10.1%	Brazil	234	8.4%
Indonesia	285	2.9%	U.S.	121	4.3%
Malaysia	123	1.2%	Peru	26	0.9%
China	67	0.7%	Kazakhstan	24	0.8%
U.S.	61	0.6%	Bolivia	20	0.7%
Other countries	129	1.3%	Egypt	15	0.5%
			S.Korea	16	0.6%
			Other countries	101	3.6%
Total	9938			2800	

Figure 2.8: Origin of final biofuels consumed in the EU in 2010 (EU 2013)

investors interested in biofuels development in Europe when ‘further efforts are needed to achieve the 2020 targets’ (EC 2013). A deficit of biofuels production is thus expected in Europe starting in 2013.

2.2.2.7 The ILUC directive (2015/1513)

In 2015 the European Commission acknowledges that ILUC in biofuels production can ‘lead to significant greenhouse gas emissions’ (EU 2015). Given that most of the biofuel production for 2020 is ‘expected to come from crops grown on land that could be used to satisfy food and feed markets’, this could thus ‘negate (...) the greenhouse gas emission savings of individual biofuels’ (EU 2015). However the Commission acknowledges the complexity of quantifying ILUC, a phenomenon depending of ‘trends in agricultural yields and productivity, co-product allocation and observed global land-use change and deforestation rates’, factors which are not under control of biofuels producers (EU 2015). The Commission also recognises that the consequences of ILUC are mostly expected outside of the European Union ‘in areas where the additional production is likely to be realised at the lowest cost’. The conversion of peat lands or tropical forest for example would have disastrous consequences on GHG savings induced from biofuel production. ILUC quantification has thus not yet been fully formalised (EU 2015).

However, the Commission has set a limit of 7% of conventional biofuels in the final energy consumption in the European transportation sector by 2020. Member States are free to set more stringent limits, in order to arrange their own trajectory to comply with the 10% target of renewable energy in the transportation sector (EU 2015). On the other hand the Commission strongly encourages the production of advanced biofuels (based on algae and waste) that do not compete with food production for agricultural lands, hoping to reach ‘a significantly higher level of consumption’ by 2020 (EU 2015). In this sense the accounting factors developed to foster advanced biofuels are maintained, but no mandatory targets are set for advanced biofuels (an indicative target of 0.5% accounted twice is mentioned). The Commission also recognises that energy crops developed for second and third generation biofuels have ‘the potential to contribute to the restoration of severely degraded and heavily contaminated land’, but that the knowledge of the matter is still limited (EU 2015). However the Commission acknowledges that such biofuels are still ‘currently not commercially available in large quantities’ and might counter effect the trend of ‘increase(d) recycling and the efficient and sustainable use of available resources’ actually developing in Europe (EU 2015).

2.2.2.8 Summary

Biofuels have been considered a viable option for road transportation in the EU starting in XIXth century, as illustrated in this literature review. However the EU policy framework concerning biofuels has considerably changed since its informal introduction in 1992 via a CAP directive. This is mainly due to the evolution of the importance of the different political drivers, namely energy security, rural development and environmental preservation. Indeed the first main concern to justify biofuel development was energy security. It rapidly switched to rural development and especially environmental issues, in line with the Kyoto negotiations in the second half of the nineties.

This lead in 2003 to the formal starting point of biofuel policy in Europe: the biofuel directive. The biofuel directive stresses all three political drivers, but is mainly focusing on environmental concerns. The European policy-making process is clearly pro-biofuel at that point, with the European Commission proposing a non-binding target of 20% substitution of conventional fuels by alternative fuels in the road transport sector by the year 2020. However, the controversial aspect of biofuels is already present in the discussion, but not directly mentioned as the amendments calling for environmental criteria did not find their way in the final directive.

In 2009, the EU shows its will to address climatic issues via the Climate and Energy Package (CEP) and its 20-20-20 targets: a 20% reduction of GHG emissions, a 20% share of renewable in final energy consumption and a 20% improvement in energy efficiency by 2020 in the European Union. The CEP includes the Renewable Energy Directive (RED) and the FQD (Fuel Quality Directive). The RED has multiple goals, but mainly formalises the 10% target of energy from renewable sources in road transport by 2020. Even though the contribution of biofuels towards these targets is expected to be significant, the European Commission fears their land use impact inside and outside Europe, and thus creates sustainability criteria to prevent this from happening. The CEP also includes the FQD, which rather than impose quotas (such as the RED) tries to implement a carbon approach: it aims to reduce life cycle greenhouse gas emissions by up to 10% per unit of energy from fuel and energy supplied by end 2020 in order to gradually decarbonise transport.

Even though biofuel production is fostered by the CEP, the industry is at that point slowed down, showing no sign of new investments. Indeed while the European Commission is trying to provide the business community with the long-term stability it needs to make rational, sustainable investments in the renewable energy sector, the industry fears the land-use debate and feels the EU officials hesitating about the right move to do. Those fears are materialised by the Indirect Land Use Change (ILUC) debate, which leads to major amendments of the CEP in 2012. Even though the European Commission still wishes protect existing investments until 2020, the directives include now an undifferentiated cap of 5% on food-based biofuels (thus not all land-based biofuels) in order to prevent potential environmental damages. This is mainly done in order to make room in the future for advanced biofuels (advanced biofuels), thought to have much less impact on land use and food prices, as well as being more environmentally friendly since they're theoretically produced from waste.

As ILUC is a complex issue, three years of debate took place after 2012 in order to try to estimate ILUC's potential effects via complex mathematical models. Those years of efforts lead to the ILUC directive in 2015: this directive states that ILUC biofuels production can lead to greenhouse gas emissions so significant that it can negate their emission savings, especially when taking place outside of Europe. The European Commission has thus set a cap of 7% on conventional biofuel production within the 10% target of renewable energy in the transportation sector, which Member States are free to restrict even further.

2.2.2.9 The state of the European biofuel policy framework today

As it is today, Europe has informally set ambitious targets for 2030: all emissions in EU territory should be by that time reduced by at least 40% compared to 1990 levels. Non-EU ETS sectors like road transportation will have to face a GHG saving of 30% (compared to 2005 levels) by 2030 (EU 2014). Still the u-turn in policy in 2012 has had devastating consequences on the biofuels industry. Worse, the position of the Commission about biofuels is still ambiguous today: in 2014 for example the Commission insisted on the important role advanced biofuels as well as 'other sustainable fuels as part of a more holistic and integrated approach' will have to play in the future of European transportation (climate and energy policy framework from 2020 to 2030). However the Commission recently suggested that conventional biofuels will not be subsidised after 2020 or might even be phased-out, since the ILUC significantly limits their role in the decarbonisation of the transport sector (Simon 2016). This is in addition of the ILUC directive, which besides capping conventional biofuels, doesn't set a mandatory goal for advanced biofuels as a share in the energy used for transportation in Europe. The lack of certainty about whether or not there will be a market for advanced biofuels after 2020 blocks most investments in the biofuels industry today. The impact of european policies on Ethanol Europe will be extensively discussed in the results and discussion section.

In order to clarify the future of biofuels in Europe, the future directive on renewable energy will need to be ‘substantially revised for the period after 2020’ in order to meet the 2030 target, which will happen in late 2016 (EC 2014). The revision will be preceded by a communication on decarbonising transport, which will be released in July 2016 by the European Commission. The Commission will also submit a report by late 2017 to estimate the quantity of advanced cost-efficient biofuels needed by 2020, as well as an update of ILUC quantification knowledge to strengthen the sustainability criteria and analyse the possibility of new environmental criteria. In 2018 the Commission will also submit a Renewable Energy Roadmap for the post-2020 period (EU 2015).

Chapter 3

Methodology

This study aims to assess the different strategies put in place by Ethanol Europe in order to strive in the rapidly moving European sector of biofuels. In order to achieve that goal, this thesis is mainly based on:

- an extensive literature review of the evolution of European policies concerning biofuels;
- an in-depth analysis of the lobbying activities (formal and informal interactions) of Ethanol Europe at the European level with the other main stakeholders of the biofuels debate, namely the policy-makers and environmental NGOs, via semi-structured interviews

As technical insights are needed in order to understand the nuances of the biofuel debate, a short introduction about technical specificities of the different biofuels generations is given in the introduction.

3.1 Field methods

3.1.1 Data gathering

3.1.1.1 Interviews

This thesis is based on 16 semi-structured interviews of an average 70 minutes length. All interviews have been conducted in person in Brussels or Budapest. Small series of questions answered via telephone or email have also been conducted, but are not considered as interviews and are thus not enumerated below. As the biofuel debate is still controversial, most of the interviewees' names have not been given. This standard practice in sociological research has also encouraged interviewees to be more explicit about their personal views (especially when it contradicts the view of the society they work in). It also helped revealing more sensitive issues. Notice that the genre used to refer to anonymous interviewees is always masculine, in order to protect their privacy. The interviewees from Ethanol Europe and Pannonia Ethanol did not wish to hide their names or opinions.

Most interviewees have been chosen based on their professional background and the firms they were working in. The first interviews were conducted with representatives of Ethanol Europe, since this firm is at the core of this thesis. The informations arising from those interviews helped to frame the people needed to nuance the views of the industry. To improve this process, the method of snowball sampling was adopted: interviewees were asked during the interview to help identify other subjects which might be relevant to the topic. Many subjects were assessed during the interviews, including the general opinions of interviewees about biofuels (and then specifically about renewable ethanol), their feeling about the revision of the RED coming in late 2016 and Miss Donnelly's statement (about how we should get rid of conventional biofuels, see (Simon 2016)), their role relating to policy evolution and their relations with the industry (and especially Ethanol Europe), eNGOs and policy-makers. An example of an interview question lists is given in Appendix D.

Concerning the conduct of the interviews, a semi-structured framework has been considered. In practice this means that interviews are conducted within a more general framework which is used as a base for the following discussion. Contrary to structured interviews, semi-structured interviews do not restrict the themes assessed during the interview: the interviewees are free to make connections with themes or subjects originally unexpected. The general framework for an interview thus continuously evolves based on knowledge brought by the previous research. Notice that the general framework is adapted to the interviewee's general background (industry, environmental NGOs, sustainability consultancy, policy-makers) and individual deeds (scientific/opinion papers, past professional experience, potential connections, etc). The addition of flexibility provided by semi-structured interviews also prevents the researcher of failing to investigate a crucial subject as an unexperienced and external observer.

Industry representatives

In order to assess the impact of the political shift on Ethanol Europe as well as Ethanol Europe's reaction towards the rapidly moving political framework, different Ethanol Europe's and Pannonia Ethanol's representatives were interviewed from March until May 2016. Interviewees include:

- Eric Sievers, CEO of Ethanol Europe renewable ltd since June 2010 (two interviews were conducted);
- Zoltan Reng, CEO of Pannonia Ethanol Zrt since March 2012;
- Dick Roche, a former Irish Minister for the Environment, now part-time PE's representative in charge of its relation with the European Parliament and the Council of Europe via the independent consultancy 'the Skill Set' (Transparency Register 2016);
- James Cogan, a technology, industry and policy analyst working as part-time representative for Ethanol Europe on advocacy and public affairs at the European Commission (Transparency register 2016);

- Zoltan Szabo, an independent environmental consultant at LátensDimenzió Bt unofficially in charge of the interactions between Ethanol Europe and European eNGOs (two interviews were conducted).

A representative of ePURE has also been interviewed. ePURE, or the European renewable ethanol association, is an association aiming to promote renewable ethanol use in Europe as the 'unified voice of the European renewable ethanol industry' (ePURE 2016). It protects the interests of major European renewable ethanol producers at the European level, as well as towards the academia, media and public. ePURE is based in Brussels and represents 58 member companies, including 24 ethanol producers based in 16 European countries which accounts for 90% of the renewable ethanol production in Europe (ePURE 2016). ePURE officially represents the interests of Pannonia Ethanol at the European level.

EU officials

In order to deepen the analysis, interviews of European policy-makers have been conducted. The interviews were conducted between mid-May and Mid-June 2016. The interviews included representatives from:

- Directorate General for Energy (DG ENER), section C1 (Renewables and CCS policy) and C2 (New energy technologies, innovation and clean coal)
- Directorate General for Mobility and Transport (DG MOVE), section C1 (Clean transport & sustainable urban mobility)
- Environment Directorate-General (DG ENVI), section F1 (Resource Efficiency & Economic Analysis)

Representatives from DG AGRI and DG CLIMA were also contacted but could not be interviewed for this work because of their tight schedules.

NGOs representatives

In order to contextualise Ethanol Europe's strategies in the biofuel debate, interviews of environmental NGOs and environmental consultancies have been conducted between mid-May and Mid-June 2016 as well. Interviewees include biofuel specialists from:

- Transport & Environment (T&E). T&E is an environmental NGO which tries to promote a European transport policy based on the principles of sustainable development to minimise harmful impacts on environment and health (T&E 2016a);
- the European Environmental Bureau (EEB), an environmental NGO representing the voice of European citizens and tries to influence EU policymaking and implementation based on various principles such as environmental justice or sustainable development (EEB 2016);
- the Institute for European Environmental Policy (IEEP) (two interviews), a non-profit research organisation 'dedicated to advancing an environmentally sustainable Europe through the analysis and development of policy, and dissemination of research results' (IEEP 2016).

Representatives from Oxfam, Fern and Birdlife were also contacted but could not be interviewed due to their tight schedules.

