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RESEARCH REPORT

Biofuels—At What Cost?

A review of costs and benefits of France's biofuel policies

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Acronyms

ADEME	Environment and Energy Management Agency
ASCM	Agreement on Subsidies and Countervailing Measures
CAP	European Union's Common Agricultural Policy
FQD	Fuel Quality Directive
IEA	International Energy Agency
ILUC	Indirect land-use change
NREAP	National Renewable Energy Action Plan
RED	Renewable Energy Directive
SNPAA	Syndicat national des producteurs d'alcool agricole
SPS	Single Payment Scheme
TICPE	Taxe intérieure de consommation sur les produits énergétiques
TGAP	Taxe générale sur les activités polluantes
WTO	World Trade Organization

Executive Summary

This report evaluates some of the principal issues associated with France's biofuels industry, including support policies, employment creation, emissions abatement, and the role of biofuels and other renewable technologies in meeting EU renewable energy targets. The report assesses the costs and benefits of the objectives that EU Member States have set out to achieve: increased energy security, improvements in environmental performance and the generation of additional economic value.

In the National Energy Strategy passed into law in July 2005,[1] the French government proposed a range of measures for diversifying the energy matrix in key sectors. Increasing blending targets led to greater market penetration of biofuels. A partial tax exemption for biofuels and a pollution tax that acts as a fine for distributors who miss blending targets were introduced in conjunction with biofuel mandates.

Support to Biofuels

Support to France's biofuels industry in 2011 was estimated at between €170 million and €210 million for ethanol and between €612 million and €800 million for biodiesel.

The main support mechanism for promoting biofuels in France in 2011 were blending mandates putting upwards pressure on EU wholesale biofuels prices compared to lower world wholesale biofuel prices. The French biofuels sector was estimated at receiving market price support between €57 million and €97 million for ethanol and between €455 million and €643 million for biodiesel via higher EU wholesale prices.

2011 excise tax exemptions where biofuels received an exemption on final tax applied to transport fuels when calculated on a per-litre basis totalled €113 million for ethanol and €157 million for biodiesel in 2011.

When adjusted for energy content (resulting in a higher rate of taxation for biofuels when compared to a per-litre basis) the excise tax exemption for ethanol resulted in a positive contribution of €53 million from the industry to government revenues, and the loss of revenue from the exemption for biodiesel decreased to €91 million.

The support estimate for ethanol was then between €3 million and €44 million and for biodiesel was between €546 million and €734 million.

Biofuels Carbon Abatement Costs

Based on a 2011 biofuel consumption figures emissions scenario using average EU feedstock distributions and central indirect land use change (ILUC) factors, conventional biodiesel was responsible for net emissions increases compared to conventional diesel, and therefore carbon abatement costs could not be calculated. Using central ILUC factors and 2011 biofuel consumption figures, French ethanol is estimated as having an abatement cost of around €247 per tonne. When calculated using an energy-adjusted subsidy estimate, abatement costs are around €31 per tonne.

Combined ethanol and biodiesel abatement costs result in biofuels on average having abatement costs of over €5,544 per tonne when subsidies are calculated on a per-litre basis (with an energy-adjusted subsidy estimate the combined abatement cost was estimated at €4,107 per tonne). High abatement costs resulting from the use of

[1] Law 2005-781 of July 13, 2005. The relevant article 4 was amended by Law 2006-11 of January 5, 2006 to raise and extend blending targets.

biodiesel (which is responsible for net emissions increases) and the lower abatement costs for ethanol indicate that polices aimed at emissions savings should distinguish between conventional biodiesel and ethanol use.

Energy Security and Biofuel and Feedstock Trade

Trade in biodiesel and feedstock is significant for France (given demand for diesel is high due to a large diesel vehicle fleet). Approximately one-fifth of biodiesel consumption in 2011 was met through imported biodiesel, with national production relying significantly on foreign, mostly non-European, feedstock. France is a net exporter of bioethanol, mostly produced from domestically grown feedstock. Biofuel production contributes to a diversified energy matrix based on the following percentages: bioethanol has displaced an estimated 5.78 per cent of gasoline consumption (on an energetic basis) while biodiesel has replaced an estimated 7.07 per cent of diesel consumption in 2011 (on an energetic basis) (DGEC, 2011, p. 36).

Jobs Created by the French Biofuels Industry

This study identified a wide range for the number of direct and indirect jobs created by the French biofuels sector, estimated at between 20,000 and 30,000 in 2011. A variety of job counting approaches are applied in measuring biofuel and renewable energy jobs, reflecting the challenges in accurately assessing the numbers and quality of sectorial jobs. The French government tracks the number of biofuel-related jobs, which goes some way to allowing an assessment of biofuel policies in meeting their official objectives.

Conclusions

The performance of France's biofuel policies in relation to meeting their stated objectives has been debated. This report shows that, in some instances, the benefits accruing to the French biofuels sector and economy have been small, such as in the case of imported biodiesel feedstocks. In many instances, the benefits of France's biofuels policies have been marginal, unclear or require greater monitoring and elaboration in order to examine the costs and benefits of meeting France's biofuel policy objectives.

1.0 Introduction

Biofuels can be used as liquid transport fuels and are principally produced from biomass. They can substitute for petrol or diesel for use in vehicles engines. The two main biofuels in use are bioethanol and biodiesel. The main production process for bioethanol is through a process of fermentation of sugar crops, with the more common feedstocks being corn and sugar beets. Biodiesel is produced through the transesterification of fats, either from plants or other sources. Feedstocks include crops containing vegetable oils, such as palm oil, rapeseed and soybean. They can also be produced from waste products such as used cooking oil (UCO) and tallow, which is rendered fat from animals. A range of other advanced production processes not using food-based feedstocks are being investigated in Europe.

Greenhouse gas emissions from burning fossil transport fuels are a major issue policy-makers have been trying to tackle in order to mitigate climate change. Biofuels have been pursued as a potential way to reduce the use of conventional petroleum products in order to reduce greenhouse gas emissions. Crop-based feedstocks remove carbon from the atmosphere as part of photosynthesis during their lifetime, and when converted to biofuels and burned in combustion engines they can propel a vehicle with no net production of greenhouse gases. Biofuels offer a less carbon-intensive transport fuel in a sector where renewable alternatives to fossil transport fuels are difficult for policy-makers to implement.

As energy and climate policy has developed, policy-makers have begun to implement targets for emissions savings for biofuels on the basis that different biofuel production pathways have different emissions savings and life cycle effects. These include emissions generated by chemical inputs and fertilizers, fossil fuel used to run farm machinery and refineries and emissions from transporting the fuels from point of production to point of use. A source of emissions has been identified as coming from land-use change linked to human activities such as deforestation resulting from changes in cropping patterns to accommodate the increased production of biofeedstocks (JJoint Research Centre [JRC], 2010a; JRC, 2010b), with emissions from land-use change being direct or indirect.

1.1 Key Policies

1.1.1 EU Policies and Objectives

The two principal EU Directives for increasing biofuel usage that French policy takes into account are the Renewable Energy Directive (RED) and Fuel Quality Directive (FQD). France is obliged to comply with the RED 2009/28/EC (European Commission, 2009a), which requires member states to meet 10 per cent of their transport energy demand from renewable sources by 2020, and the Directive on the Quality of Petrol and Diesel Fuels (Fuel Quality Directive, or FQD, 2009/30/EC) (European Commission, 2009b), which requires that member states reduce the emissions intensity of their transport fuels by at least 6 per cent by 2020. Both the RED and FQD require that transport biofuels deliver emissions reductions in relation to fossil transport fuels of at least 35 per cent. From 2017 this target rises to 50 per cent, and from 2018 it increases further to 60 per cent for new biofuel production refineries. Support is provided to biofuels on the basis that they can deliver a range of public goods. Key policy objectives are (a) reducing greenhouse gas emissions, (b) promoting the security of energy supply, and (c) providing opportunities for employment and regional development, particularly in rural and isolated areas (European Commission, 2009a).

1.1.2 France's Policies and Objectives

Policy decisions to promote the production of biofuels in France go back at least two decades. After the reform of the European Union's Common Agricultural Policy (CAP) in 1992, France tried to limit excess cereal production by imposing compulsory regulations to keep 15 per cent of agricultural land fallow. In 1993 it allowed energy crops to be grown on fallow land, which probably contributed to a first boost in the production of energy crops such as rapeseed and sunflower (Chakir & Vermont, 2013).

More important policy changes were introduced in the mid-2000s. In the National Energy Strategy passed into law in July 2005,[2] the French government proposed a range of measures for diversifying the energy matrix in key sectors. The strategy identified a need for a profound reorganization of the transport sector, as it is the main source of greenhouse gas emissions in France. Several potential new sources of energy are mentioned, including hybrid and electric vehicles and hydrogen fuels. However, the strategy mainly relies on the promotion of biofuels to achieve greater diversification. It sets clear targets for the percentage of fuels that must come from biofuels.

Initially, these blending targets were set so as to reflect the European Commission's Biofuels Directive (European Commission, 2003). However, less than a year later, in January 2006, more ambitious blending rates were introduced, resulting in a significant government intervention in the transport fuels market and providing a key policy promoting the uptake of biofuels in France.[3]

- 1.2% by the end of 2005
- 1.75% by the end of 2006
- 3.5% by the end of 2007
- 5.75% by the end of 2008
- 6.25% by the end of 2009
- 7% by the end of 2010
- 7% from 2012

Biofuels made from tallow or UCO count double towards achieving the blending rate targets. It is also important to note that blending rates are set by energy content rather than volume. Because biofuels have lower energy content per volume, a given blending rate by energy translates into a higher blending rate by volume. The currently valid 7 per cent blending rate by energy content is equivalent to a 7.57 per cent blending rate for biodiesel and 10.28 per cent for ethanol (Cour des comptes, 2012).

These targets for biofuel blending exceed the requirements of the European Commission's Biofuels Directive. They also support compliance with two more recent pieces of EU legislation, the RED, 2009/28/EC (European Commission, 2009a), which requires member states to meet 10 per cent of their transport energy demand from renewable sources by 2020, and the Directive on the Quality of Petrol and Diesel Fuels (Fuel Quality Directive, or FQD, 2009/30/EC) (European Commission, 2009b), which requires that member states reduce the emissions intensity of their transport fuels by at least 6 per cent by 2020.

1.1.3 Policy Instruments for Achieving Blending Targets

Two key policy instruments support the above mandated targets: a carrot and a stick. The "carrot" is a partial tax exemption which was first introduced in 1992. Since 2004, biofuel producers need to apply for exemptions through a competitive bidding process. Successful bidders receive production licences called *agréments* (approvals), which

[2] Law 2005-781 of July 13, 2005. The relevant article 4 was amended by Law 2006-11 of January 5, 2006 to raise and extend blending targets.

[3] Only 2008, 2010 and 2015 goals are mentioned in the law. Objectives for other timeframes are from the Ministry of Ecology, Sustainable Development and Energy (2011). (http://www.developpement-durable.gouv.fr/Les-biocarburants-quelle-politique.html)

allow them to benefit from a partial reduction of the domestic petroleum tax (the *taxe intérieure de consommation sur les produits énergétiques*, TICPE, applied to the consumption of energy products and a major source of government revenue and large part of the final price of fuels sold to consumers) over a period of six years. In 2011, 53 production sites had such an approval, of which 10 were located in other European countries.[4] In 2004, the exemption amounted to €0.37 per litre for ethanol and €0.33 per litre for biodiesel, but these rates have since been steadily lowered and in 2011 were €0.14 per litre and €0.08 per litre, respectively. For comparison, the applicable TICPE was approximately €0.61 per litre for gasoline and €0.43 per litre for diesel.[5] The government has promised to keep these tax exemptions until 2015 (Cour des comptes, 2012).

The "stick" is a general tax on polluting activities (*taxe générale sur les activités polluantes*, TGAP), which is designed to incentivize fuel distributors who sell gasoline and diesel with blending rates to meet the official objectives, which currently stands at 7 per cent in energy content for all fuels and all distributors.[6] A fuel supplier that reaches 7 per cent in energy of bioethanol in gasoline and 7 per cent in energy of biodiesel in diesel does not pay any TGAP. If the target rate is missed, the fuel supplier pays a tax which is equivalent to the price of conventional fuels for the gap between the actual and the target blending rates. For example, if a fuel supplier incorporates 6 per cent in energy content of bioethanol in gasoline, they will pay TGAP in proportion to the gap of 1 per cent. The tax is the price of these missing litres of petrol without VAT. The TGAP is thought to be very high and thus to create a strong incentive for distributors to blend biofuels into petroleum fuels (Gagnepain, 2012).

1.1.4 Market Formation and Trends

According to one source, 881 million litres of ethanol were produced for fuel purposes in France in 2011. In the same year, 811 million litres were consumed, making France a net exporter of ethanol (SOeS, 2013).[7] These levels correspond to 19 per cent of EU production and 16 per cent of EU consumption. Both production and consumption have more than tripled since 2006, in line with the increasing blending mandate. But most of the growth, especially on the production side, occurred prior to 2009 (Flach et al., 2012).

Biodiesel accounts for a significantly larger share of the market than ethanol. In 2011, 2,144 million litres were produced in France, while consumption totalled 2,677 million litres in the same year (SOeS, 2013). This corresponds to 22 per cent of EU production and 19 per cent of EU consumption. Production increased by a factor of four between 2006 and 2009, also in line with the blending mandate (and with the diesel market) but has since decreased by about 10 per cent. Consumption also skyrocketed between 2006 and 2009 and has since remained stable (Flach et al., 2012).

France's biofuels industry turned over €2.45 billion EUR in 2011, according to EurObserv'ER (2013). The biodiesel market was dominated by Sofiprotéol and its subsidiary Diester Industrie until 2010, but they have since lost market share to importers of tallow and UCO, who benefit from the double-counting rule. The Syndicat français des estérificateurs (Esterifrance), created by Sofiprotéol, represents the interests of the biodiesel industry. The ethanol market, on the other hand, involves five significant producers in France, including two major producers: Cristal Union and Tereos, which are both cooperative associations (Cour des comptes, 2012). It also has an industry association, the Syndicat national des producteurs d'alcool agricole (SNPAA).

[4] http://www.douane.gouv.fr/data/file/4478.pdf
[5] http://www.developpement-durable.gouv.fr/La-fiscalite-des-produits,11221
[6] http://www.douane.gouv.fr/data/file/8207.pdf
[7] Other data sources show higher production and consumption values. Flach et al. (2012) estimate that 949 million litres were produced and consumed. EPure's (2013) figure for production in 2011 is 1,007 million litres.

1.1.5 Objectives of This Study

The study is set against the three key EU official objectives justifying the support provided to the EU biofuels industry: (a) reducing carbon emissions from transport, (b) supporting rural development, and (c) improving energy security. This study aims to help promote a better understanding of the cost-effectiveness of this support.

This study reviews a selection of costs and benefits associated with the use of biofuels which are linked to a wide range of stakeholders, including motorists, the general public, tax payers, the biofuels industry itself and EU farmers. Depending on the method used to assess biofuel use, it may deliver a cost under one scenario and benefit under another. Some costs of using biofuels include subsidizing the industry, which can be paid for by taxpayers or motorists; increased food prices due to the use of conventional biofuels pushing up commodity prices;[8] higher motoring costs, as biofuels are more expensive than fossil fuels; and food-based feedstocks resulting in ILUC generating more emissions than it displaces.

Some of the benefits of using biofuels are their ability to displace the use of fossil fuels to improve energy security because countries are less reliant on unstable imports of oil for the refining of petrol and diesel; a reduction in emissions as biofuel replace dirty petroleum transport fuels; employment creation ranging from biofuel production and refining facilities to other parts of the supply chain and wider economy; biofuel companies contributing to the tax base of governments through company tax returns; the use of first-generation feedstocks improving farmers' income via higher commodity prices; production of co-products (such as domestically produced protein-based by-products like *press cake* coming from rapeseed used in biodiesel production, which can be used as animal feed); and bioethanol's use as a fuel additive to improve vehicles' engine performance in order to increase the lifespan of the motors.[9]

1.1.6 Methodology Section

For empirical data used in this study, discrepancies among different data sources have been evident and have even occurred for yearly biofuel production and consumption figures. The authors have compared different sources of data, paying particular attention to the most frequently cited ones. Where possible, government data sources were used, in particular from the Ministry of Ecology, Sustainable Development and Energy and from the customs agency. Reports from well-respected institutes such as the Environment and Energy Management Agency (ADEME) informed key parts of the report. We also used information compiled by industry associations (EBB, ePure, FEDIOL) and also used by Ecofys and EurObserv'ER.[10]

The year 2011 has been chosen as a reference year for the study, and most of the calculations have been conducted for this year, excluding the cases where this has not been possible due to the lack of data or estimates. However, this report recognizes that for biodiesel consumption, due to the double counting of UCO methyl ester (UCOME) made from UCO and tallow methyl ester (TME), there was a drop (from 6 per cent to 5 per cent) in fatty acid methyl ester (FAME) use relative to 2010 levels (SOeS, 2013).

[8] A significant amount has been written on the effects of biofuels on food commodity prices and this report does not address this issue. Research by Ecofys (2012) found that between 2007 and 2010 EU-27 biofuel production may have contributed to relatively low increases of between 1 and 2 per cent for wheat and coarse grain prices and 4 per cent for non-cereal food commodities prices.

[9] Some of these issues are explored in an earlier IISD research publication: *Biofuels – At What Cost? A review of costs and benefits of EU biofuel policies* (Charles, Gerasimchuk, Bridle, & Morenhout, 2013). Additional information on these issues is available from intergovernmental organizations, such as the Organisation for Economic Co-operation and Development (OECD), Food and Agriculture Organization of the United Nations, the International Energy Agency (IEA), biofuel industry associations, and a wide range of research organizations.