3.1.1.2 Policy review

Documents issued by the CEC (the Council of European Communities), the CoEC (Commission of the European Communities), the European Commission (European Commission) and the official journal of the EU have been used. Different books and reports (Kutas et al. 2007; FAO 2008; Ackrill and Kay 2014; UNEP 2009) were also analysed to provide information about the general background of the biofuel debate.

3.1.1.3 Other document and events

Other documents provided by European policy-makers, industries as well as environmental NGOs and environmental consultancy during the interviews have also been considered in this thesis. Examples include the 'State of the industry 2015' (ePURE 2015), the 'Globiom study' (ePURE 2015) and the 'State of the Art on Alternative Fuels Transport Systems in the European Union' (EC 2015b).

This thesis is also based on informations received the Sustainable Energy Week, organised by the European Commission in Brussels. Two different conferences concerning the decarbonisation of transport were attended:

- 'Smart energy solutions for transport - anticipating future challenges', on the 14th of June 2016. Speakers included mainly Mr Cacciaguerra (Head of Energy Unit in the Environment and Energy Directorate) and Mr Van Honacker (Senior Expert Team Leader for Clean transport European Commission)

- 'Decarbonising transport & advanced renewable fuels', on the 16th of June 2016. Speakers included Miss Donnelly (Director of section C within DG ENER), Miss Kopczynska (Director of section C of DG MOVE) and Mr Runge-Metzger (Director of section C of DG CLIMA)

3.1.2 Analysis

All interviewees but one allowed to be recorded. Interview recordings were later transcribed and extensively analysed. The analysis include confrontation of the different interviewee's arguments, as well as thorough research in differentiate scientific facts from assumptions and political statements.

3.1.3 Quality of data

A research is of high quality if the data collected are representative of the phenomena they describe (Silvermann 2006). To make sure the research is valid, data from the three main stakeholders of the biofuels debate (industries, policy-makers, NGOs) have been considered. This triangulation of data-sources, in addition with other types of data sources (policy document, reports, books, scientific articles) helps the research to gain a fuller picture of the different strategies put in place by Ethanol Europe in order so strive in the European market, as well as their consequences. The constant update of the interview protocol on the base of the information collected also helps increasing the validity of the research.

3.2 Deficiencies and limitations of the study

There are many limitation to this study, the first being the large variety of subjects of relevance when it comes to biofuels issues. Indeed biofuels constitute a large sector: even when restricted only to Europe, the numbers of factors of significant relevance can be overwhelming. A biofuel study is by definition transdisciplinary and in relation with several sectors such as energy, agriculture, transport, climate and environment. The interactions between those sectors are complex and each one of them could require a thorough analysis in itself.

Another problem is the still highly controversial aspect of biofuels: most interviewees wanted to keep their anonymity in order to avoid troubles with collaborating partners. Some interviewees also had views directly contradicting the more general way of thinking of their work place, making them in some case hesitant to communicate where relevant background informations could be found to support their opinion.

Another limitation is the professional secrecy: Ethanol Europe Renewable ltd has to restrain informations going public in order to avoid competition issues. Many crucial numbers like the GHG savings have not been publicly displayed for a few years (see for example figure 4.4), making fact-checking difficult. Lobbying activities can also be quite secretive, as some interactions are informal. This limitation is worsened by the lack of time for travelling out of Budapest and the difficulty to match this short time with the highly busy agenda of some people.

A last limitation is the complexity of the European policy-making process: this research is especially focusing on the influence between industries, eNGO and the European Commission, thus on the technical aspect of the biofuels issue. The European Parliament and the Council of Ministers are mentioned in this thesis but are not extensively assessed, since the influences there are mainly political. To extensively analyse the evolution of biofuels policy in Europe, further research might explore the significant influence of the European Parliament and the Council of Ministers, as well as the different political games and lobbying happening within the two.

Chapter 4

Results

This chapter focuses on answering the thesis' aim, aka how did Ethanol Europe adapt to the political change in Europe. In order to answer this question, this chapter is going through two main objectives: an analysis of the impact of the political shift on Ethanol Europe, and an extensive analysis of how Ethanol Europe's reacted to this change. The latter includes an analysis of the different Ethanol Europe's strategies and implementation, as well as of how Ethanol Europe's reaction is perceived in Brussels by other stakeholders. This is mainly done via interviews of EU policy-makers and eNGO's representatives active at the EU level. Both analyses are discussed based on the thorough political review from the literature review.

4.1 Background informations

Ethanol Europe, or Ethanol Europe Renewables Ltd., is a holding company based in Ireland which owns Pannonia Ethanol as well as other biofuels-related investments and facilities such as companies responsible for corn trading in Hungary. Pannonia Ethanol built and owns a biorefinery producing bioethanol from corn in Dunaföldvár, a small town of around a 1000 inhabitants 100km south of Budapest (figure 4.1). Pannonia Ethanol's administration office is based in Budapest, Hungary. Pannonia Ethanol Hungary for its refinery since it is one of the country with the highest corn surplus in Europe, with a production of about 8 million tons of corn a year and a yearly surplus of around 5-10% on average (Jessen 2012; HBT

2012).

Figure 4.1: A view of Pannonia Ethanol's biorefinery in Dunaföldvár, Hungary (PE 2016)

4.2 Ethanol Europe's story

The influence of EU's policy framework concerning biofuels on Ethanol Europe's development is highly significant. Ethanol Europe was created in 2009, and directly created Pannonia Ethanol, which started the building of its biorefinery project in Dunaföldvár (Hungary) the same year (PE 2015a). This quick development was made following the incentive of the CEP, formulated in 2009. As outlined in the literature review, the CEP created a clear policy incentive in favour of biofuel: the RED formalised a target of 10% for energy from renewable sources in transport, while the FQD promoted the use of biofuels to decrease GHG emissions by up to 10% per unit of energy from fuel and energy supplied (EU 2009a; EU 2009b). The EU ambition was then to clearly stimulate the production of renewable energy, and the contribution of biofuels towards (...) was expected to be significant' (EU 2009a).

The building of Pannonia Ethanol's plant took place starting in July 2010, and the facility started being producing bioethanol in April 2012 (PE 2015a). However during this period the European Commission is handling the potential environmental issues of biofuels (influence on food prices and ILUC effect), pushed by the growing opposition to biofuels in Europe. Even if the two ILUC models created at that time did not create a scientific consensus, the growing concerns about potential ILUC effect made biofuels opponent gather behind the argument (see policy review for more details). The future of biofuels became uncertain, especially since there are no binding targets for biofuels specifically within the CEP (EU 2009a; EU 2009b). In 2012 the amendments for the CEP such as an undifferentiated cap on all conventional biofuels and stronger environmental criteria were formulated. Thus, between the beginning and the end of Pannonia Ethanol's plant building process, biofuels went from a promising tool to decarbonise transport to a technology with potentially enormous social and environmental consequences such as deforestation (via ILUC) and starvation (via influence on food prices), especially in third countries.

This political shift created a significant impact on Ethanol Europe's development: while Pannonia Ethanol's biorefinery was built in April 2012, the CEP amendments were only formulated in October 2012. Between April and October, Ethanol Europe announced in June 2012 its intention of building a new biorefinery based on its success (Jessen 2016). The plant was supposed to be roughly the same size as the one in Dunaföldvár, and located in Mohács (Hungary). By August 2012, E. Sievers (CEO of Ethanol Europe) was supposed to even present a third project in Hungary (Jessen 2016). The foresight of the CEP's amendments crushed this dynamic: in order to minimise Ethanol Europe's losses, the two projects were abandoned in late 2012 (Reng 2016). According to Mr Sievers and Mr Reng, 10 millions had already been wasted on the Mohács site (see picture 4.2) before it was definitely stopped (Sievers 2016; Reng 2016). Ethanol Europe also projected to build what would have been the largest cellulosic ethanol plant in the world in Prilep (Macedonia) in collaboration with the chemical industry DuPont. The project, located in a poor area of Macedonia, requires 300 million euros of investment and could create up to a thousand jobs (Sievers 2016). The biorefinery would use a sorghum and switchgrass as main crops in an area where actually low yield tobacco is grown. However the project is currently on hold for an indefinite period, due to changing legislation concerning energy crops (Reng 2016).

Figure 4.2: The aborted biorefinery project of Ethanol Europe in Mohács, Hungary (Reng 2016)

The brutal political shift between 2009 and 2012 blocked nearly all kind of investments in the biofuel sector (Sievers 2016). It is however important to notice that Pannonia Ethanol was able to expand its only existing biorefinery in Dunaföldvár in late 2014 thanks to a 33.8 million euro loan from the Hungarian Export/Import bank in collaboration with the Canadian investment fund Cordiant Capital (Cordiant 2011). Pannonia Ethanol is in this sense one of the only biofuel industry that could develop its activities after the 2012 political shift in Europe (Sievers 2016). The expansion was completed in 2015, year of the ILUC directive and its 7% cap on all conventional biofuels.

Ethanol Europe is today one of the largest renewable ethanol producers in Europe: from a production of 220.000 liters of ethanol in 2012, it went to more than 450.000 in 2015 (see table 4.1). The plant can nowadays handle up to 1,000,000 tons of corn annually. With the expansion included, the amount of money invested in the facility reach roughly 200 million euro. As Zoltan Reng, the CEO of Pannonia Ethanol, puts it: 'We're very pleased to be able to deliver on our original business plan and commitments to this community made in 2010, even despite a challenging regulatory climate and the closure of other ethanol plants in Europe' (Jessen 2014).

Table 4.1: The production of Ethanol Europe (Reng 2016)

	2012	2013	2014
Ethanol (liters)	220.000	270.000	450.000
DDGS (tons)	165.000	200.000	330.000
Corn oil (tons)	0	5.000	15.000

4.3 Ethanol Europe's reaction

As highlighted above, Ethanol Europe was strongly impacted by the political shift of 2012. The political change was quick and unexpected: Mr Sievers claims that Ethanol Europe's investors were the 'furthest thing from Brussels' in 2012, and 'intrinsically not interested in regulatory affairs and government relations' (Sievers 2016). Ethanol Europe and Pannonia Ethanol representatives considered the CEP before October 2012 as a robust and long-lasting framework. Mr Sievers recalls this approach today as 'stupid and completely wrong' (Sievers 2016).

To adapt as promptly as possible to the new regulatory framework, Ethanol Europe started two strategies in 2012. The first one is happening outside of the firm: Ethanol Europe started investing in lobbying activities in Brussels in order to fight for a more favourable political framework for bioethanol. Internally, Ethanol Europe started to diversify its activities in order to increase its resilience towards the changing political framework. The two strategies are extensively reviewed below.

4.3.1 Lobbying activities

Ethanol Europe pursues two lobbying activities in Brussels. The first one is directly via three of its own lobbyists: James Cogan, Dick Roche and Zoltan Szabo. The second lobbying activity is indirect via a representation in ePURE, an association representing the vast majority of renewable ethanol producers at the European level (see the methodology section for more details).

4.3.1.1 ePURE

ePURE is an association representing Ethanol Europe at the EU level as well as the vast majority of bioethanol producers' representation in Europe (ePURE 2016). Created in 2010 after the merging of eBIO and UEPA (the European Union of Ethanol Producers), ePURE directly started to influence the policy-making process in Brussels in order to avoid a too radical political shift in 2012.

To influence the policy-making process efficiently, ePURE's first step is making sure that the European renewable ethanol industry has a common position on important subjects, which was a process described by ePURE's representative as 'long and exhausting' (ePURE's rep. 2016). The process of creating a common opinion for all ePURE's members starts in the working groups and special task forces which are handled by the different ethanol producers on a voluntary basis. The drafts opinions are then brought up to the board of directors, which will adopt a 'position of principles'. The board of directors then meets a few times a year (at least four times) and is responsible for determining the positions, strategies, and the actions/representations of the association (ePURE 2016). ePURE's internal structure is schematised on figure 4.3.