[10] When interpreting these estimates for policy, the authors were guided by the precautionary principle, which states that "when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause-and-effect relationships are not fully established scientifically" (SEHN, 1998). This Principle is legally binding for the European Union and has taken the form of Article 191 of the Treaty on the Functioning of the European Union (European Union, 2008).

2.0 Support to France's Biofuels Sector

2.1 Purpose

This section provides an assessment and quantified figure for the level of support provided to biofuel production and consumption in France. The support estimate put forward here is principally for conventional biofuels.[11]

2.2 Introduction

This section provides an assessment and quantified figure for the level of support provided to biofuel production and consumption in France. The support estimate put forward here is principally for conventional biofuels but also refers to support for second-generation or advanced biofuels. Often the necessary data are not available, either because member states do not report on their measures or because official statistical data—for example on trade volumes—are not available.

The GSI method for estimating support is based on valuing individual support programs and a bottom-up approach. The method aims to value individual policies or programs provided by policy-makers at different points in the production and consumption value chain. The benefit of this approach is that it provides better information on who bears the costs of the policy and who will potentially benefit. For example, it provides a financial value of the benefit of EU mandates for those biofuel producers selling into the EU biofuels market. At the same time, measuring the cost of excise tax exemptions for biofuel consumption allows for a better an understanding of the cost to tax payers due to foregone revenue.

There are other approaches to measuring subsidies, such as that used by the IEA and described further below. The price-gap approach applied by the IEA is relatively less resource-intensive and measures the cost of using biofuels by estimating the additional expense of ethanol and biodiesel per litre (multiplied by the amount of biofuels consumed in a given year and country) versus petrol and diesel. Motorists' additional expenditure on biofuels is estimated as the cost of the policy or subsidy. It does, however, mean the cost of individual policy instruments such R&D grants, capital grants or special excise taxes are not valued nor are the beneficiaries clearly identified.

The support estimate provided by GSI looks to estimate the support provided by a variety of policies (and identify their beneficiaries) and is a broad estimate that should be considered to be for the wider industry or sector, as opposed specifically to biofuel producers.

BOX 1: CONTEXTUALIZING THE NUMBERS—SUBSIDIES TO BIOFUELS COMPARED TO SUBSIDIES TO OTHER ENERGY SOURCES

All energy sources in the world are subsidized. Historically, the most subsidized energy source is fossil fuels. The International Energy Agency (IEA) estimates that fossil-fuel consumer subsidies in non-OECD (Organisation for Economic Co-operation and Development] countries amounted to US$523 billion in 2011 (IEA, 2012), while IISD's Global Subsidies Initiative (GSI) estimates fossil-fuel producer subsidies worldwide at US$100 billion (APEC Energy Working Group, 2012). These estimates of fossil-fuel subsidy value do not include non-internalized environmental externalities, the first of which is the cost of greenhouse gas emissions to the society. Hence, many countries introduced energy efficiency measures and subsidies to biofuels and renewable technologies, amongst other objectives, with the aim of creating public good in the form of carbon emission reductions and to level the playing field already distorted by subsidies to fossil fuels. The high level of subsidies to fossil fuels, and especially petroleum transport fuels, posed barriers to introducing a diversified energy mix, especially in the area of transport, due to subsidies to fossil-fuel producers encouraging the continued exploration and extraction of fossil fuels and consumer subsidies lowering the price of the final product.

[11] A basic overview of R&D programs for second-generation or advanced biofuels is contained in Appendix 3.

French support polices have included a legally enforceable mandate to blend biofuels, tax exemptions and R&D grants to second-generation biofuels. At present, the principal policy supporting the deployment of conventional biofuels in France is the National Energy Strategy passed into law in July 2005.

BOX 2: THE MECHANICS OF BIOFUEL SUBSIDIES IN EUROPE

In layman's terms, the word "subsidy" is often thought to refer only to a direct transfer of funds from a government to a private actor. In contrast, under international law the notion of subsidy includes a wide range of preferential treatment—financial and otherwise—that governments provide to consumers and producers on various grounds. Subsidies are often justified as being designed to supply public goods that the market fails to create or as being temporary measures to enable maturation of new technologies and to create a larger market for subsidized products with the objective of reducing their cost and increasing their competitiveness over time (OECD, 1996).

One of the most authoritative "subsidy" definitions is formulated in Article 1 of the Agreement on Subsidies and Countervailing Measures (ASCM), which has been agreed by 155 members of the World Trade Organization (WTO) and covers direct and indirect transfer of funds and liabilities, various forms of tax relief, R&D grants, provision of access to capital, land, water and public infrastructure at below-market rates, as well as market and price support. Importantly, in order to be considered a subsidy, such preferential treatment has to be specific to a company or industry, as opposed to other economic agents.

Importantly for the subject matter of this report, the ASCM definition does not include market price support induced through tariffs or mandates. Meanwhile, consumption mandates have become the main policy providing government support to biofuels in many countries.

Therefore, a number of stakeholders and experts, including the IEA and the GSI, consider the market price support enabled by consumption mandates to be a subsidy (Lang, 2010; IEA, 2011). Mandates act in the same way as other subsidy forms, driving up market clearing prices and setting the demand floor, thereby improving competitiveness of biofuel producers (Koplow, 2009).

2.3 France's Support Measures

2.3.1 Market Transfers

Market price support broadly measures the intervention affecting both consumer and producer prices by artificially elevating the price of biofuels. In the European Union, among the most important instruments are mandatory blending rates and border protection through tariffs (European Commission, 2011).

The former establishes mandatory requirements for the share of biofuels in transport fuels sold, whereas the latter aims at protecting European production of biofuels through tariffs on biofuel imports. A mandate allows biofuel producers to overcome technical or other barriers imposed by primary fuel suppliers, who may object to the use of biofuels, while also providing long(er)-term targets, thus enhancing the predictability of market developments and reducing investment risks. As mandates put upward pressure on wholesale biofuel clearing prices, the beneficiaries of this policy are biofuel producers who would be able to sell into the EU market at an elevated price if the mandates were reduced or removed. As biofuels are currently more expensive to produce than fossil fuels, the additional costs at the pump are borne by consumers.

Market size (the total value of transactions) can be estimated from measuring the total production or consumption of biofuels and some measure of the market price. To put the following market price support estimates in context, the 2011 market size of the French ethanol industry was estimated at €510[12] million and the biodiesel market at €2,409 million.[13]

[12] The ethanol industry's market size in France in 2011 was calculated as the number of litres of ethanol consumed (811 million) multiplied by an average EU price per litre for ethanol (€0.63 per litre).

[13] The biodiesel industry's market size in France in 2011 was calculated as the number of litres of biodiesel consumed in 2011 (2,667 million) multiplied by an average EU price per litre for biodiesel (€0.90 per litre).

Valuing the support provided to the biofuels sector from mandates is challenging. This paper recognizes there are a range of factors other than blending mandates which may affect EU wholesale biofuel prices (such as higher production costs, sustainability costs and tariffs on imported biofuels), hence this is an initial effort to put forward a preliminary assessment of the level of market price support provided via blending mandates.

BOX 3: METHODOLOGICAL NOTE ON ESTIMATING THE SUPPORT PROVIDED BY MEMBER STATE CONSUMPTION MANDATES

The level of support provided by the consumption mandates is assessed from the viewpoint of a theoretical producer of biofuel (whether located inside or outside of the EU region). A biofuel producer will identify the best market in which to sell their product based on range of factors, but it will be principally determined by the price they are able to secure. In the European Union, prices for bioethanol and biodiesel are higher than average world prices; hence, a biofuel producer will factor in transport costs for their product and then estimate the profit they could make from selling into the EU market. The higher price for biofuel in the European Union represents demand (and supply) forces. This analysis attempts to estimate the value of biofuel consumption mandates introduced by Member States (the consumption mandates help establish a market for biofuels) while recognizing there are a range of other factors affecting biofuel clearing prices (these are discussed further below). The value of consumption mandates implemented by EU Member States in support of bioethanol and biodiesel consumption was estimated as the difference between the EU wholesale price for biofuels and a world reference price, minus an adjustment for freight costs. The amount of support estimated is very sensitive to changes in either world or EU reference prices.* See Koplow (2009) for a deeper discussion on the challenges of applying a price-gap methodology.