Once the industry has a common position, ePURE can start lobbying in Brussels. As explained by ePURE's representative (2016), this is a two step process: the first is to identify opportunities/threat in the upstream legislation process, so stay in contact with members of the different DG (ePURE's rep. 2016). In this sense ePURE influences policy-makers before

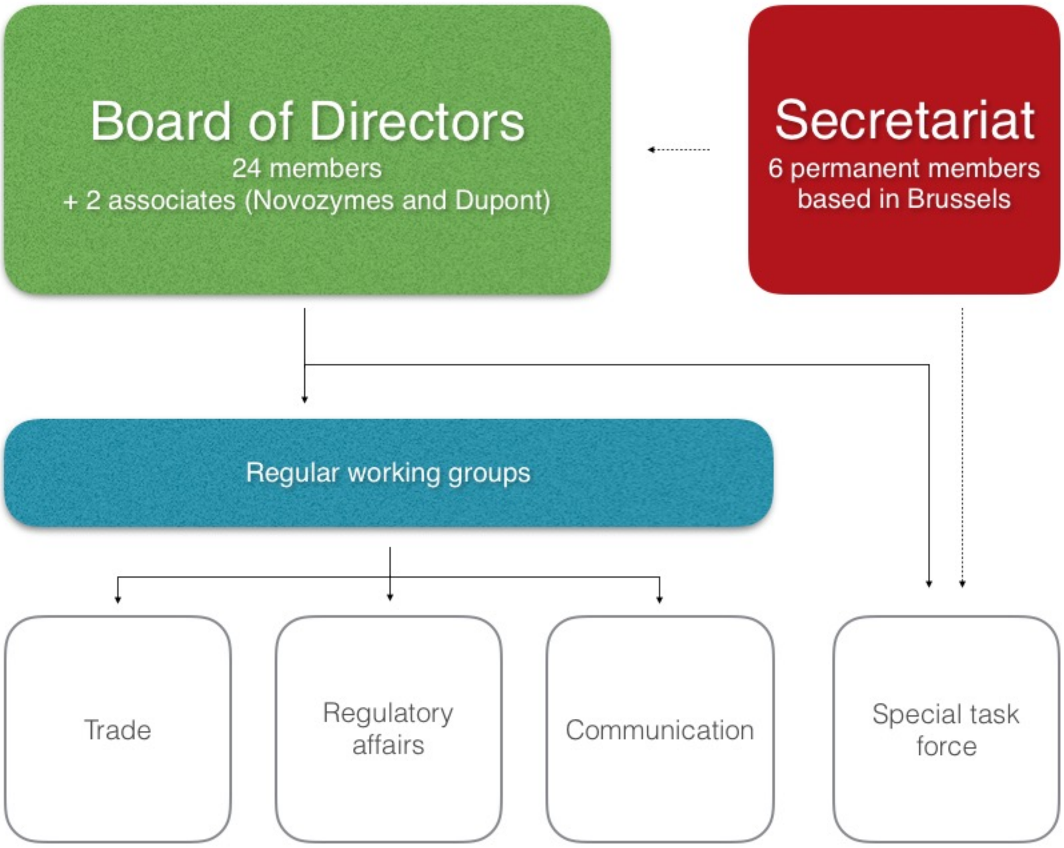

Figure 4.3: Internal working structure of ePURE (adapted from (ePURE's rep. 2016; ePURE 2016)

any legislative proposal is made by the EC. This is crucial since the interviewee estimates that approximately 85% of the legislative proposal made by the European Commission will stay in the definitive legislation (ePURE's rep. 2016). The second step is the major piece of work: influencing the European Parliament in order to get a legislation more in favour to bioethanol industry. In order to achieve this ePURE begins by influencing the attribution of the draft legislation by mobilising MEPs (Member of Parliament) that previously expressed interests in biofuels matters. ePURE then focuses on each MEP appointed on the matter by its political group in order to influence discussions (ePURE's rep. 2016). To convince MEPs, ePURE is calibrating specific arguments for each ones of them, preferably linked to their respective country such as national industrial interests. When a MEP is favourable to ePURE's opinion, ePURE even draft specific amendments for the MEP to use. Finally ePURE influences the repartition of the amendments for the vote and tries to include as many favourable policy elements as possible in the so-called 'compromise amendments' (which are agreed by all appointed MEPs). When the amendments version is final, ePURE sends voting recommendations to the different MEPs favourable to bioethanol's industry interests (ePURE's rep. 2016).

4.3.1.2 Direct lobbying

Ethanol Europe's own lobbyists have a less formal way of working compared to ePURE. Mr Roche for example mainly aims at occupying space on the political stage with bioethanol issues while highlighting the inconstancies of the political framework concerning conventional biofuels such as an undifferentiated cap on the whole variety of conventional biofuels (Roche 2016). In order to achieve this Mr Roche uses its political background and former contacts to help moving forward the issues in a more favourable way for the bioethanol industry.

Mr Cogan has a more specific way of working which is close to ePURE's method: first determining the specific legislative processes being designed, second identifying and meeting the people in charge of those processes, third carefully targeted communications with those individuals (Cogan 2016). In order to communicate with EU policy-makers, Mr Cogan is in close contact via emails and meetings if possible. Another channel of communication is the consultation process of the European Commission, which allows people from different sector to express their views on specific topics. A last way of communicating is via the publication of articles in the main news channel read by the policy-makers, which then spreads in different forms such as newsletters within the European Commission (Cogan 2016).

The last Ethanol Europe's lobbyists, Mr Szabo, achieves its lobbying activities via digital communications and the review of scientific papers as well as of policy documents since he is based in Budapest and not Brussels like Mr Cogan and Mr Roche. If meeting with eNGOs, Mr Szabo uses the latest studies concerning bioethanol in particular in order to influence the different representatives (Szabo 2016).

4.3.2 The argument of the bioethanol industry

In order to improve the current political framework, Ethanol Europe's representatives (Mr Sievers, Mr Reng, Mr Cogan, Mr Roche and Mr Szabo) and ePURE's representative put forward multiple arguments, listed below. The arguments are contextualised within the EU policy framework, and then confronted with the opinions of EU policy-makers and eNGOS active at the EU level.

4.3.2.1 GHG savings

The key argument in favour of bioethanol is of course its significant savings of GHG compared to its fossil equivalent (petrol). The evolution of GHG emission savings allowed by the use of ethanol as a renewable fuel are illustrated in figure 4.4. We can see that since 2009 the industry has made significant improvement, going from around 50% of GHG savings to almost 60% in 2013. Notice that data on GHG savings and ethanol GHG emissions for specific company are not public since 2013 because they are considered sensitive informations (Sievers 2016). Eric Sievers (2016), the CEO of Ethanol Europe, estimates that the GHG savings achieved in late 2015 and early 2016 by Pannonia Ethanol were close to 70%, and expects them to be close to 90% by the end of the decade (see dotted lines on figure 4.4). The performance and expectations of Pannonia Ethanol and Ethanol Europe are considered 'consistent with the rest of the (European) industry' by Mr Sievers (Sievers 2016).

It is interesting to compare those numbers to the evolution of the different environmental criteria implemented in Europe. The first sustainability criteria was implemented via the RED in 2009 (EU 2009a). These sustainability criteria imposed a GHG savings target for biofuels of at least 35%, starting in 2013. This target is then of 50% for 2017 and 60% for 2018. This means that in 2009, bioethanol was 15% more environmentally efficient than what was required. The minimal goal of the FQD, the second part of the CEP with the RED, was in 2009 a 6% reduction of actual GHG per unit of energy from fuel and energy supplied by 2020 (EU 2009b). This means that in 2009, if only bioethanol is used to decarbonise

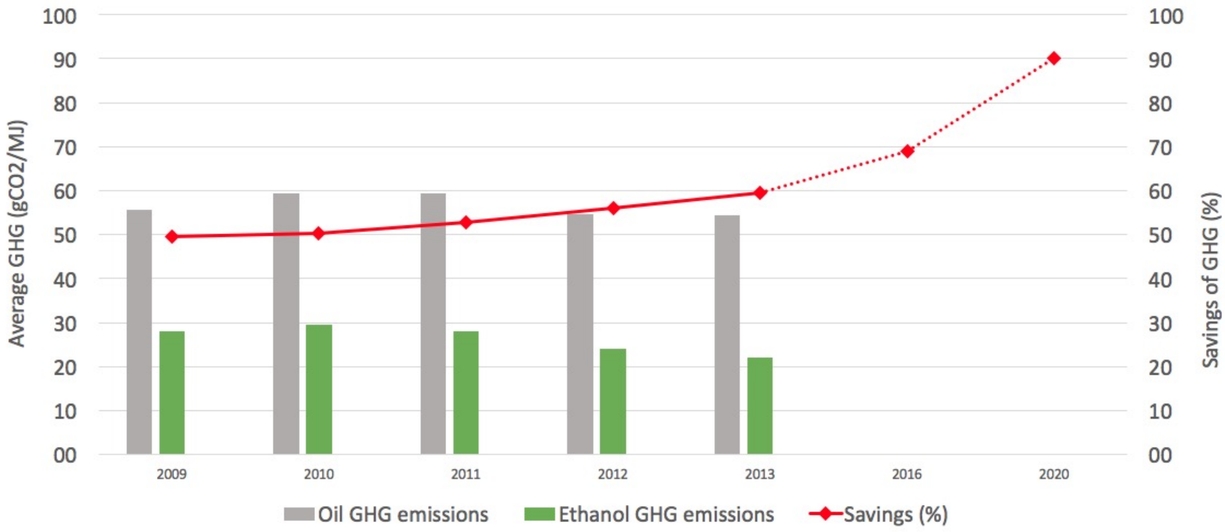

Figure 4.4: Average oil and ethanol GHG emission in Europe along with the associated GHG savings and their predicted evolution (data adapted from (PE 2016b; Sievers 2016))

transport, a minimum of 12% of bioethanol blending (E12) was needed to achieve a 6% GHG savings.

The development of the ILUC concept between 2009 and 2012 via different mathematical models such as Aglink-Cosimo and Mirage makes the GHG emissions accounting more complex. As the models are based on different assumptions, the variability in the results increases. To prevent potential devastating consequences, the European Commission decides to make the environmental criteria of the CEP more stringent in 2012: newly built refineries will have to reach a 60% GHG savings by 2014 (so in two years) (EC 2012). Refineries built before 2014 gain an extra year to reach 50% of GHG savings (so in 2018), but will they have to include estimates of ILUC effect. Notice that the impact assessment accompanying the 2012 amendments (see figure 2.5) estimate that corn-based bioethanol a little bit above 50% of GHG savings (including ILUC effects). Ethanol Europe estimates the GHG savings of corn-based bioethanol around 55% (PE 2016b). Given that the ILUC effect of corn-based bioethanol is low (around 20% in figure 2.5), the variability is low as well. Corn-based bioethanol is in 2012 already respecting the more stringent environmental criteria of 2018. Mr Sievers' even estimated GHG savings for corn-based bioethanol around 70% for 2016 and 90% for 2020 (Sievers 2016). If Mr Sievers' expectations are met, by 2020 a blending of only

6.7% will be required to achieve a 6% GHG savings per unit of energy from fuel and energy supplied.

The good environmental performance of corn-based ethanol (high GHG savings and low ILUC) is thus a key argument for Ethanol Europe in order to protect the bioethanol industry. This argument was shared by all policy-makers interviewed during this work: they were all in favour of biofuels, or at least considering the option seriously, because of their significant GHG savings (DG ENER C1 rep. 2016; DG ENER C2 rep. 2016; DG ENVI F1 rep. 2016; DG MOVE C1 rep. 2016). The interviewees estimate that biofuels constitutes a good transition solution to a greener economy, since they display significant GHG savings and need low infrastructure/engines modification. This is while other more sustainable options such as electrification are being developed for the longer term. The argument was however nuanced by the interviewee from the DG ENVI, which estimates that while biofuels originating from agricultural surplus or increased yields might have a positive impact, other negative environmental consequences such as land use competition and the negative impact on soil and biodiversity needs to be considered as well (DG ENVI F1 rep. 2016).

However recent reports about bioenergy are not as optimistic as Mr Sievers. In 2016 a key study, the Globiom report, estimated corn-based ethanol around 50 gCO_2/MJ, so a GHG savings of around 42% (including ILUC emissions from the most updated science, see figure 4.6) (Valin et al. 2015). Those numbers put the industry in jeopardy since the industry might not reach the minimum of 50% GHG savings by 2018. Given that the RED makes sure that 'biofuels and bioliquids that do not fulfil the sustainability criteria (...) shall not be taken into account' in the targets (EU 2009a), the bioethanol industry might lose their subsidies in the near future if those numbers were accurate.

4.3.2.2 The use of irrelevant and outdated data

The discrepancies between the data from the Globiom report and Ethanol Europe's numbers about GHG savings and ILUC effect is an illustration of how technical and complex the discussions about biofuels can be.

This argument is highlighted by the interviewee DG ENER C1 (2016), which estimates that fact-based discussion about biofuels are very difficult due to 'lack of facts and misunderstanding of the complexity and linkages between different sectors'. This interviewee also highlights the large variety of sectors involved and the strong interactions between some of them such as agriculture, oil and car sectors. The interviewee thus concludes oversimplification in populistic statements are very common (DG ENER C1 rep. 2016).

Oversimplification and populistic statements including the use of outdated or irrelevant data thus logically constitute another major argument put forward by Ethanol Europe's representatives. This is supposedly mainly done by biofuels opponents in order to send contradictory messages and harm the reputation of biofuels. Mr Szabo for example strongly criticises the inability or unwillingness of eNGO to create a clear differentiation within conventional biofuels (Szabo 2016). He argues that since the ILUC impact analysis of 2012 and more recently the Globiom study in 2016, biodiesel and bioethanol have significantly different environmental impacts (as illustrated on figure 2.5 and 4.6) and should therefore not be considered as equal under the denomination of bioenergy. He argues that this non-distinction has dramatic consequences for ethanol and push policy-makers to 'throw out the baby (ethanol and other promising conventional biofuels) with the bathwater' (Szabo 2016). He also estimates that palm oil-based biodiesel, demonstrated a numerous times as environmentally inefficient, is used as a scapegoat by environmentalists while the fraction of palm oil used for biofuels is small (around 10%) compared to the fraction used by the food industry (Szabo 2016). Mr Szabo argues that because of opinion papers publicly released years ago, eNGO can no longer nuance their opinion without directly contradicting themselves and appear publicly unreliable. This argument is supported by the interviewee from T&E for example, which estimates that its main aim is to 'eliminate biodiesel' from the European market even if it means giving up more promising technologies in the process (T&E rep. 2016).