Limitations to This Analysis

There are a number of factors which complicate this method of assessment. There may also be a range of other factors pushing up (or down) EU wholesale market prices that are not accounted for in this method. These may include the following:

- **EU biofuel production costs will be higher than production costs in non-EU countries** due to a range of factors including higher energy costs, salaries, health and safety compliance, etc.
- **The extent to which the EU market prices contribute to world reference prices will also affect any price-gap calculations**. While bioethanol produced in the European Union is a small part of the world market (as an average, between 2008 and 2010, around 6 per cent of world production), biodiesel produced in Europe forms a significant part of the global biodiesel market (as an average, between 2008 and 2010, around 52 per cent of world production**) (OECD, 2011).
- **Sustainability costs** involving administrative and reporting requirements to meet EU regulations can result in additional operational costs pushing up EU biofuel prices, as opposed to upward pressure from blending mandates. These costs can push up EU prices and the theoretical size of support provided by the mandates (Charles & Wooders, 2011).
- **Imported biofuel from outside of the European Union is subject to border taxes**, such as taxes of €0.19 and €0.10 on denatured bioethanol and import duty on biodiesel (6.5 per cent ad valorem) (Ecofys & German Union for the Promotion of Oils and Protein Plants, 2012). EU tariffs or anti-dumping duties on bioethanol and biodiesel, while correcting unfair market situations, also push up the costs of imported biofuels, thereby increasing EU biofuel prices and increasing the size of the price-gap and the support value.
- There could also be a range of other policies or market forces affecting wholesale market prices.

Due to the complexity of these forces acting on EU whole market prices they were not accounted for as part of the method for measuring market price support.

* Reference prices, both EU and world wholesale biofuel market prices, used in this report to measure the size of market price support vary slightly from wholesale biofuel reference prices applied in IISD's 2013 study, which may reflect any differences in support estimates.

** Based on average volumes between 2008 and 2010.

Market price support for bioethanol was calculated by multiplying production and import figures by a price gap of between €0.07 and €0.12 per litre (the difference between EU bioethanol wholesale average price of between €0.58 and €0.63 per litre and the world bioethanol average price of €0.47 per litre, minus transport and handling charges).

TABLE 1: MARKET PRICE SUPPORT TO ETHANOL IN 2011†

	LOW-HIGH RANGE
France consumption of fuel ethanol (million litres)	811
France fuel ethanol imports (million litres)	0
EU ethanol wholesale average price (€/litre)	0.58-0.63
World ethanol average price (€/litre)	0.47
Transport and handling charges, Brazil to the EU (€/litre)	0.04
Price gap (€/litre)	0.07-0.12
Market price support-production (million €)	57-97
Total Market price support (million €)	57-97

Sources:

† Due to rounding column and row totals may vary slightly
**Bioethanol consumption for 2011 calendar year: SOeS (2013).*

No bioethanol imports were observed in the 2011 calendar year, hence mandates were supporting bioethanol consumption.

***EU ethanol wholesale average price: OECD-FAO Agricultural Outlook (2011-2020).*

****World ethanol wholesale average price: OECD-FAO Agricultural Outlook (2011-2020).*

*****Transport and handling charges, Brazil to the EU (Euros/litre): personal communications with Brazilian bioethanol expert (2013). €0.04 per litre for shipping bioethanol from Brazil to Europe was used as a proxy for distribution costs which would need to be paid by the bioethanol producer (personal communications with Brazilian bioethanol expert, 2013). It is possible that this is a lower bound estimate, with shipping costs from Brazil to Europe being higher depending on conditions, which would reduce the price gap figure and the level of subsidy via the mandates to bioethanol.*

Market price support for biodiesel was calculated by multiplying production and import figures by a price gap of between €0.17 and €0.24 per litre (the difference between EU biodiesel wholesale average price of €0.83 and €0.90 per litre and the world biodiesel average price of €0.62 per litre, minus transport and handling charges).

TABLE 2: MARKET PRICE SUPPORT TO BIODIESEL IN 2011†

	LOW-HIGH RANGE
France production of biodiesel (million litres)	2,144
France biodiesel imports (million litres)	533
EU biodiesel wholesale average price (€/litre)	0.83-0.90
World biodiesel average price (€/litre)	0.62
Internal domestic transport and handling charges (€/litre)	0.04
Price gap (EUR/litre)	0.17-0.24
Market price support-production (million €)	365-515
Market price support-imports (million €)	91-128
Total market price support (million €)	455-643

† Due to rounding column and row totals may vary slightly
Sources:

**Biodiesel production statistics: 2011 calendar year: SOeS (2013).*

***Biodiesel imports, 2011 calendar year: SOeS (2013).*

****EU biodiesel wholesale average price: BigOil.net. Platts European Market Scan (2012).*

*****World ethanol wholesale average price: source (Ecofys & German Union for the Promotion of Oils and Protein Plants, 2012, p.82).*

******Internal domestic transport and handling charges (€/litre): source authors' estimates: €0.04 per litre for biodiesel distributed within Europe was used as a proxy for distribution costs which would need to be paid by the biodiesel producers.*

2.3.2 Budgetary Support Linked to Volume Produced or Consumed

To decrease the end prices of biofuels to consumers and make them similar to the prices of the conventional petroleum-based fuels, fiscal incentives supporting the sale of biofuels have been introduced in EU countries. The beneficiaries of these policies are fuel distributors, able to claim back the exemption, and the biofuels industry, which benefits from reduced motorist resistance to a more expensive product. The cost of the foregone revenue is met by government and ultimately by tax payers across the economy.

In support of meeting biofuel consumption targets as contained in France's biofuel strategy, financial instruments within its general fuel tax system, under which transport fuels are charged VAT and a domestic tax on petroleum products (*taxe intérieure sur la consommation*, TIC), are used to offer biofuels a partial tax exemption based on domestic consumption of fuels (Cour des comptes, 2012). When taxation rates are adjusted for energy content (biofuels having lower energy content than petrol and diesel) on an energetic basis, tax exemptions result in no fiscal loss for ethanol and biodiesel, with a smaller revenue loss resulting from just the exemption component.

Within the European Union the Commission's proposed amendments to the Energy Taxation Directive focuses on setting taxation levels of products based on energy and carbon traits of fuels (European Commission, 2013). Applying the Energy Taxation Directive would result in a per-litre excise tax exemption for biofuels up to a level consistent with the energy content of petrol and ethanol, and biodiesel and diesel, so the fuels would be taxed equally on an energetic basis, removing any subsidy to biofuels.

The application of excise ethanol and biodiesel tax exemptions on an energetic basis is contained in Appendix 2.

Ethanol

Since 2011, the excise tax reduction on ethanol amounts to €0.14 per litre on the usual excise tax on petrol of €0.61 per litre. This reduction is paid to fuel retailers but eventually benefits biofuel producers who obtain an agreement (approval) through a competitive bidding process (Cour des comptes, 2012). This rate was originally set at €0.37 per litre in 2004 but has since been steadily lowered. The Cour des comptes, a quasi-judicial court of auditors, estimates that the government's excise tax income between 2005 and 2010 was €150 million higher than it would have been without the blending mandate, thanks to increased ethanol consumption and due to lower energy content (per litre) of ethanol compared to gasoline (Cour des comptes, 2012). Table 3 displays excise tax exemptions on a per-litre basis (as opposed to on an energetic basis).

TABLE 3: EXCISE TAX EXEMPTIONS FOR ETHANOL ON A PER-LITRE BASIS

ETHANOL					
2011	QUANTITIES (MILLION LITRES)	EXCISE TAX ON PETROL (€/L)	EXCISE TAX ON ETHANOL (€/L)	EXEMPTION (€/L)	LOSS OF FISCAL REVENUES (MILLION €)
France	811	0.61	0.47	0.14	114

Sources: consumption: SOeS (2013); excise tax on petrol: Ministry of Ecology (2013); loss of fiscal revenue: authors' calculations.

When considering excise tax exemptions for ethanol on an energetic basis, there is a net revenue gain due to increased use of ethanol due to its lower calorific energy value. Just focusing on 2011, taking the balance of TICPE plus VAT charges for ethanol and subtracting any fiscal loss from the exemption, overall tax revenue to the state was approximately €125 million (Cour des comptes, 2012) Energy adjusted fiscal losses and gains are displayed for both ethanol and biodiesel in Appendix B.

Biodiesel

The excise tax reduction on biodiesel is lower than for ethanol. In 2011 the reduction was €0.08 per litre vis-à-vis the excise tax on diesel of €0.43 per litre. This reduction is paid to producers who obtain an agreement (approval) through a competitive bidding process. This rate was originally set at €0.33 per litre in 2004, but has since been steadily lowered. In sum, the government's excise tax income between 2005 and 2010 decreased by €1.29 billion due to the tax reduction, according to the Cour des comptes (2012).

TABLE 4: EXCISE TAX EXEMPTIONS FOR BIODIESEL ON A PER-LITRE BASIS

BIODIESEL AND PURE PLANT OIL					
2011	QUANTITIES (MILLION LITRES)	EXCISE TAX ON DIESEL (€/L)	EXCISE TAX BIODIESEL (€/L)	EXEMPTION (€/L)	LOSS OF FISCAL REVENUES (MILLION €)
France	1,959	0.43	0.35	0.08	157

Sources: biodiesel eligible for exemption: DGEC, (2011); excise tax rate petrol: Ministry of Ecology (2013); loss of fiscal revenue: authors' calculations.

2.3.3 Summary of Subsidies to Biofuels

Table 5 summarizes the level of support provided to the French biofuels sector in 2011 via excise tax exemptions and blending mandates.