The tendency of NGO to take informations out of context to support their case is an argument shared by different interviewees from the DGs (DG ENER C2 rep. 2016; DG ENER C1 rep. 2016; DG MOVE C1 rep. 2016). Even though all interviewees from the European Commission were concerned about being equally accessible to industry and NGOs, many were quite critical about NGOs. The interviewee DG ENER C1 for example argues that NGOs don't have a practical view about what is feasible, and that they focus on should be done. He argues that it's easy to blame biofuels for everything, even though 'biofuels have done more for palm oil security than all the food sector all together' via the sustainability criteria and GHG methodology (DG ENER C1 rep. 2016). The interviewee DG ENER C2 qualifies the NGOs as 'aggressive' and 'extreme' in their attitude towards BF, and estimates that the majority of politicians is influenced negatively because of NGOs' tendency to take sentences out of context (DG ENER C2 rep. 2016).

ePURE's interviewee (2016) estimate that eNGO do not have any interest in supporting a particular biofuel such as bioethanol in the future, as it would greatly weaken their main message about biofuels (ePURE's rep. 2016). As Mr Szabo, the interviewee argues that it would also directly contradicts their prior releases about conventional biofuels and make them appear unreliable. However the interviewee nuanced NGO's attitude: even though NGOs campaigned for many years against all kind of biofuels, creating a clear schism with ePURE, he estimates the relations between ePURE and NGOs has got better in the last years (ePURE's rep. 2016). The interviewee estimates that NGOs are currently adjusting their message accordingly to the latest science by for example targeting palm oil-based biodiesel more compared to conventional biofuels in general. However ePURE's interviewee estimates that eNGO will rather move on and find another enemy to fight such as palm oil than acknowledging a potential misinterpretation and nuance their discourse (ePURE's rep. 2016). While this shift in attitude has been confirmed by T&E's representative, the latter also estimates that the bioethanol industry should clearly position itself against the biodiesel industry in order to definitely stabilise the relations between NGOs and the bioethanol industry (T&E rep. 2016). This position is shared by the EEB's representative as well, which further argues that ePURE's ambiguous position indirectly lead to the ILUC directive in 2015 and its undifferentiated cap on all types of conventional biofuels (EEB rep. 2016).

On the other hand, it is important to notice that even though relations between Ethanol Europe and NGO can be chaotic, all interviewees from the European Commission highlighted their good relationship with Ethanol Europe and the bioethanol industry in general. The interviewee DG ENER C2 (2016) for example argues that its top priority is to 'know how the different actors in the market think' (DG ENER C2 rep. 2016). The interviewee has had many open discussions with Ethanol Europe's and Pannonia Ethanol's representatives, and is aware for example of the advancements made at the biorefinery in Dunaföldvár (see 'other strategies' below for more informations). Meetings between industry representatives are mainly formal via planned meetings and experts conferences, as highlighted by interviewee from DG MOVE (DG MOVE C1 rep. 2016). Meetings are used to confront DG's opinion with the experience of other stakeholders, as well as to gather new elements and data, as argued by the representative of DG ENVI (DG ENVI F1 rep. 2016).

The interviewees from the European Commission also highlighted the role played by associations such as ePURE, which has a more holistic view of the sector compared to single companies such as Ethanol Europe. An interviewee even claims to complement Eurostat numbers with statistics compiled by ePURE given their great clarity and completeness (DG ENER C1 rep. 2016). It is interesting however to notice that since European Commission interviewee meet directly with the industry, some estimate that independent lobbyists (such as Mr Roche and Mr Cogan) are completely ineffective and useless (DG ENER C2 rep. 2016).

4.3.2.3 The EU's unbalanced fuel taxation

There is a tendency from the different Ethanol Europe's representatives to portray the bioethanol industry as a victim of bigger forces. As seen above, a good illustration of this is the argument of Mr Szabo, which displays the bioethanol industry as a victims of its association with less environmentally efficient conventional biofuels such as palm oil-based biodiesel. Another 'victimisation argument' put forward is the unbalanced EU's fuel taxation (Szabo 2016).

Many Ethanol Europe's representatives such as Mr Roche have indeed brought up the EU's fuel taxation and its preferential treatment towards diesel rather than renewable energy such as biofuel (Roche 2016). Bioethanol is indeed heavily taxed compared to its energy content, as illustrated on figure 4.5. Mr Cogan argues that the taxation originates from the lobby of the huge oil companies in collaboration with huge car companies, in order to create a system with enormous inertia which prevents the biofuel industry from growing in the European market (Cogan 2016). Mr Roche argues that this system is twisted and counter-intuitive, especially after the dieselgate and the public leaks demonstrating how the car manufacturers were cheating on the diesel emissions. Mr Roche concludes by denouncing a 'continuum of guilt across the whole spectrum of EU policies' in this matter (Roche 2016).

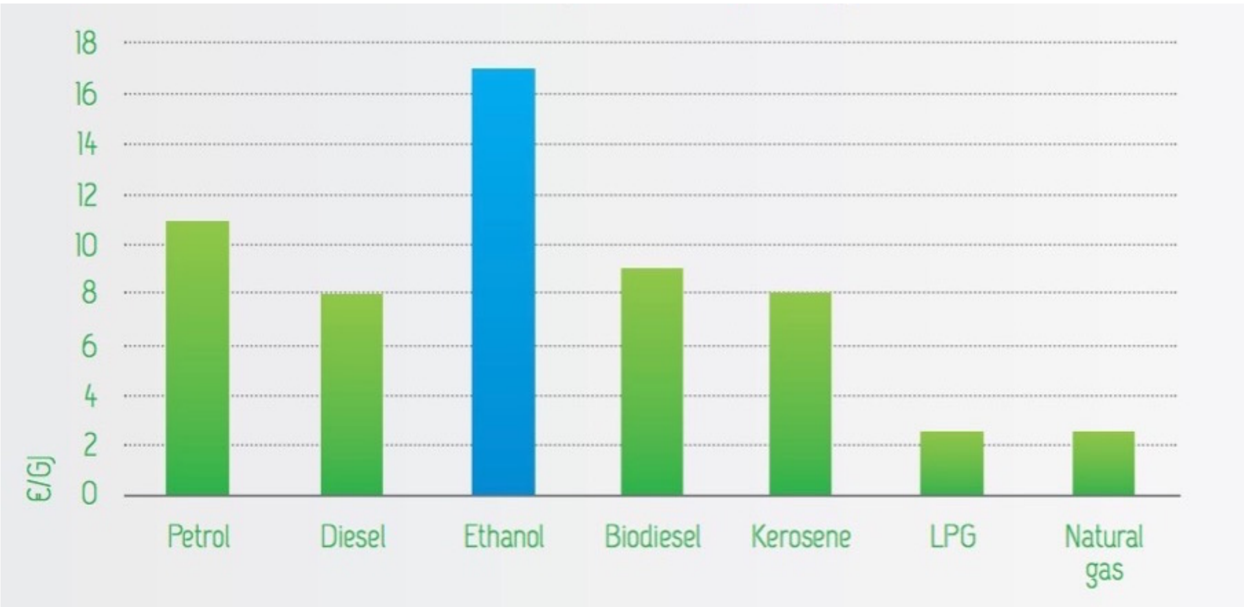

Figure 4.5: Taxation of transport fuels by energy content (ePURE 2015)

It is interesting to notice that the argument about preferential taxation treatment towards diesel, one of the most polluting liquid fuels, is also controversial within the different DGs. The interviewee DG ENER C1 (2016) for example strongly denounces the current system (DG ENER C1 rep. 2016). However there are a few reasons explaining the taxation systems:

the first one is that taxation is a member state competence and not an EU one, as pointed out by an interviewee from DG ENER (DG ENER C1 rep. 2016). The interviewee argues that member states are not ready to give up preferential treatment to diesel because of its extensive use in heating and cooling, which is a very sensitive political question because of its social aspect (DG ENER C1 rep. 2016).

Another reason explaining the EU taxation treatment is the so-called 'European diesel deficit' (see the introduction for more details). The interviewee DG ENER C1 (2016) argues that while gasoline is on average more abundant in the rest of the world compared to diesel, the situation is the opposite in Europe (DG ENER C1 rep. 2016). The EU diesel deficit thus fostered gasoline exportation from the EU and diesel importation to the EU. In this sense, biodiesel produced in Europe theoretically can increase energy security and help to reach environmental targets in Europe by replacing fossil diesel imports from outside of Europe. This might explain why the biodiesel is less taxed compared to bioethanol in Europe, the latter being of less use. It is important to notice however that in practice biodiesel doesn't display significant GHG savings and can even be more pollutive than its fossil equivalent because of its high ILUC effects (see figure 4.6). While Mr Roche (2016) argues that the European diesel deficit has been caused by the EU taxation framework, it is thus more likely that the unbalanced taxation system is just the reflection of physical scarcity of resources such as diesel in Europe. In this sense, bioethanol industry is thus indeed victim of other forces such as disparate physical resources in Europe and social aspects of other fuels such as diesel. It is also important to notice that the development of shale gas in the US and the massive production of bioethanol in the US and Brazil might threaten the market for EU gasoline exportation in the future, decreasing the demand for bioethanol in Europe even more compared to biodiesel.

4.3.2.4 Economic benefits

Another argument put forward by Ethanol Europe's representatives is the large economic benefits bioethanol production creates. As biofuels are produced all year long, growing crops for biofuel production brings economic stability to farmers as 'cash crops' especially for farmers in Eastern Europe countries such as Hungary or Romania (Roche 2016; Sievers 2016). In practice Ethanol Europe is under contract with many farmers, guaranteeing a fixed price for grown corn (PE 2015c). As the leading ethanol producer in CCE, Pannonia Ethanol has an estimated impact of 500 millions euro on Hungary's GDP (PE 2015c). The plant in Dunaföldvár has created 2000 long-term jobs, mostly in the rural areas around the plant. As the mayor of Dunaföldvár puts it: 'As a stable, large employer operating a pollution-free industrial asset, Pannonia (Ethanol) has given this community the income and anchor investment necessary to enable our transition to a sustainable future based on the rural bioeconomy' (Jessen 2014).

This argument is also shared by some DGs such as the DG AGRI and DG ENER. As argued by the EEB's interviewee, the DG AGRI is pro-biofuels as it has blocked the amendments of the CEP in 2012 in order to protect the additional steam of income for the farmers originating from biofuels (EEB rep. 2016). The DG AGRI is thus less concerned by environmental issues, compared to the DG ENVI. The bioethanol industry also displays agricultural benefits: by stabilising the farmer's incomes, farmers can invest more in equipment and commodities and increase the productivity of their agricultural lands.

In this sense Mr Roche argues that the cap on conventional biofuels might lead to the loss of a huge economic opportunity for Eastern Europe countries (Roche 2016). Indeed he estimates that those countries 'have important unused lands' which could be used for biofuels production, but that 'their interests have not been properly defended and looked at' (Roche 2016). This argument is not agreed upon by EU policy-makers and eNGOs. Interviewee DG ENER C2 (2016) for example argues that it is more about how proactive EU countries are (DG ENER C2 rep. 2016). Interviewee DG ENER C2 also argues that the 7% undifferentiated cap from the ILUC directive on conventional biofuels doesn't match the actual production, which leaves room for more investments (DG ENER C2 rep. 2016). On the other hand all the eNGOS interviewed for this work highlights the potential risks for biodiversity resulting from growing crops on currently 'unused land' (T&E rep. 2016; EEB rep. 2016; IEEP 2016). Those interviewees argues that aiming for energy efficiency would be a far better solution, which might also end up being a greater economic opportunity in the long term.

4.3.2.5 The generalised approach towards conventional biofuels

A last argument widely used by Ethanol Europe's representatives is the critique of the undifferentiated cap formulated in the CEP amendments in 2012 and then the ILUC directive in 2015 (Sievers 2016; Reng 2016; Cogan 2016; Szabo 2016). Those caps make the bioethanol industry face a clear regulatory risk for the period post-2020, by tying the bioethanol industry to less environmentally efficient type of conventional biofuels such as biodiesel. This discriminating approach towards conventional biofuels has thus been strongly criticised by all Ethanol Europe's representatives interviewed for this work. The lack of differentiation between bioethanol and biodiesel in EU policies, two biofuels diverging by the process and environmental performance, has for example been qualified 'as the most frustrating part of the policies' by Mr Szabo (Szabo 2016).

However EU policy-makers and eNGO's representatives are well aware of the differences within conventional biofuels. An extensive distinction between the different types of biofuels can be found in many different official EU documents such as the RED (Annex III), the FQD (Annex IV), the impact assessment accompanying the ILUC amendments in 2012 or the Globiom study requested by the European Commission in 2015 (Valin et al. 2015). In addition, the policy-makers met during this work all stressed the crucial need to meet regularly with the industry to update their knowledge, getting insights about practicalities, and more generally argue about how to improve the current situation. Qualifying EU officials and eNGO representatives as not knowledgeable/competent enough is thus more of a political statement than a practical reality.

In practice, an element that might have lead to the undifferentiated cap between conven-

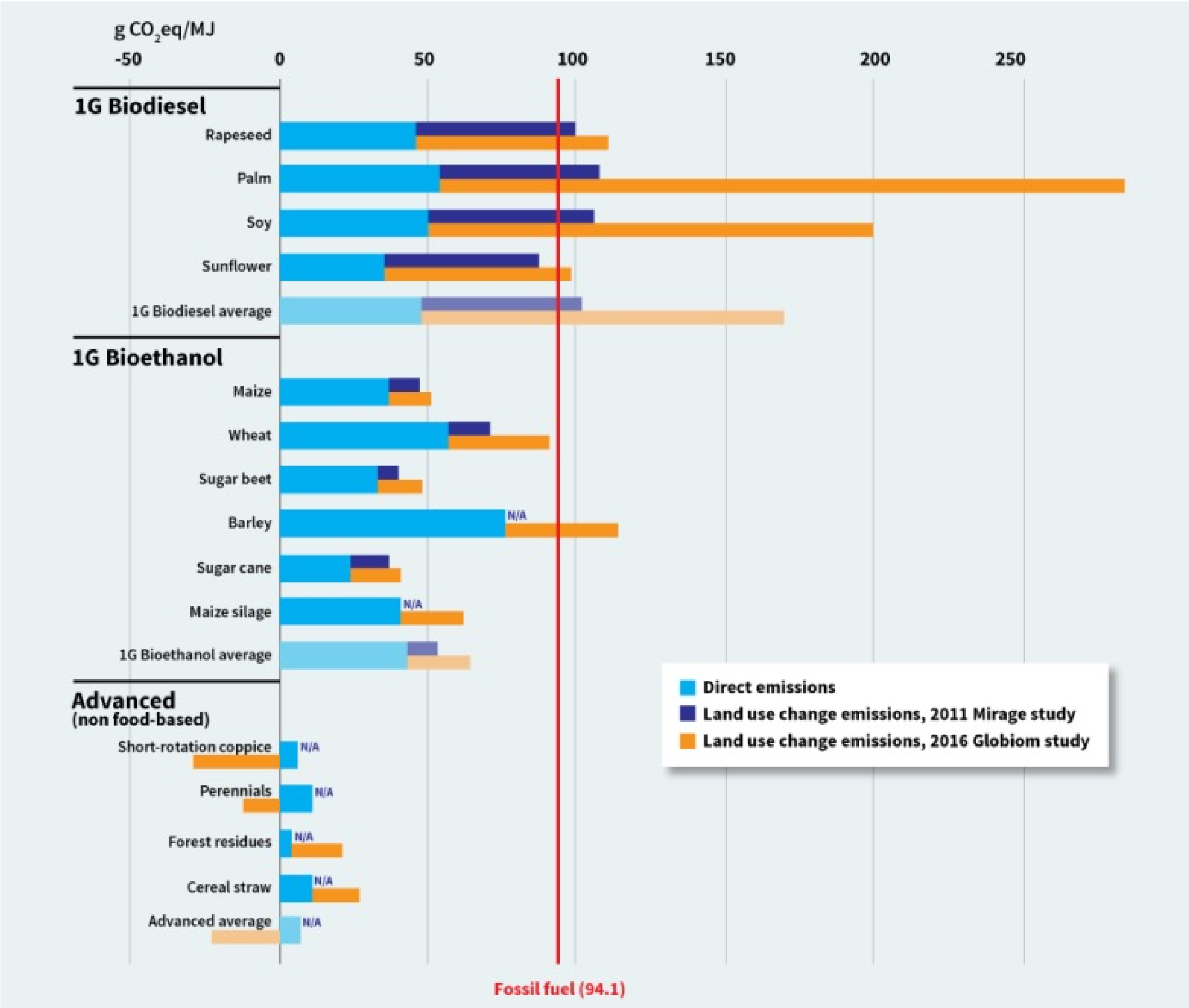

Figure 4.6: Emissions from biofuels made from different feedstocks, composed of direct emissions (from Renewable Energy Directive) and land-use change emissions (from Mirage and Globiom studies) (T&E 2016d)

tional biofuels is the ambiguous position of the bioethanol industry. Indeed while bioethanol and biodiesel are biofuels with very different environmental performances (as highlighted by Ethanol Europe's representatives), the interests of the two industries are tied in practice because they share common interests. bioethanol's industry ambiguous approach is especially apparent within ePURE: indeed the association also includes agricultural cooperatives with interests in the biodiesel industry. When asked about the issue, ePURE's representative explains that 'the bioethanol industry can't fight the biodiesel industry since it is basically the same people' (ePURE's rep. 2016). When it comes to Ethanol Europe, the development of advanced biofuels at the Dunaföldvár biorefinery is also a good illustration of the blurry boundary between bioethanol and biodiesel industry's interests: while Ethanol Europe is specialised in bioethanol production (as its name indicates), it is today developing a process via Naturally Scientific which will be involved in (advanced) biodiesel production (see the 'Research and Development' section below).

Because bioethanol and biodiesel are very different products, they call for different lobbying strategies. Biodiesel has proved many times to have a great environmental consequences with high ILUC effect (creating deforestation in third countries because of palm oil production) which resulted in low or even negative GHG savings (see figure 4.6). The biodiesel industry is thus involved in more aggressive lobbying activities that include denial of scientific evidence (EBB 2016a; EBB 2016b) and obstruction of the release of new scientific studies such as the Globiom study (EEB rep. 2016). This is in clear contrast with Ethanol Europe's representatives, who push for a GHG quota approach, the acknowledgement of new science study and especially the Globiom study, which is more in favour of bioethanol than biodiesel (Sievers 2016; Szabo 2016). However the bioethanol industry do not issue statements publicly backing up new science, which contrasts with how strongly the Globiom study is publicly antagonised by the biodiesel industry.

The love-hate relationship between the biodiesel and the bioethanol industries has devastating effect for the latter. ePURE and the bioethanol industry are stuck: the nasty game played by the biodiesel industry is poisoning the biofuel debate, and leading a potential phase-out of subsidies for conventional biofuels for the period post-2020 (such as suggested by Marie Donnelly, the director of Directorate C of DG ENER, see (Simon 2016)). Biodiesel's bad environmental performance is the main reason of eNGOs opposition to a conventional biofuels development in Europe. Indeed phasing-out biodiesel is the top priority of eNGOs', and especially palm oil-based biodiesel, which is evaluated as 3 times worse than its fossil equivalent in the Globiom study (see figure 4.6). In the NGO's sense, palm oil-based biodiesel is sufficiently bad to justify the loss of other better performing product such as bioethanol (T&E rep. 2016). This statement is even clearer after one of T&E's latest release in May 2015 highlighting that 45% of imported palm oil in EU is used for biodiesel production, as opposed to the traditional 10% number advanced by the industry (T&E 2016c). As explained by an EEB's representative, the EEB and ePURE were 'close to a common position, but that it did not materialise because of ePURE's lack of will to differentiate itself from the biodiesel industry' (EEB rep. 2016).

4.3.3 The perfect policy framework

Ethanol Europe's representatives are lobbying in Brussels in order to shape a policy framework more favourable to bioethanol. Such a perfect (or at least better) policy framework would in their sense recognise the role ethanol could play in reducing GHGs and stop assimilating ethanol to other kind of less performant conventional biofuels such as biodiesel (Sievers 2016; Szabo 2016; Cogan 2016). In this sense, a policy framework based on a carbon intensity approach such as the FQD's (see policy review for more details), has been praised by all Ethanol Europe's representatives. Such an approach, combined with a phase-out of subsidies, would let the markets differentiate the different biofuels based on the environmental performance and economic cost. This might thus theoretically foster bioethanol compared to biodiesel in a free market, given bioethanol's far better environmental performance (see Globiom estimations on figure 4.6).

Fostering the carbon intensity approach of the FQD in the period post-2020 compared to the RED approach has been praised by all interviewees from the European Commission and eNGO's representatives as well. However T&E and the EEB (2016) would support such an approach at the strict condition that the environmental criteria are strengthened even more (T&E rep. 2016; EEB rep. 2016). This means that GHG accounting should includes all types of GHG emissions originating from biofuels production, especially the ones originating from ILUC effect, in order to not go back to the legislation of 2009 before the ILUC debate (T&E rep. 2016; EEB 2016). This framework would in their sense develop advanced biofuels by limiting biomass overexploitation and decreasing ILUC effect in third countries by penalising high ILUC biofuels such as biodiesel. In order to smooth the transition, T&E's interviewee argues that gradual indicative targets for advanced biofuels (such as in 2025) are needed as well as an explicit long-term objective to stabilise the investments (T&E rep. 2016). The indicative targets would be constantly reevaluated in order to make sure that the advanced biofuels produced are not environmentally disruptive.

However many interviewees argue that lots of unknowns remain about the most efficient way to reach a carbon-free transportation sector in the long term. The interviewee DG ENER C2 (2016) for example argues that the likely policy approach post-2020 is the transfer of quotas (so an extension of the RED approach) from member states to market operators (oil companies) (DG ENER C2 rep. 2016). The interviewee agrees that a carbon approach would be more effective, but argues that it would be hardly doable politically speaking. On the other hand eNGOS are strictly against the quotas approach such as volume/blending mandate for biofuels (T&E rep. 2016; EEB 2016). T&E's interviewee for example estimates that biofuels mandates is a risky option since advanced biofuels might also hide great potential environmental risks (T&E rep. 2016). The interviewee argues that the ILUC effect came as a surprise for conventional biofuels, and that a new environmental threat might create a new u-turn in European policies.

There are thus discrepancies between what would be environmentally desirable and what is politically doable, respectively a carbon intensity approach associated with strong environmental criteria and a quota approach. Even if policy-makers, Ethanol Europe's and eNGO's representatives praise an 'improved FQD approach' for the period post-2020, the likely approach for the future is a transfer of quotas from the European to the national level, as pointed out by one interviewee of DG ENER and the interviewee from DG ENVI (DG ENER C2 rep. 2016; DG ENVI F1 rep. 2016). This is mainly due to the extreme political difficulty originating from the complexity of the biofuel debate. While all European Commission interviewees push for the development of advanced biofuels and the electrification of road transport in the mid and long term, the interviewees also acknowledge that the future of biofuels in Europe is too complex to predict. The variability originates from a variety of factors: the first one is the differences between the technological development of the different advanced biofuels. While the ILUC directive has an indicative target of 0.5% of advanced biofuels for 2020 (EU 2015), it is quite difficult to predict the amount of advanced biofuels that will be available on the markets by 2030, as highlighted by an interviewee from DG ENER (DG ENER C2 rep. 2016). The interviewee DG ENER C1 (2016) highlights that a good policy framework would foster diversification of feedstocks needed for the different advanced biofuels in order to stabilise energy security in Europe (DG ENER C1 rep. 2016). The successful transition of advanced biofuels through the so-called valley of death and their introduction in markets is also a difficult step, as explained by an interviewee from DG ENER (DG ENER C1 rep. 2016).

Another major source of uncertainty is the shift of paradigm in the biofuel debate during the last ten years, from 'biofuels vs oil industry' to 'internal combustion engines vs electrical engines', as explained by the interviewee DG MOVE (DG MOVE C1 rep. 2016). The interviewee indeed estimates that the future of biofuel might be threatened in the near future by a technological breakthrough in electrical battery development, which will greatly accelerate the development of cheap electric cars. In this sense, the interviewee estimates that the decarbonisation of transport has become more of a technological than a political challenge, and is thus uncertain as well as out of politicians' hands (DG MOVE C1 rep. 2016). It is however important to notice that breaking down a European target into national targets might create a legal system too soft to succeed, as pointed out by the interviewee from DG ENVI (DG ENVI F1 rep. 2016). The interviewee argues that in such a case success will depend on the will and efforts of the European Member States to promote renewables, as well as on more general framework conditions such as oil price or the cost of renewable energy development. The interviewee concludes that the EU 'won't be able to hold the Member States legally accountable' in the case of failure (DG ENVI F1 rep. 2016). Such an approach might thus threaten bioethanol industry's future.

Apart from the political difficulty, another reason explaining the success of the quota approach compared to the carbon intensity (even though the latter is praised by all interviewees in this work) is the lack of coordination of bioethanol producers. Many Ethanol Europe's representatives estimate that the vast majority of ePURE members are neglecting their representation at the European level, or at least not investing enough effort and money to allow ePURE to have a significant impact on the policy-making process (Sievers 2016; Cogan 2016). Ethanol Europe's representatives also argue that ePURE lacks efficiency, ambition and a long-term vision. Those are mainly caused by the variety of point of views within ePURE's members about the most efficient strategy to adopt in order to protect the renewable ethanol industry. Some interviewee then describes ePURE as a mirror of the ambient disorganisation in the ethanol sector. This lack of efficiency from both ethanol producers and ePURE is the reason that pushed Ethanol Europe to invest unilaterally and send its own lobbyists to Brussels (Mr Cogan and Roche), in addition of being heavily involved within all the different regular and special working groups of ePURE (see ePURE's internal structure on figure 4.3).

ePURE's lack of efficiency is nuanced by its representative, which argues that effective lobbying activities on the national level are crucial as well since the Council of Ministers is a crucial element of the European decision-making (ePURE's rep. 2016). Indeed the Council is out of ePURE reach, and a usual obstacle to a legislation more in favour of biofuels. In 2012 for example ePURE succeeded in introducing a sub-target specific for ethanol in the proposal for the CEP amendments, which was voted by the European Parliament (ePURE's rep. 2016). The proposal was however unfortunately rejected when analysed by the Council of Europe, mainly because of a lack of lobbying from ePURE's members at the national level (ePURE's rep. 2016). ePURE's representative estimates that the climate-friendly argument of the bioethanol industry can compete with oil companies within the European Parliament, but its influence is greatly reduced within the Council, which is thus where bioethanol needs the most support. Furthermore he argues that national lobby is crucial when it comes to implement European decisions: they shape the national public opinion and help to smooth the transition from fossil to renewable fuels such as in France (ePURE's rep. 2016). Lobbying activities at the national level also prevent or at least counter-balance anti-biofuel lobbies, which can have devastating consequences such as during the E10 implementation in France (ePURE's rep. 2016).