TABLE 5: SUMMARY TABLE OF BIOFUEL SUPPORT PROVIDED IN 2011

2011†	ETHANOL	BIODIESEL	TOTALS
Excise tax exemptions (million €)	113	157	270
Market price support via blending mandates (million €)	57-97	455-643	512-740
Total subsidy (million €)	170-210	612-800	782-1,010
Total subsidy energy adjusted (million €)	3-44	546-734	550-778
French biofuel consumption (million litres)	811	2,677	3,488
Subsidy per litre (€)	0.21-0.26	0.23-0.30	0.22 -0.29
Subsidy per litre energy adjusted (€)	0.00 (less than 1 € cent)-0.05	0.20-0.27	0.16 -0.22

†Due to rounding column and row totals may vary slightly

Biofuel production and consumption in France is supported through a variety of policies, including mandatory blending targets and excise tax exemptions for biofuels. The main support mechanism is the legally binding blending requirement, which provides a strong market pull mechanism, guaranteeing investors and biofuel producers a market for their product and putting upward pressure on French wholesale biofuel prices, followed by excise tax exemptions for ethanol and biodiesel.

3.0 SPS Payments

3.1 Purpose

This section estimates the volume of agricultural payments under the Single Payment Scheme (SPS) provided to farmers growing food crops, based on their end consumptive use, whether it is for food or biofeedstock markets.

3.2 Introduction

French farmers are eligible for subsidies under the SPS, sometimes referred to as the Single Farm Payment Scheme, which is part of the European Union's Common Agricultural Policy (CAP). Introduced in 2005, the SPS was part of the CAP reforms designed to decouple subsidies from production-related aid and allows farmers greater freedom to switch to alternative enterprises, such as bioenergy crop production. The aim of the regulation was also to help simplify and modernize the CAP's administration (Europa, 2009).

There are no specific SPS payments or schemes to support biofeedstock production. Rather, annual energy crops grown for biofeedstock production, such as oilseed rape, sugar beet and cereals, are eligible for the SPS payment, as are other crops which meet the necessary SPS regulations (SPS payments are the same to farmers regardless of the crop's final market). This analysis does not imply that the SPS payments are a direct subsidy or transfer to the biofuels industry. Calculating the portion of the SPS payments going to farmers growing energy crops is aimed at providing better information on how the CAP is spent and the types of activities that are helpful to policy-makers. Hence, knowing what percentage of SPS payments accrues to farmers for growing crops destined for the biofuels market, versus crops destined for food or feed markets, is of public benefit.

Hectares used for biofeedstock production have been published by the French Environment and Energy Management Agency[14] (Gagnepain, 2012). Average SPS per hectare rates were drawn from a European Parliament study estimating average SPS rates in EU countries in 2013 (European Parliament, 2010).

The following formula was applied:

Hectares used for biofeedstock production p.a. X SPS per hectare rate =

SPS payments for French biofeed production per annum

Table 6 shows the amount of land being used to grow biofeedstocks and the SPS payments which have accrued to farmers for this activity.

TABLE 6: SPS PAYMENTS TO AREAS USED FOR BIOFEEDSTOCK PRODUCTION

COUNTRY	BIOFUEL	HA FEEDSTOCK	YEAR (HA)	AVERAGE (€/HA)[1]	TOTAL (€MILLION)
European Union	Total	3,600,000[2]	2008	266	958
France	Total	826,100	2009	310	256
	Biodiesel	665,000	2009	310	206
	Ethanol	161,100	2009	310	50

Sources: 1. European Parliament (2010), 2. Ecofys, Agra CEAS, Chalmers University, IIASA & Winrock (2011).

[14] The Gagnepain study, published by the French Environment and Energy Management Agency, contains land-use data from the year 2009. The number of hectares of arable land used for biofeedstock production may be underestimated in certain cases as a result of a lack of data. SPS payments may also be overestimated as this calculation does not take into account the production of co-products from biofuel production.

This section summarizes the distribution of SPS payments based on the quantities of land used to produce biofeedstocks, noting SPS payments are not used to promote energy crops directly and are available to farmers regardless of a crop's final end use. Based on 2009 cropping data, €256 million in farm payments went to farmers growing crops that went to biofuel production. Of this figure, around €206 million in SPS payments went to farmers growing biodiesel feedstock and around €50 million went to farmers producing ethanol feedstock. The amount of SPS payments provided to farmers growing crops channelled to food or other markets wasn't calculated.

4.0 Emission Reductions

4.1 Purpose

This section estimates the amount of direct and indirect emissions from biofuels based on French government biofuel consumption data and European Commission emission factors, generating carbon abatement costs for ethanol and biodiesel.

4.2 Introduction

Emissions from biofuels can be broadly split up into two different groups: (1) direct emissions from the cultivation, processing and transport of biofuels, including direct land-use change and (2) emissions from ILUC associated with the growing of biofuel feedstock crops (European Commission, 2012a). This section assesses total emissions and emission savings associated with biodiesel, ethanol and total first-generation biofuel consumption in France.

4.3 Methodology and Application of Sensitivity

This analysis has used lower, medium and higher bounds of emissions associated with biofuels consumption. The lower and higher bounds for biodiesel and ethanol are based upon the respective lower and higher values of emissions per energy unit of different types of feedstock used for biodiesel and ethanol production. For example, as a lower value of direct emissions per megajoule for biodiesel, the direct emission factor for sunflower-based biodiesel was used to provide a conservative estimate. Since this feedstock type is not frequently used for the production of biofuels consumed in the EU, the lower bound emission estimate is by definition an underestimate, as feedstocks with higher ILUC values are used in the European Union. The medium estimate is based on the proportion of feedstock types used to produce the biodiesel and ethanol consumed in the European Union. Contrary to many individual member states, this type of data was available for the European Union in 2011. The application of ILUC factors is recognized as a controversial issue and there is an expanded discussion later in this section of some of the issues.

For estimates of direct emissions from biofuels, the assessment relied on the figures used by the European Commission in its proposal of October 17, 2012 to amend the FQD and the RED (European Commission, 2012b). To estimate biofuel-associated emissions from ILUC, the analysis used central ILUC factors proposed by the European Commission in the same proposal. These factors are based on the Laborde (2011) study, which the European Commission considers the best available science in the area of ILUC modelling (European Commission, 2012a).

This analysis estimates the amount of emissions and emission savings for the year 2011 based on actual consumption data, and for the year 2020 based on projections of biodiesel and ethanol consumption in France's National Renewable Energy Action Plan (NREAP) (Beurskens et al., 2011),[15] with 2020 figures on the amount of emissions and emissions savings assuming a business-as-usual scenario with no major policy changes.[16]

[15] Any projections for biofuel consumption may be affected by pending EU legislative proposals limiting the use of conventional biofuels.

[16] Based on the annual European Union greenhouse gas inventory report 2012, submitted to the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat on May 27, 2012, emissions from road energy transportation for the EU15 were estimated at 871 million tonnes (European Environment Agency, 2012). This figure covers only tailpipe emissions of the EU15 but provides some context on the emission levels in Table 7.

4.4 Direct, Indirect and Total Emissions Associated with Biofuel Consumption in France

TABLE 7: EMISSIONS ASSOCIATED WITH BIOFUEL CONSUMPTION IN FRANCE IN 2011 AND 2020 (UNDER A MEDIUM SCENARIO, MT CO_2EQ)

	DIRECT EMISSIONS		ILUC EMISSIONS		TOTAL EMISSIONS	
	2011	2020	2011	2020	2011	2020
Conventional biodiesel	3.74	5.04	4.87	6.56	8.61	11.60
Ethanol	0.58	0.91	0.21	0.33	0.79	1.24
Total	4.32	5.95	5.08	6.89	9.40	12.84

Sources: authors' calculations; 2011 consumption: SOeS (2013); 2020 consumption: ECN (2011); ILUC factors: European Commission (2012a); Direct emission factors: European Commission (2012b).

In 2011, France consumed about five times as much biodiesel as ethanol. This partly explains why emissions related to biodiesel consumption are higher than those related to ethanol consumption, but another key reason is that biodiesel is generally more emission-intensive than ethanol. This is true for direct emissions and even more so for ILUC emissions, in which ethanol generally emits an amount of carbon dioxide about four times less per unit of energy than biodiesel (Laborde, 2011).

4.4.1 Direct Emissions

In terms of direct emissions, biofuels consumed in France were responsible for between 3 million tonnes (lower bound) and 5 million tonnes (higher bound) of carbon dioxide equivalent, of which between 2.75 million tonnes and 4.35 million tonnes were associated with biodiesel. When projecting forward to 2020, France's National NREAP estimates that the consumption of ethanol is set to increase by 70 per cent compared to 2011 consumption levels. Biodiesel, on the other hand, will increase by about 40 per cent relative to current levels. However, given that it was the main biofuel consumed in 2011, it will still have about 80 per cent of the market share. It is estimated that in 2020, biofuels will be responsible for direct emissions of around 6 million tonnes of carbon dioxide equivalent, of which roughly 5 million tonnes will be biodiesel-related.