4.3.4 Other strategies

Apart from its lobbying activities, Ethanol Europe is also heavily involved in a variety of technical developments. This strategy has been implemented starting in 2012 in reaction to the changing political framework in the EU. The different technological developments include research and development of advanced biofuels as well as the diversification of existing production methods, in order to increase Ethanol Europe's inertia towards any future political shift. The different projects are reviewed below.

4.3.4.1 Research and development

As explained above, Ethanol Europe's development was greatly impacted by the political shift in Europe in 2012. In reaction, Ethanol Europe greatly developed its research and development section in addition of its lobbying activities. The technological development is so significant that Mr Sievers (CEO of Ethanol Europe) estimates that the firm moved from a 'development and operating company', generating incomes from 'buy(ing) someone else's technology' to a technology company (Sievers 2016). Mr Sievers claims that Ethanol Europe might diversify so much in the future that ethanol would not constitute its core income anymore, considering such a scenario a 'success' (Sievers 2016).

Ethanol Europe has been testing more than ten new technologies in Dunaföldvár starting in 2012, the year of the CEP amendments (Sievers 2016). Mr Sievers claims that the majority of those investments turned out to be economically profitable. An example is corn oil: after developing an original system to produce corn oil, the technology paid off within a year (Sievers 2016). Corn oil industrial production started in 2014 with a production of 5.000 tons (see table 4.1). An example of commercial failure is the attempt to convert the fibers originating from the ethanol production process into cellulosic ethanol. The enormous amount of fibers from the ethanol production process could have resulted in 20 millions liters of cellulosic ethanol, but the technology proved unsuccessful (Sievers 2016).

Naturally Scientific technologies limited

In order to boost its research capacities even more, Ethanol Europe also bought the firm Naturally Scientific technologies limited (referred to later as 'Naturally Scientific'), a promising R&D company focusing its efforts on the development of advanced biofuels (Sievers 2016). The advancements achieved by Naturally Scientific ltd are illustrated by the filing of two main patents: the first one is entitled 'Production of biofuels from tissue culture sources' and has been filed in 2009 (Whitton, Dixon, and Merrel 2009). The second one is called 'The photosynthesis process' and has been filed in 2012 (Whitton 2012). The two patents make use of the photosynthesis process while trying to optimise its conditions (lightening, nutrient and medium composition, etc).

In the 2009 patent, Naturally Scientific aims to produce Pure Vegetable Oil (PVO) via a suspension culture of cells in a strictly controlled environment. The process either use both photosynthetic and mesoderm cells (in which case the only inputs needed are light and water), or only mesoderm cells (with artificial inputs of sugar and oxygen). The newly created PVO can then later be converted via a trans-esterification into Fatty Acid Methyl Ester (FAME), the main component biodiesel, or 'in any other product that comprises FFA and vegetable oils' (Whitton, Dixon, and Merrel 2009). Naturally Scientific discovered that maintaining a pH between 4.5 and 5 provokes the acidification of the cytoplasm of the grown cells, causing the release of the oils/FFA from the intracellular storage into the cytosol of the cells and then into the culture medium, creating a micro-emulsion. A pH above 4.5 then breaks down the emulsion and allows the oil/FFA to bioethanol collected in a very east way: on the surface of the culture medium as a discrete layer. Using enzyme inhibitors (to help the transesterification) as well as antibacterial and anti-fungi compounds (to prevent contamination), Naturally Scientific can 'keep cell populations healthy for over a year' (Sievers 2016). The whole process is illustrated in figure 4.7.

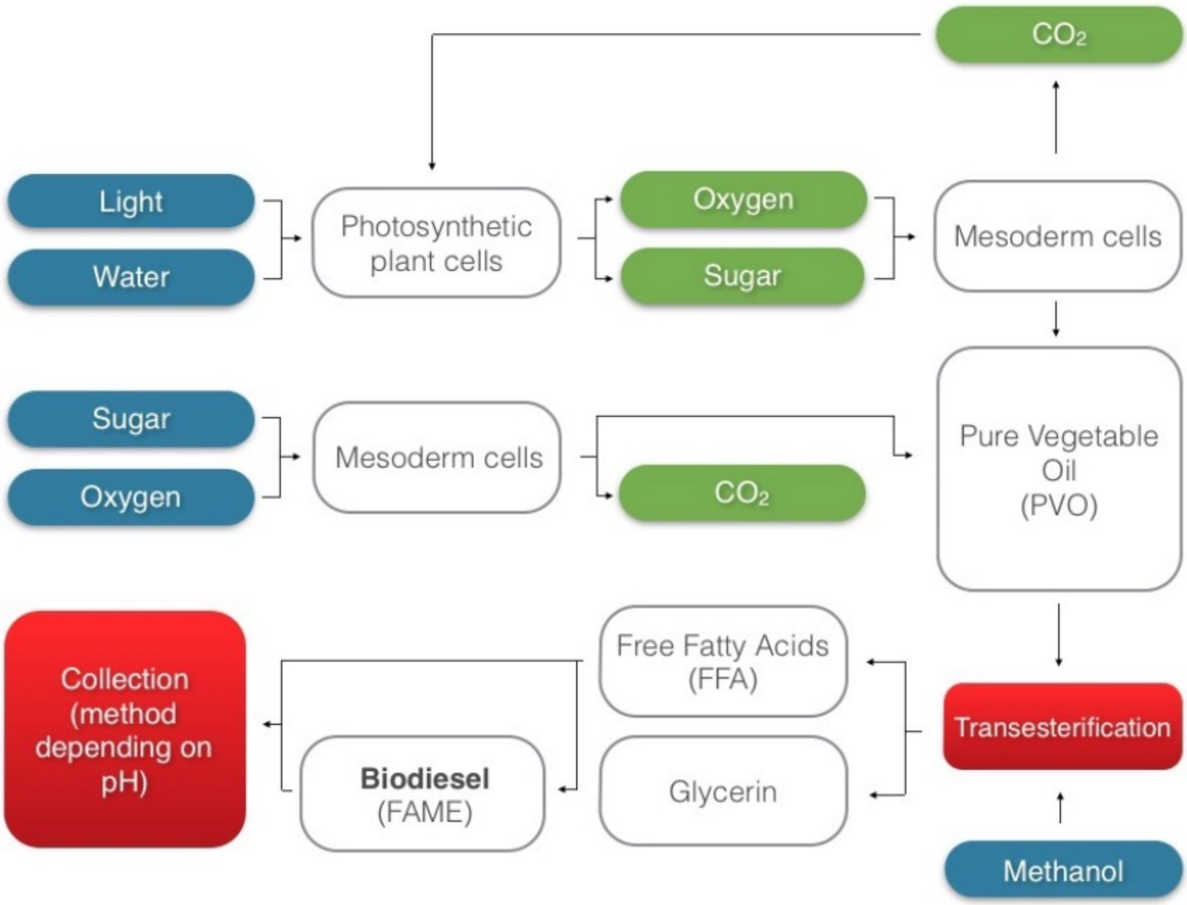

Figure 4.7: Schematisation of the two different processes of the patent 'Production of biofuels from tissue culture sources' filed by Naturally Scientific ltd in 2009

The 2012 patent describes two improvements done to the conventional photosynthetic process (Whitton 2012). The major one is the use of carbonic acid instead of gaseous CO_2 to feed the autotrophic plant cells. This increases of a factor 1000 the concentration of carbonic compounds reaching the plants compared to CO_2 present in ambient air. This approach was never considered before since such high levels of carbonic acid were thought to be toxic. The second improvement is the low pH used during the process: Naturally Scientific discovered that a decrease in pH lowers the energy requirements for photosynthesis (Whitton 2012).

The main advantage of the third generation biofuels produced via the two patents explained above is its lack of competition with conventional food production: as the advanced biofuels is produced in a batch via cell culture, the process doesn't require arable lands. Furthermore, given that the process only requires light and water and thus no feedstock, it doesn't compete with other industries. The low amount of resource needed to run the process also makes it cheap on paper, compared to conventional agriculture processes. For example cells in a controlled medium culture grow at a much faster pace than plants do in natural conditions (soil) (Whitton 2012). It was theoretically determined by Naturally Scientific that the two-culture system of the two patents requires 20 times less energy to produce sugars than what would be needed by plants planted in soil (Whitton 2012). Compared to previous published work of oil-producing algae (which requires energy to lyse the cells and for the recovery of the oil produced), the improvement of energetic efficiency is about 35% (Whitton 2012). The use of solar energy as light input might decrease the costs of the process even further.

The strictly controlled medium also impact the quality of the product: biofuels originating from this new process present a very uniform distribution of chain lengths compared to the ones produced by agricultural means (Whitton 2012). The product can be thus considered more reliable than conventional biofuels. Other improvements were achieved during the research of Naturally Scientific: the amount of methanol required for the transesterification for example has been greatly lowered. Beforehand, a ratio of 6:1 of methanol was needed in addition to PVO to create FFA (Whitton 2012). In this process, the ratio is only 1/7.5, therefore a 4500% improvement of efficiency in methanol use (Whitton 2012). This lowers the final price of the product even more by decreasing the price of the input needed of methanol. However as this new process is currently being tested in Ethanol Europe's biorefinery in Dunaföldvár, there is no empirical evidence to demonstrate that process is feasible in practice, or that the energetic balance is profitable yet.

4.3.4.2 Valorisation of ethanol production by-products

In addition to the research and development of advanced biofuels, Ethanol Europe also started to optimise its production process of bioethanol and valorise its by-products. This strategy has three advantages: firstly it increases the benefits from the process, making it possible for Ethanol Europe to lower the price of the ethanol sold on the market, making renewable fuel production more competitive in Europe on global markets. Secondly, the process produce less waste and sewage as well as more desirable commodities which can be used efficiently by other industries, on a circular economy model. Thirdly, it creates additional streams of incomes for the company, making it more resilient to changes in European policies such as the amendment of the CEP in 2012.

As illustrated in the introduction with figure 2.2, there are currently three main products created during ethanol production. The first one Distiller's Dried Grains with Solubles, or DDGS. DDGS production started in 2012 and is branded as 'Pannonia Gold', a 'superior (animal) feed ingredient produced from Hungarian maize' which is GMO and antibiotics free as well as GMP+ certified (PE 2016a). Research is being made to take the fibers out of the product to reduce transportation costs (Sievers 2016). The second ethanol by-product is corn oil. Corn oil is being valorised as an 'ideal for feeding swine and poultry', with a digestibility in the swine digestive tract of 94% and more (PE 2016b). The production of corn oil started in 2014.

A last ethanol by-product is the CO_2 released during by the yeasts during the fermentation process. The CO_2 released in the process is still not being valorised for the moment, as pointed out by Mr Sievers (Sievers 2016). However the CO_2 released is pure and thus doesn't need to be filtrated or concentrated in order to be sold (Sievers 2016). The CO_2 could be used for example by beverages company, but this option is considered 'not very inspiring either from an environmental standpoint or revenues standpoint' by Mr Sievers (Sievers 2016). Other options are being considered as we speak in order to valorise its output of pure CO_2 on the market.

4.3.4.3 Conquest of sectors external to biofuels production

As a commodity, bioethanol can also be used in industries external to the biofuel sector such as the pharmaceutical industry. The mixture of ethanol with additives in order to make an undrinkable solution has for example a wide range of industry uses as a general purpose solvent (PE 2015b). Another application in the pharmaceutical industry is the use of DDGS fibers, one of the by-products from ethanol production. According to Mr Sievers, fibers do provide an immune benefit when degraded the right way in swines' intestinal tract (Sievers 2016). If this market can be reached, Ethanol Europe might valorise its yearly production of 100.000 tons of fibers a year, which have currently a very low economic value.

In the future Mr Sievers has also potential plans to team up with the bioplastic industry (Sievers 2016). Plastic bottles for example are partially made of PET (mono-ethylene glycol), which is a derivative of ethanol (Lligadas et al. 2013). The production of poly-amides is made possible as well, based on the process developed by Naturally Scientific (see the two patents above). Beverages producers or car manufacturers could use those compounds traditionally produced via fossil fuels, without any significant transformation to their industrial process (Sievers 2016). It is also important to notice that the use of renewable input in the bioplastics industry could also benefit the image of the companies using them as a marketing argument (see Coca Cola green for example).

Chapter 5

Discussion

This chapter aims to discuss the position of Ethanol Europe and its strategies in the current context of the biofuel debate, based on the literature review and the results section of this work. In addition, this chapter seeks to identify the different major elements of the biofuel debate, analyse how they interact with the bioethanol industry (and Ethanol Europe in particular) in order to predict different future scenarios for Ethanol Europe and the bioethanol industry. Based on the analysis, some recommendations are given as well.

As we saw, the political framework concerning biofuels quickly changed in Europe: in 2003, the biofuels directive was formulated and the European Commission informally aimed to reach a 20% substitution of conventional fuels by 2020 (EU 2003). Biofuels were meant to increase energy security, while helping environmental preservation and stimulate rural development, the three drivers that have lead the biofuels policy evolution since 1985. However from a logic of minimum target in 2003 (in order to stimulate as much as possible the production), biofuels went to an undifferentiated cap on all conventional biofuels in 2012 (with the amendments of the CEP) and then in 2015 (with the ILUC directive) (EU 2015; EU 2009a). Biofuels went thus from crucial tools for decarbonising EU transport while helping Europe to reach its climatic target and green its EU economy, to technologies with potential disastrous environmental consequences. As highlighted in the policy review and the results section, this shift in attitude towards biofuels in EU legislation originates from two potential environmental consequences of biofuel: their influence on food prices (an effect famous as the ‘food vs fuel’ debate) and the ILUC effect.