4.4.2 ILUC-Related Emissions

What is ILUC?

ILUC refers to the displacement of farming for feed or food production to other areas as a result of arable land being used for biofuel feedstock production. Simply put, when the use of arable land in the European Union shifts from food or feed production to the production of biofeedstocks and food or feed demand patterns do not change, extra crops grown on additional land is needed to meet food demand and substitute for biofeedstocks diverted to biofuel production (Edwards et al., 2008; Edwards, et al., 2010).

This additional demand is often met by increasing the cultivation of food or feed crops in jurisdictions outside of the European Union for subsequent exportation to the EU market. When carbon sinks such as forests and peat lands are cleared for such production, indirect emissions as a result of EU biofuel policies occur (Edwards et al., 2008; Edwards et al., 2010). In particular, vegetable oil markets are globally linked and thus prone to ILUC. Direct and indirect LUC are not phenomena exclusive to biofuels. Agricultural and trade policies, among others, can have significant land-use change effects.

Measuring or observing the exact extent of ILUC is not possible, as feedstock producers cannot measure land-use change patterns in different parts of the world, but it is possible to model some estimates (di Lucia, Ahlgren, & Ericsson, 2012). This analysis estimates ILUC-associated emissions in line with the proposal of the European Commission for biofuel emission reporting (European Commission, 2012b). The European Commission relies on ILUC factors developed by Laborde (2011).

Background on the IFPRI Model

The Laborde study is built upon a General Equilibrium Model that is based on future projections of agricultural productivity, biofuel policies and international trade. Such projections are based on assumptions that are subject to a wide degree of uncertainty (Edwards et al., 2008; Laborde, 2011). The most advanced modeling exercise to date was performed by the International Food Policy Research Institute (IFPRI). To reduce uncertainty, IFPRI performed 1,000 rounds of Monte Carlo simulations with a sensitivity analysis and seven parameters that have the most important effect on the supply side of the model were scrutinized.

Some Key Issues

Uncertainty relating to the projected results is the main reason why models are often criticized. Like any model, the IFPRI model is imperfect. As the authors themselves recognize, there is room for improvement with regards to assumptions related to land-use expansion and substitution. Uncertainties related to additional land needed are both independent from and dependent on policies (Laborde, 2011).

Other issues have included whether the model sufficiently accounts for the protein content of biofuels co-products and that palm oil is modeled as a perennial crop. Consequently, the reporting factors in the proposals are criticized for being inaccurate. Analysis by the French National Institute for Agricultural Research (INRA) recently published a report stating assumptions on crop yields for biodiesel feedstocks may be lower than actually observed (INRA, 2013).

Another issue is how the modelled emissions are partially dependent on the assumption that increased palm oil production will take place on peat land forest areas in countries like Indonesia and Malaysia. According to Delzeit et al. (2012), this is formally illegal according to Indonesian law and the assumption is dependent on political factors such as the non-enforcement of existing regulations. A review of this Indonesian moratorium on new forest concessions indeed found that there have been clearings in primary forests in spite of the moratorium. In addition, the moratorium applies only to new concessions and it excludes secondary forests, which are also large carbon sinks (Union of Concerned Scientists, Greenpeace and World Resources Institute, 2012). Similarly, one could argue that IFPRI numbers are underestimated as they assume higher yields in the baseline than most other ILUC models (Marelli, 2013).

The use of Laborde's ILUC factors for consumption in 2011 may raise some questions as well. This is mainly because the ILUC factors in that study are factors for the year 2020, based on an increase in biofuel consumption relative to a 2008 baseline. In this regard, it is important to note that as part of the sensitivity analysis mentioned above, the European Commission requested that Laborde investigate the linearity of the ILUC factors. As the European

Commission points out in its impact assessment accompanying the proposal, it should be noted that some crops with a strong non-linearity effect will indeed have a lower ILUC factor at lower consumption volumes (European Commission, 2012a). This is particularly the case for vegetable oils like rapeseed.

Nevertheless, based on the Laborde analysis, the European Commission still regards the factors as the best available factors to estimate ILUC-related emissions of all biofuel consumption today. This is the approach this and subsequent studies will follow, until a more sound methodology is developed and published in an authoritative source. It is advisable to take into account the uncertainties related to ILUC emission estimation for the year 2011 when analyzing the results of this study.[17]

4.4.3 LUC-Related Emissions

ILUC-related emissions in France are much higher for biodiesel than for ethanol. In 2011, ILUC emissions related to French biofuel consumption were around 4.9 million tonnes of carbon dioxide equivalent, of which almost 4.7 million tonnes was from biodiesel. Even though the use of ethanol relative to biodiesel is projected to increase in the years leading up to 2020, the vast majority of ILUC-related emissions will still be associated with biodiesel feedstock. More precisely, of the 6.9 million tonnes of carbon dioxide equivalent of ILUC-related emissions in 2020, about 6.6 million tonnes would be related to biodiesel.

Total Emissions

Total emissions associated with biofuel consumption in France reached between 8 million tonnes and 10 million tonnes of carbon dioxide equivalent in 2011, with a medium value of 9 million tonnes of carbon dioxide equivalent (greenhouse gas emissions from transport, million tonnes of carbon dioxide equivalent, including bunker fuel, was estimated at 154.5 in 2009, with 71 per cent of France's emissions coming from road transportation) (European Commission, 2012c). Most of those emissions (about 8 metric tonnes) were related to biodiesel. A little over half of the total emissions were related to ILUC, demonstrating the significance of supply displacement in the global vegetable oil market. If NREAP projections hold true, total emissions from biofuels in 2020 would amount to between 11 million tonnes and 14 million tonnes of carbon dioxide equivalent, with biodiesel being responsible for between about 10 million tonnes and 12.5 million tonnes of carbon dioxide equivalent.

[17] For di Lucia, Ahlgren and Ericsson (2012) the precautionary principle implies the selection of high ILUC factors to guide policy making that aims to improve the certainty no negative ILUC occurs. The choice of factors from middle values would imply a preventive approach, which aims at reducing the risk of negative ILUC but has less certainty of its success than higher values. This analysis is, in line with the approach of the European Commission, based on central ILUC factors.

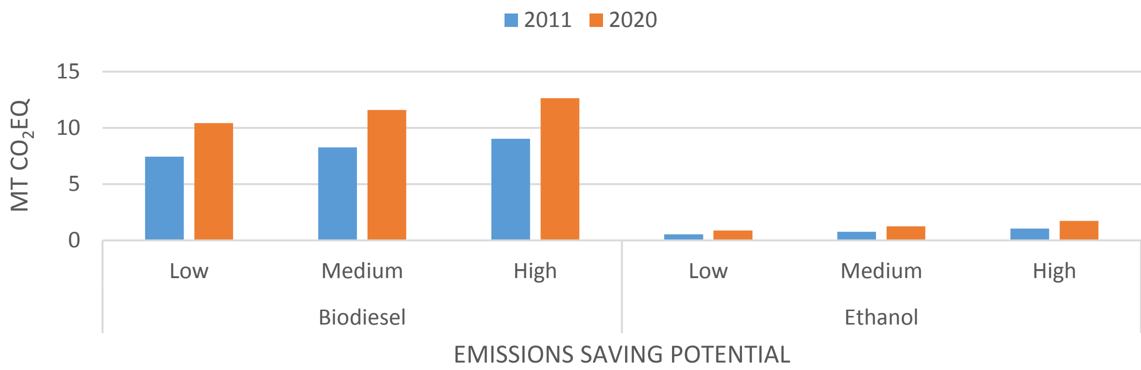

FIGURE 1: TOTAL EMISSIONS ASSOCIATED WITH BIOFUEL CONSUMPTION IN FRANCE

Sources: authors' calculations; 2011 consumption: SOeS (2013); 2020 consumption: ECN (2011); ILUC factors: European Commission (2012a); Direct emission factors: European Commission (2012b).

4.5 Emissions Savings from French Biofuels

Once the total emissions associated with biofuel consumption have been estimated, a next step is to find out whether the use of biofuels in France is responsible for net emissions savings or not. This is done by first calculating the level of emissions which would have been emitted if fossil fuels were used to cover an equal amount of energy in transport. In line with the European Commission, the analysis used a fossil fuel comparator of 90.3 grams per megajoule (European Commission, 2012a).

The results indicate a large difference between biodiesel and ethanol. Biodiesel in the medium scenario is responsible for net emission increases. This is already the case in 2011. At best, when assuming high emissions saving potential for biodiesel, it is responsible for a similar amount of emissions as diesel.[18]

Under the medium scenario ethanol was responsible for some emission reductions. In 2011, they were limited to less than 1 metric tonne of carbon dioxide equivalent. In total, biofuels as a group were in the medium scenario responsible for hardly any emission savings. In the scenario with the most optimistic emissions-saving potential, biofuels were responsible for 1.2 metric tonnes of carbon dioxide equivalent emission savings.

In line with France's NREAP, an increase in ethanol consumption could lead to emissions savings of around 1.2 million tonnes of carbon dioxide equivalent in 2020 for ethanol. When assuming a high emissions-saving potential for biodiesel and ethanol, a maximum of 2 million tonnes of carbon dioxide equivalent could be saved from the use of biofuels. When a net emission reduction is found, an important question any policy-maker should ask is at what cost this emission reduction occurs.

[18] This is likely a lower-bound estimate, as the value used to calculate direct emissions was for sunflower, which has a low emissions factor, and EU feedstock production is generally made of feedstocks with higher emissions values.

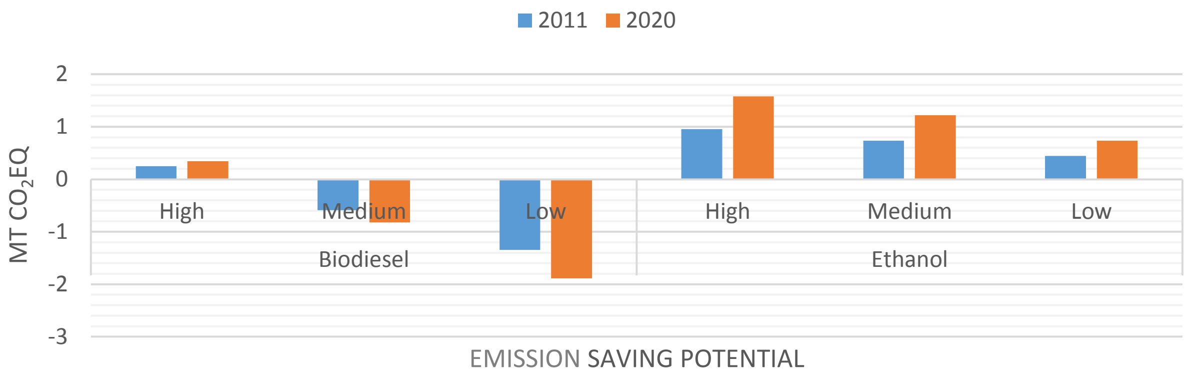

FIGURE 2: TOTAL EMISSIONS SAVED AS A RESULT OF BIOFUEL CONSUMPTION IN FRANCE

Sources: authors' calculations; 2011 consumption: SOeS (2013); 2020 consumption: ECN (2011); ILUC factors: European Commission (2012a); Direct emission factors: European Commission (2012b).

4.6 Carbon Dioxide Abatement Costs

Carbon abatement costs were estimated for ethanol and biodiesel technologies to reduce 1 tonne of carbon dioxide equivalent relative to the cost of the industry represented by the level of subsidy. Based on this approach abatement costs are highly dependent on subsidy estimates, which can be calculated using a variety of methodologies and may vary significantly (they can also change from year to year depending on the policies assessed and estimation method).

Because biodiesel is in most scenarios responsible for emission increases, no abatement cost can be calculated. When using a lower bound value (assuming a high emissions saving potential), the abatement cost of biodiesel in France (including ILUC emissions) is high under central assumptions a fuel that is responsible for net emission increases. French ethanol had an abatement cost in 2011 of around €247 per tonne of carbon avoided. A carbon abatement cost based on a subsidy estimate with an energy-adjusted component relating to higher taxation rate for biofuels resulted in a cost of €31 per tonne. A carbon abatement cost for ethanol and biodiesel combined was estimated at €5,544 per tonne and €4,107 per tonne when the subsidy estimate was adjusted for energy.

5.0 Employment Creation

5.1 Purpose

This section provides a review of employment estimates generated for the French biofuels sector.

5.2 Introduction

This section provides a review of employment generated by the French biofuels sector. In a time of economic recession, the French government, like many EU governments, considers the potential impacts of various options on employment in developing biofuel and energy sector policy. As this section illustrates, if job creation is considered an important objective for supporting the development and deployment of biofuels, the level of detailed information available on employment effects is probably inadequate.

Ethanol and biodiesel industry representatives claim an expansion of biofuel consumption, either first-generation or second-generation fuels, would create direct jobs within the industry and additional jobs in other sectors, such as agriculture (ePure, 2012b; EBB, 2012).

BOX 4: BIOFUEL PRODUCTION: WHAT TYPES OF JOBS ARE BEING CREATED?

The biofuels industry involves the construction of biofuels plants, which can provide short-term construction-related jobs that can employ labourers, civil works personnel, surveyors, structural engineers, quantity surveyors and electricians (IEEP, 2011, p. 45; Greene & Wiley, 2012).

Once the plants are completed, examples of jobs in the general administration and management include plant and operations managers, office administrators, health and safety managers, environment officers, labourers, financial accounting staff, feedstock purchasers, and marketing and logistics personnel (IEEP, 2011, p. 45; Greene and Wiley, 2012).

Liquid biofuels for transport differ from wind and solar renewable energy, as they involve energy inputs that are not freely available (in contrast with wind and solar radiation), such as crops used as biofeedstocks or residues from various industries. The production of agricultural commodities used as biofuel feedstocks results in jobs in agriculture—notably those of farmers and seasonal workers (IISD, 2013).

For second-generation biofuels, to the extent that they are based on residues or waste products, their collection and pre-treatment generates jobs at this stage of the production process. Refining bioethanol and biodiesel requires technically skilled personnel like chemists, plant operators and engineers before the biofuel can be distributed for sale (ePure, 2012b).

Research and development activity is carried out by the industry and can also involve academic institutions throughout the United Kingdom (IEEP, 2011, p. 45; Greene and Wiley, 2012).

5.3 Is it a Numbers Game? Jobs in the Ethanol and Biodiesel Industry

Based on an employment factor[19] proposed by the European Renewable Ethanol Association (ePure), for every 1 million litres of domestically produced renewable ethanol, approximately 16 jobs are created (ePure, 2012b). The Cour des comptes report (2012) noted an employment figure of six jobs per 1,000 tonnes of ethanol was potentially an overestimate and biofuel employment levels were linked to prevailing agricultural conditions. Based on the ePure

[19] Employment factors: estimates the average number of jobs per unit of capacity installed or fuel generated in litres, multiplied across the production base or volume of litres produced in the European Union in a given year (data sources could include reports and studies, surveys in industry and farming, case studies and national statistics on consumption and production capacities).

multiplier, French ethanol production in 2011 (881,287,500 litres) generated 14,101 jobs (production figures from SOeS, 2013; GSI; authors' calculations). Based on an employment factor for the EU biodiesel industry extrapolated from a EurObserv'ER figure of 0.007 jobs per TOE, every 1 million litres of biodiesel produced in the European Union is roughly estimated to create 5.3 jobs[20] (EurObserv'ER, 2012, p. 157). Applying this employment factor to 2011 biodiesel production figures (2,144,218,605 litres) the number of jobs generated by the industry was 11,364 (production figures from SOeS, 2013; GSI; authors' calculations). A combined total 25,465 jobs were estimated.

Other estimates are within a similar range. PricewaterhouseCoopers (PwC) estimates that per 1000 tonnes of produced biodiesel, 6.1 jobs would be created (Proléa, 2007). Using this multiplier, 11,555 people were employed in the biodiesel supply chain in 2011 (SOeS, 2013; GSI; author's calculations). Based on another PwC study, the bioethanol sector created 8,900 jobs in 2010, of which 4,500 were directly employed by the industry, 1,500 indirectly employed by suppliers, and 2,900 jobs were induced by the expenses of the 6,000 direct and indirect employees (AGPM et al., 2013). A report published by EurObserv'ER (2012) estimated jobs across the entire biofuels supply chain at 29,900 in 2011.

One criticism relating to the claims that the biofuels sector creates new jobs is that many of the farm-related jobs would likely have existed with or without biofuels. A key issue is one of additionality, in that the additional jobs created by the biofuels sector are likely those associated with biofuel processing facilities or transport (due to the increased use of tanker drivers, given challenges in piping biofuels) (Swenson, 2006). These additional jobs may be offset by losses in petroleum processing facilities, for example.

5.4 The Sustainability of Jobs

If jobs creation is a key goal for supporting the biofuels industry, the sustainability and quality of jobs are key challenges. Employment factors are based on biofuel production remaining in France, or the European Union, but increasing amounts of imported biofuels and feedstocks (such as wheat and corn produced in France) have been observed. Increased imports of biofuels and feedstocks will lead to a reduction in jobs within France and the European Union and an increase in jobs in foreign countries where biofuels are produced and exported to the European Union (IISD, 2013).