Ethanol Europe reacted to this political shift in different ways. The first is starting lobbying activities, which are extensively reviewed in the results section. As highlighted, Ethanol Europe’s representatives used five main arguments during their direct (via its Ethanol Europe’s own lobbyists) and indirect lobbying (via ePURE) at the EU level. The key argument used is the significant GHG savings that allows ethanol use. While the quality of this argument is dependent of the feedstock to produce bioethanol (the Globiom report for example estimates that wheat-based bioethanol doesn’t create significant GHG savings, see figure 4.6), the GHG savings originating from corn-based bioethanol has always proved significant. This is especially true for Ethanol Europe, since the corn it uses is in vast majority originating from Hungary, a country with vast areas of unused lands an ILUC effect with low environmental consequences, if any. Another irrefutable argument in favour of bioethanol is the large economic benefits it creates: Ethanol Europe has an estimated impact of 500 millions euro on Hungary’s GDP, as highlighted in the results section. In the current time of growing urban migration, this wealth creation is even more positive since it benefits rural communities and allow them to develop. Ethanol Europe’s production of biofuels in a decentralised way is also increasing energy security in Europe. Bioethanol is thus increasing energy security (local energy production), environmental preservation (via GHG savings) and rural development (significant impact of the biorefinery in the Dunaföldvár region).

Why then would a policy framework put a cap on conventional biofuels? The answer to this question is complex. As highlighted in the results section, the biofuels debate is by definition transdisciplinary. Each sector involved have interacts differently and adds its own layer of complexity to the debate. The ILUC effect, one of the two environmental consequences of biofuels that lead to the shift of attitude in the EU policy, is a good example of how long and exhausting trying to solve a biofuel issue can be. The concerns about ILUC effects were introduced in the biofuels directive proposal (EU 2003), but were removed from the final version, as highlighted in the policy review. They were formally issued in 2009, the debate took place during 6 years to find a common ground, which lead to the CEP amendments in 2012 (EU 2009a), and the final ILUC directive in 2015 (EU 2015). Creating a science around ILUC robust enough to lead the European Commission and European Parliament revealed a difficult task, as illustrated by the great variability in results between the Mirage and the Aglink-Cosimo models, or more recently the Globiom model (Valin et al. 2015). Apart from science complexity, finding a common ground around biofuels was made even more pressing by biofuels opponents such as eNGO, which were strongly polarising the public opinion about biofuels, increasing the pressure even more on bureaucrats and politicians.

Given the intense complexity of the ILUC debate, the resulting policy from such a controversial debate could not be satisfactory. Indeed policy-makers met during this work explicitly acknowledge that the 5% cap of the CEP amendments, and then the 7% cap of the ILUC directive, are not great solutions. But they were the only solutions doable at that time in order to restrain biofuel production in order to make time to understand their consequences a little more. It was just a precaution to prevent catastrophic consequences originating from biofuels production.

However understandable, the EU legislation went only in three years from stimulating biofuels growth (CEP) to restrain it (CEP amendments). A three years period is extremely short in a policy environment: policies are indeed supposed to be time-consistent guidelines in order to stimulate investments. As highlighted in the results section, Ethanol Europe's biorefinery in Dunaföldvár took three years to be built. The investments based on the 2009 CEP were thus compromised because of political uncertainty, and investors such as Ethanol Europe felt that they were cheated.

Policy-makers however are well aware of the huge consequences such a rapid political shift has had on the conventional biofuels sector. As highlighted in the results section, policy-makers are still today largely in favour of biofuels production. In order to smooth the transition as much as possible, the emphasis in EU policies has been put on advanced biofuels. In that sense, policy-makers can safely push for increasing biofuels production, since advanced biofuels theoretically avoid environmental consequences: because created from waste of without lands, advanced biofuels display no ILUC and no influence on food price (see the literature review for more details). In order to publicly display it and stimulate investments again, a large push for advanced biofuels development has been made available throughout the years, without real success. Because they are no mandatory targets for advanced biofuels yet, investors in the biofuel sector are still on hold today.

Summer 2016 is a crucial period for conventional biofuels producers: a communication about goals for decarbonising transport is expected in July 2016. This communication precedes a new revision of the RED in late 2016. The new legislation is expected to clarify the future of advanced biofuels, and confirm or not the drawback of subsidies for conventional biofuels for the period post-2020. There is a strong controversy currently going on about what such a revision might include. Marie Donnelly, director of section C within the DG ENER, has for example displayed various and sometimes contradictory statements about biofuels future. While the DG ENER is traditionally more in favour of biofuels (since it increases energy security, one of the DG's main concern) compared to other DGs (such as DG ENVI, more concerned by environmental impact of biofuels), Marie Donnelly has claimed that the 10% target for renewable energy in Europe might disappear in the newly revised RED (Simon 2016). Even if such a radical statement has later been denied by representatives from DG ENER, the confusion revolving around biofuels' future is higher than ever. However the new policy framework turns out, it will need to be time-consistent in order to gain back the trust of investors. Such a situation is for the moment unlikely.

As highlighted in the results section, a privileged approach by policy-makers, eNGOs and the bioethanol industry is the carbon intensity approach. Such an approach would focus on reducing the amount of carbon used per unit of energy, as in the FQD (EU 2009b). This is in opposition of implementing fixed quotas of renewable energy, as in the RED. If this 'extended FQD' approach is coupled to strong environmental criteria (to avoid ILUC and influence on food prices), it would allow the different biofuels to compete with each other, based on their ratio 'price per unit of energy/GHG savings'. This would in theory lead to the most cost-competitive way for the EU to decarbonise its transport sector with minimum environmental consequences. In such an approach, given that bioethanol is one the cheapest biofuels available on the market and display significant GHG savings (see figure 4.4 and 4.6), it might in theory dominate the competition compared to biodiesel for example.

In practice, things might go a different way for the bioethanol industry. As highlighted in the results section, the European market is in diesel deficit. Given that ethanol can only be blended in gasoline (and biodiesel in diesel), this gives a clear advantage to biodiesel. Increasing biodiesel production will help to reduce the EU diesel deficit, and thus increase the energy security significantly. Bioethanol however is of less use since gasoline is in over-production and thus exported, mainly to the US. Diesel is also used extensively for heating and cooling, as well as for trucks in the EU. Those two usage are politically highly sensitive subjects. The diesel deficit and its extensive usage in activities with a strong social aspect lead to a preferential taxation treatment towards diesel, which increases even more the advantage of biodiesel compared to bioethanol. If left in free competition in the EU market, bioethanol might be crushed by biodiesel even if it displays better economic and environmental performances.

Counter-intuitively, another advantage to biodiesel is given by the bioethanol industry itself. As highlighted in the results section, the boundaries between the bioethanol's and biodiesel's industries interests are very often blurry. Bioethanol and biodiesel are both conventional biofuels, and thus based on feedstocks. Both industries differ mainly differ by the feedstocks they use, and later by the process is involved. The interests of the bioethanol industry can thus sometimes be shared with the biodiesel industry: some producers might be involved in both bioethanol and biodiesel, as some investors.

However as highlighted throughout this work, bioethanol and biodiesel display very different economic and environmental performance. Biodiesel displays way lower environmental performance, which can sometimes be worse than the fossil equivalent it is supposed to replace. This is especially true for palm oil-based biodiesel, which can be three times more pollutive than the diesel (see figure 4.6). Those bad environmental performance made biodiesel and especially palm oil-based biodiesel the number one target for environmental NGOs: in addition of consuming food perfectly suitable for humans and thus influencing its price, biodiesel often don't even deliver GHG savings, which is its original goal (the environmental driver is the strongest driver in the EU, as highlighted in the literature review). As summarised by T&E, when it comes to biodiesel, the 'cure can worse than the disease' (T&E 2016b).

Phasing-out biodiesel and its subsidies in future legislation has thus become a priority target for eNGOs. This attitude is largely understandable: the biodiesel industry is playing a dirty game such as withholding of new scientific evidence when they disclose biodiesel's bad environmental performance and the denial of existing evidence. Describing the current science about biofuels as not robust and denying biodiesel's (and especially palm oil-based biodiesel) bad environmental performance (see (EEB 2016; EBB 2016b)) is intellectually dishonest: it reminds of the attitude that cigarettes manufacturers adopted towards the growing evidence between tobacco consumption and lung cancer. This kind of lobbying only aims to slow down the debate by poisoning it, in order to gain time and make more profits.

The reaction of Ethanol Europe towards this trend is contradictory: as highlighted in the results section, many Ethanol Europe's representatives were quite critique towards biodiesel and especially palm oil-based biodiesel. Ethanol Europe's representatives were strongly in favour of new scientific evidence, as it was confirming the good environmental performance of bioethanol. Ethanol Europe supports a carbon intensity approach, stronger environmental criteria to limit ILUC and the influence of biofuels on food prices. They share some opinions of the NGO, as illustrated by the recent convergence between ePURE and T&E in the results section. However, the bioethanol industry never went publicly against biodiesel and its excesses. The silence of bioethanol's industry in the media about biodiesel and especially palm oil-based biodiesel speaks volume when compared to how harshly the biodiesel industry antagonises the current scientific evidence.

The bioethanol industry has thus not been able to clearly position itself in the biofuel debate, and especially publicly clarify its position towards the biodiesel industry. In addition to shared interests, this is probably also a consequence of the disorganisation of the bioethanol industry, not being able to decide a clear strategy. As summarised by Mr Cogan: the more you are, the less impact you have' (Cogan 2016). The bioethanol industry, by its passivity when it comes to confront the biodiesel industry, is thus likely to be associated with the other conventional biofuels in a potential future phase-out post-2020. The ambiguity of bioethanol's industry position towards the biodiesel industry might have thus taken the lead over its great environmental performance.

It is interesting to notice that the bioethanol's industry ambiguous attitude might have greater consequences than expected on its activities. While a phase-out of the current production of conventional biofuels for the period post-2020 is possible but unlikely to happen during the revision of the RED in late 2016, a phase-out of subsidies is very likely to take place in order to stimulate the development of advanced biofuels even more. This phase-out of subsidies will not affect the bioethanol and the biodiesel industries in the same way: because of the EU diesel deficit and the preferential taxation treatment towards diesel, the bioethanol industry might well be crushed if left in market in free competition with biodiesel. If environmental criteria are not strengthened, the biodiesel industry might also use more and more palm oil, a very cheap feedstock compared to the one used for ethanol.

While less extensively reviewed during this work, it is also important to consider the influence of the lobbying activities from oil producers. Those are logically negative in majority: as the biofuel sector tries to develop, it takes part of the market formerly acquired by oil producers. However the oil producers strategies can be ambiguous: some for example invested in biofuels development. While this may be done to destroy biofuels industry from the inside (as suggested by ePURE's representative), the companies goal are for the moment unclear. It however already leads to interesting consequences, because the shale gas production in the US threatens the gasoline exportation market from the EU, some oil companies transform existing refineries into biorefineries. Total for example transform in France an existing refinery into a biorefinery producing biodiesel based on palm oil-residues (Biofuelstp 2016). This might increase the competition towards the EU bioethanol industry even more. The development of palm oil use in biodiesel production is indeed currently growing, as illustrated by T&E in the results section: the use of palm oil for the biodiesel industry in Europe has gone from 10% to 45%, far more than food industry share (T&E 2016c). In addition of greatly reducing biodiesel's prices, this massive use of palm oil will also affect the conventional biofuels image even more. In addition of being outcompeted, the bioethanol's industry might thus see its public image even more deteriorated.

In order to fix the current situation, there is only one solution in Ethanol Europe's hands: cut its ties with biodiesel industry, and publicly antagonise its strategy towards scientific evidence in general as well as ILUC modelling in particular. External factors negatively impacting bioethanol's position such as the preferential taxation towards diesel or the EU diesel deficit are indeed unfairly distorting the competition between bioethanol and biodiesel. However such factors are for the main part out of politicians' hands, and are not likely to change anytime soon.

Apart from distancing itself from the biodiesel industry, another way of moving forward for Ethanol Europe is to diversify its activities. Rather than trying to change the current political framework, Ethanol Europe is thus also trying to increase its inertia towards any political change that might happen in the future. Ethanol Europe moved successfully down this path: since 2013, Ethanol Europe has invested in technological development, as illustrated in the results section. Ethanol Europe's change of strategy is so intense that its CEO estimates that the firm is gradually chaining its core activities from an operating company to a technology company.

The technological development has taken two forms with different time-frames: on the short-term Ethanol Europe aims to valorise the by-products originating from bioethanol production. This strategy was successful: it provoked the creation of DDGS and corn oil, two products implemented in the agricultural sector as animal feed since respectively 2012 and 2014 (see table 4.1). In addition to economic valorisation, the development of corn oil and DDGS from waste to agricultural commodities helps Ethanol Europe to develop strong linkages with the agricultural sector, in a circular economy logic. While this improves bioethanol's environmental performance even more, it also makes bioethanol more affordable by diversifying the revenues of Ethanol Europe.

Ethanol Europe also prepares its long term future by investing in advanced biofuels development. As illustrated in the results section, Ethanol Europe bought Naturally Scientific and its ground-breaking technological process based on the photosynthetic process. In addition, Ethanol Europe is also testing new process in its Dunaföldvár plant. Such investments are however economically uncertain: the Naturally Scientific process is currently tested at Dunaföldvár, and was supposed to create results in April 2016. During this work, results were delayed until June 2010, and are now expected in late 2016. The crucial need of Ethanol Europe for inherently uncertain ground-breaking technological development add thus another layer of unknown on the future of the firm.

The situation of Ethanol Europe and the bioethanol industry is thus complex. It is currently not clear whether the great environmental performance of corn-based bioethanol might be sufficient to overcome the negative influence of the biodiesel industry. The development of new technologies might help Ethanol Europe to differentiate itself from the biodiesel industry, but the process is inherently uncertain and might prove unsuccessful. In such a case, Ethanol Europe and the bioethanol industry in general might end up being crushed by the biodiesel industry in the period post-2020, for different reasons such as preferential taxation treatment towards diesel or the EU diesel deficit (see above). Such an outcome would result in the loss of one of the best performing biofuel currently available on the market, and will greatly slow down the decarbonisation of the EU transport sector. Given that the transportation sector is one of the most pollutive EU sector, with no available technological solution to decrease its emissions in the near future (electrification is not ready to be implemented for at least one or two decades at best), such a scenario might threaten the EU's capacity to reach its ambitious climatic target by 2030. A better political framework, such as a carbon-intensity approach, is thus needed but might not be politically doable. This politically issue will hopefully be addressed by the revision of the RED in late 2016, in order to clarify the future of conventional and advanced biofuels.

Chapter 6

Conclusion

The EU political framework has rapidly evolved in the last 15 years. It first started promoting all kind of biofuels in 2003 with the biofuel directive, than it lead to the CEP in 2009 and its 10% of renewable energy target for transport in 2020. However the political framework drastically changed in 2012 with the introduction of ILUC calculations in the GHG savings of BF, which lead the European Commission to put a cap of 7% on all kind of conventional biofuels in 2015 for 2020 via the ILUC directive. This undifferentiated cap has had significant consequences on Ethanol Europe and its development strategies, such as the construction abort of a bioethanol biorefinery in Mohács (Hungary) and a cellulosic ethanol plant in Prilep (Macedonia). In this study, the case of Ethanol Europe and its different strategies to adapt to the changing market is considered.

This work identifies different reaction of Ethanol Europe towards this unstable policy framework. The major one considered in this work is its lobbying activities in Brussels, in order to try to shape the EU policy-making process. Ethanol Europe is represented directly via three of its own lobbyists (J. Cogan, D. Roche, Z. Szabo) and indirectly via the EU association of renewable ethanol producers (ePURE). The lobbying activities are based on five arguments, which are then discussed. The first one is the significant GHG savings of bioethanol as a renewable fuel: this study argues that while GHG savings of corn-based bioethanol were proved significant, they might however not fill the strengthened criteria in the near future. A second argument is the use of irrelevant and outdated data in the biofuel debate, which this work relates to the technical complexities of the biofuel debate. A third argument is the unbalanced EU's taxation towards bioethanol, which this study links to external factors such as a favourable treatment towards diesel and the EU diesel deficit. A fourth argument is the significant economic benefits of ethanol production, which in the case of Ethanol Europe proved significant in Dunaföldvár, where Ethanol Europe's biorefinery is located.

The last argument considered is the generalised approach towards all conventional biofuels, in contrast of their very different environmental performances. This work suggests that the non-differentiation between conventional biofuels in the CEP amendments and the ILUC directive is a policy adopted mainly because it was the only political compromise remaining on the table after the long (six years) and exhausting ILUC debate. In contrast of Ethanol Europe's opinion, this work suggests the three stakeholders of the biofuel debate share the responsibility of this the cap and its devastating consequences. Firstly, the bioethanol industry, as it is not willing to differentiate itself from other more harmful conventional biofuels industry such as biodiesel because of strong common interests. Secondly eNGO, which were not willing to water down their main message towards bioethanol by nuancing their messages in order to keep their political impact high at the EU level. Thirdly policy-makers, which were not able to influence the EU policy-making process enough to guarantee a better outcome for the corn-based bioethanol out of a political difficult situation, even if it displays great environmental performance (high GHG savings, low ILUC). This work suggests that the generalised approach towards conventional biofuels creates a regulatory risk for Ethanol Europe and the bioethanol industry.

Apart from the regulatory risk, this work identifies two major others threats for Ethanol Europe and the bioethanol industry. The first one is the European diesel deficit. In order to reduce diesel imports and increase its energy security, the EU is thus in need of biodiesel (which can be blended with diesel) and not bioethanol (which is blended with gasoline). As the subsidies for bioethanol are likely to be phased-out post-2020, this work suggests that bioethanol risks to be crushed by the biodiesel demand in an open market. The second threat is global competition: in contrast of the EU, the rest of the world is in gasoline deficit and is thus developing its ethanol industry. This work suggests that the EU bioethanol industry, already minor within the EU, would not be able to compete on the global scale with other huge bioethanol industries from the USA and Brazil. The development of shale gas in the US, by threatening the market for EU gasoline, might boost this dynamic.

To face the three threats explained above, this study identifies other reactions of Ethanol Europe. The first one is the valorisation of ethanol production by-products, such as DDGS and corn oil which can used as animal feed, and pure CO_2, which can be sold for example to beverages company. Ethanol Europe is also involved in the testing and development of new promising technologies in the advanced biofuels sector. This is illustrated in this work by the two patents developed by Naturally Scientific technologies ltd (a technologic company owned by Ethanol Europe) which aim to produce pure vegetable oil from two cell cultures via a boosted photosynthetic process. Those strategies aim to increase the inertia of Ethanol Europe towards a rapidly changing political framework by diversifying its activities and incomes. This work however suggests that this strategy might prove unsuccessful in the near future due to the inherent variability in technological developments.

The complexity and unknowns of a potential reform of the current political framework are then addressed. This work identifies the carbon intensity approach of the FQD with a strengthened environmental criteria as the most efficient option. However this solution is considered unlikely because of political difficulties and uncertainties, the lack of coordination between bioethanol producers, and the complexity of the biofuel debate.

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Appendix A

Additional figure

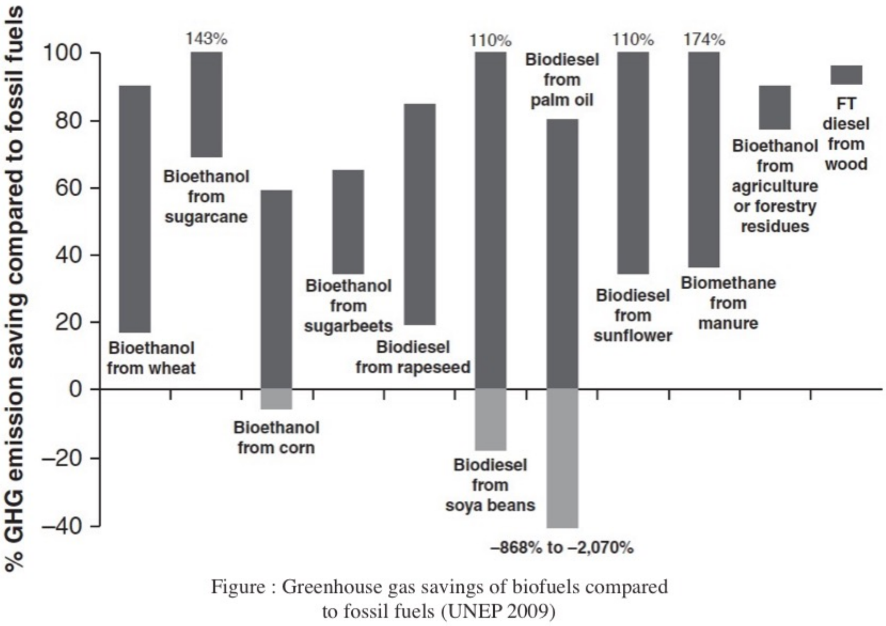

Figure A.1: Greenhouse gas savings of biofuels compared to fossil fuels (UNEP 2009)

Appendix B

Continuation of the calculation of biofuels greenhouse gas impact

$$e_l = (CS_R - CS_A) * 3,664 * \frac{1}{20} * \frac{1}{P} - e_B$$

Where:

- e_l = annualised greenhouse gas emissions from carbon stock change due to land-use change (measured as mass of CO_2-equivalent per unit biofuel energy);
- CS_R = the carbon stock per unit area associated with the reference land use (measured as mass of carbon per unit area, including both soil and vegetation). The reference land use shall be the land use in January 2008 or 20 years before the raw material was obtained, whichever was the later;
- CS_A = the carbon stock per unit area associated with the actual land use (measured as mass of carbon per unit area, including both soil and vegetation). In cases where the carbon stock accumulates over more than one year, the value attributed to CS_A shall be the estimated stock per unit area after 20 years or when the crop reaches maturity, whichever the earlier;
- P = the productivity of the crop (measured as biofuel or bioliquid energy per unit area per year);
- e_B = bonus of 29 gCO_2eq/MJ biofuel or bioliquid if biomass is obtained from restored degraded land under the conditions provided for in point 8.

Appendix C

Platt's Index

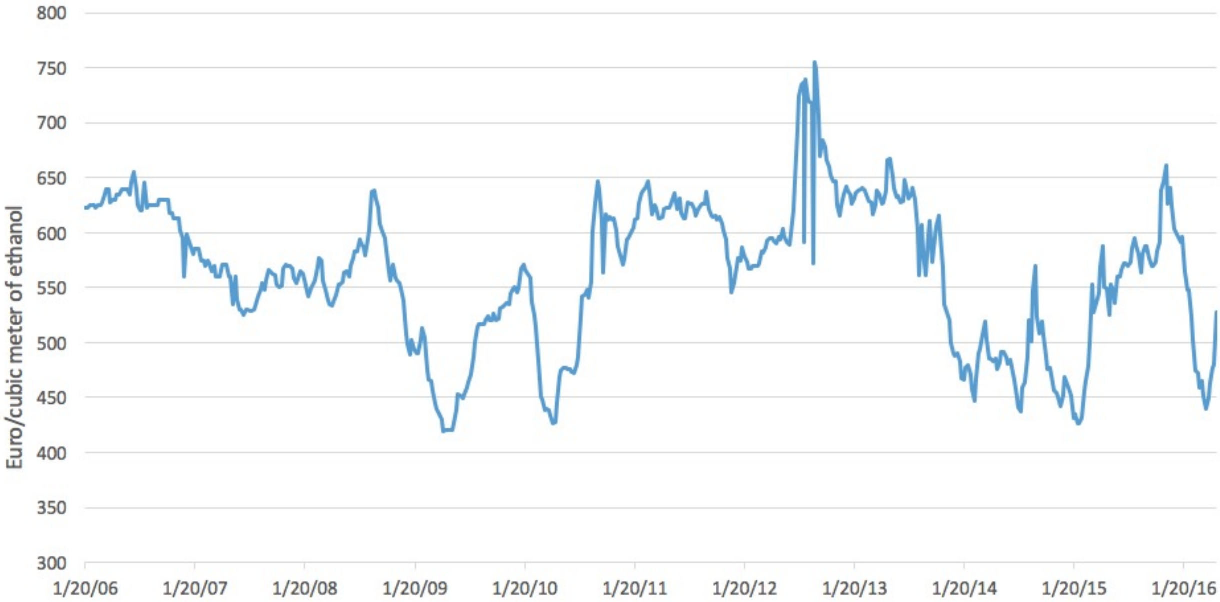

Figure C.1: Evolution of the Platt's index concerning ethanol since 2006 (data obtained via Ethanol Europe)

Appendix D

Example of a questions list for an interview

(First question) Could you describe your precise role within T&E?

Interactions with industries and policy-makers

- How would you describe your relations with the industrial sector?
  - how do NGO interact with policy-makers in general and you specifically? (Formal or informal?)
  - How do you interact back to them? Do you set regular meetings with the different parties of the debate?
  - Do you estimate the biofuel lobby significant compared to the size of the industry? Is it efficient in influencing the debate or influencing you?
  - When was the last time that you were contacted by the biofuel industry? do you have any relation with ePURE or Ethanol Europe in particular (James Cogan, Dick Roche, Eric Sievers or Zoltan Reng?)
  - What are the main conflicts/agreement that you experienced with the industries?
- How would you describe your relations with the policy-makers?
  - How would you describe your relations with the different DG when it comes to biofuels?
  - What are the main conflicts/agreements that you experienced with the policy-makers ?
- Apart from the industries and the NGOs, do you estimate that are there any other important stakeholders in the biofuels debate which are invisible for an external observer?

The future of Biofuels in Europe

- Do you think that biofuels will constitute a credible alternative for road transportation in the future?
- What do you think will happen after 2020? (An abandonment of all biofuels? A shift from the European to the national level (without targets)? Feed-in tariffs?)
- What would be in your opinion the perfect policy framework for biofuels?
- Do you think that advanced biofuels will be commercially available soon and might solve the controversial debate around BF?
- What do you think about Marie C. Donnelly statement: in your opinion should we really get rid of conventional biofuels by 2020?
- Are you aware of the technical advanced being made in Hungary for example for advanced biofuels?