Caution should be exercised when comparing the numbers of jobs for a specific industry, given the inherent variation in market structure and the technologies' stage of development. Biofuels, for example, are part of the road transport sector, while other technologies such as solar PV are for renewable electricity generation. Other renewable energy sectors generate jobs: in 2011 the wind sector is estimated to have created 20,000 jobs, solar thermal 8,100, solar PV 62,750 and solid biomass 45,500 (EurObserv'ER, 2013, p. 173). Gaudin and Vésine (2012) estimate that activities related to renewable energy and energy efficiency industries employed 308,750 people in 2011, of which 99,690 are employed in renewable energy development and sales and 209,060 in energy efficiency–related activities. Sustainable jobs will entail the phasing out of support to renewable technologies, leaving a viable ongoing industry.

If jobs creation is a key goal for supporting the biofuels industry, the sustainability and quality of jobs are important challenges. The employment factors used in this section (ePure & EurObserv'ER) are based on biofuel production remaining in France or the European Union. However, increasing amounts of imported biofuels and feedstocks (such as rapeseed, soybeans, wheat and corn) have been observed. Increased imports of biofuels and feedstocks followed by reduced production in the European Union could lead to a reduction in jobs within France and the European Union

[20] The EurObserv'ER based its estimate of the socioeconomic impacts of EU biodiesel and vegetable oil production on an assumption of 0.007 jobs per toe (EurObserv'ER, 2012, p. 157). Reference: http://www.eurobserv-er.org/pdf/barobilan11.pdf

and an increase in jobs in foreign countries exporting to the European Union (IISD, 2013). The French government has blending targets which will likely be required to continue in order to maintain production and employment levels. If support to the EU biofuels industry is steadily reduced over time, this may affect French or EU biofuel production levels, with the number of biofuel-linked jobs falling (or increasing) based on changing domestic production levels and the level of subsidies provided.

5.5 Rural Development and the Geographic Location of Jobs

The European Union supports the use of biofuels in order to pursue "opportunities offered by biofuels in terms of economic activity and job creation within the context of the cohesion policy and rural development policy" (European Commission, 2006). The geographic spread of jobs is seen as important, with many rural areas of Europe experiencing higher-than-average unemployment or lower average incomes in rural areas compared with cities. Hence, ethanol and biodiesel industry jobs in rural areas are seen to correspond to one of the original policy objectives for subsidizing biofuels: rural development.

France belongs entirely to Europe's Competitiveness and Development Regions, meaning that from a European perspective the creation of jobs in France does not per se support the spread of jobs to less developed regions. From a national perspective the biofuels industry has created some jobs in poorer rural regions through the development of five production facilities between 2007 and 2009. The Cour des comptes (2012) report argues that "many of these jobs [i.e. related to the biofuel industry] are located in rural areas with weak industrial activity, and they can by definition not be relocated."

5.6 Conclusions

Due to the complexity of job counting there are difficulties in estimating the number and quality of sectorial jobs in the biofuels sector or renewable energy sector more broadly. The range of different employment estimates produced for the biofuels sector are not directly comparable given varying methodologies. Previous reports have identified the question of additionality in job counting for biofuels, arguing that farm-based agricultural jobs in the biofuel supply chain would still exist without the biofuels industry. Given the economic slowdown in Europe and high unemployment rates, job creation is an important factor for policy-makers, and jobs created in the biofuels industry can be viewed as important to an economy in recession, especially if they are in poorer rural areas. The biofuels sector may deliver net economic and employment benefits if related jobs are sustainable and not linked to ongoing subsidies. Better monitoring of the number of biofuel sector–related jobs will help contrast the anticipated benefits from the industry against any associated costs.

6.0 Energy Security and Biofuel Trade

6.1 Purpose

This section discusses international trade in biofuels and feedstocks and the role of biofuels in supporting energy security objectives through displacing the use of crude oil or petroleum products imported from outside of the European Union.

6.2 Defining Energy Security

The International Energy Agency (IEA) defines energy security as the uninterrupted availability of energy products at an affordable price (IEA, 2013). The European Commission adds a sustainability dimension by describing security of energy supply as:

> [T]he uninterrupted physical availability of energy products on the market, at a price which is affordable for all consumers (private and industrial), while respecting environmental concerns and looking toward sustainable development. (European Commission, 2000)

Energy security can be improved by increasing the security of supply of traditional energy sources (through long-term contracts or investments), increasing diversity of energy sources (both geographically and the types of fuels), reducing demand (by improving energy efficiency), and increasing flexibility within the energy sector.

The European Commission's strategy for energy security is linked to its strategy for diversification, emission reduction and energy efficiency. Biofuels have the potential to improve energy security by diversifying fuel supply, including from primary sources that are locally available and more widely distributed than crude oil (European Commission, 2006). France considers the diversification of the energy mix as a way of achieving energy security, and the National Energy Strategy[21] uses biofuel blending targets a way to diversify energy sources to achieve this objective.

Two key parameters are used to assess the effectiveness of meeting the objective of improving energy security through expanding the share of biofuels in the energy mix:

- Quantifying the amount of imported fossil fuels replaced with biofuels;
- Analyzing to what extent the biofuels replacing fossil fuels are domestically produced or imported, because in case of their importation concerns over energy security remain.

Table 8 illustrates the amount of petrol and diesel displaced by biofuel use in France.

TABLE 8: PETROLEUM PRODUCTS DISPLACED BY FRANCE BIOFUEL USE IN 2011

	LITRES OF BIOFUEL CONSUMED 2011 (MILLION LITRES)	MILLION MJ/TOTAL	PETROL AND DIESEL DISPLACED IN 2011 (MILLION LITRES)	TOTAL PETROL AND DIESEL CONSUMED IN FRANCE IN 2011 (MILLION LITRES)
Ethanol	811	17,257	536	10,167
Biodiesel	2,677	88,619	2,468	40,135

Sources:
**Ethanol and biodiesel consumption figures: SOeS (2013).*
***Petrol and diesel consumption figures: CGDD (2012).*
Notes: Calorific Value (CV) (MJ/litre): Bioethanol 21.28, Biodiesel 33.10, Gasoline 32.2, Diesel oil, 35.9.
Gasoline and diesel consumption in 2011, source: CGDD (2012).

[21] Law 2005-781 of July 13, 2005.

The second parameter of biofuel policies impacting energy security relates to the domestic or external origin of biofuels and their feedstock. Generally, trade balance data in the European Union may be confusing because of third-party trade (re-export and re-import) and partly due to processing plants based outside but not far from France. Further, Harmonized System trade codes do not always distinguish between feedstocks and other commodities being imported or exported for biofuel or other purposes (for instance, bioethanol is also used for technical purposes other than road transport fuels and in the beverages industry).[22] Therefore, analyzing trade flows of biofuels and their feedstock in the EU necessitates a lot of assumptions and caveats.

France is a net exporter of fuel ethanol. Internal production in 2011 was over 881 million litres, compared to consumption levels of 811 million litres. Trade statistics confirm that more ethanol is exported than imported, although it is not possible to distinguish fuel ethanol from other types of ethanol in these statistics. Ethanol producers are considered to be closely associated with feedstock producers. As a result, one can currently assume that most ethanol consumed in France has been made in France from national feedstock (Gagnepain, 2012). In 2009, 72 per cent of national ethanol production was based on sugar beet, with wheat and maize contributing the remainder (see Figure 3).

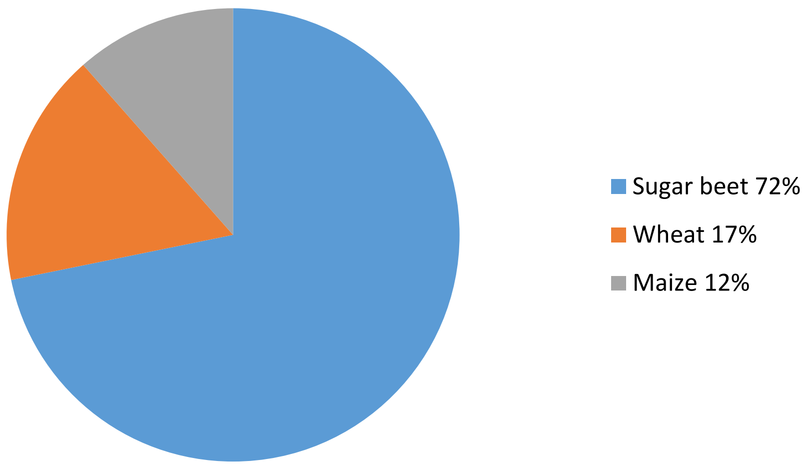

FIGURE 3: FEEDSTOCKS USED FOR ETHANOL PRODUCTION IN FRANCE IN 2009

Source: Gagnepain (2012).

The situation is different for biodiesel, where France is a net importer. In 2011, France produced approximately 2,144 million litres of biodiesel and consumed 2,677 million litres. Trade statistics now include a category that corresponds primarily to biodiesel. The numbers for 2011 show that only about 49 million litres were exported, against 553 million litres imported (Douane, 2013). Within France, biodiesel has mainly been produced with rapeseed and to a lesser extent with soy, palm oil and sunflowers (Gagnepain, 2012).

[22] Biofuels can also be traded as blends with fossil fuels, and trade statistics do not always make a clear distinction between pure and blended products.

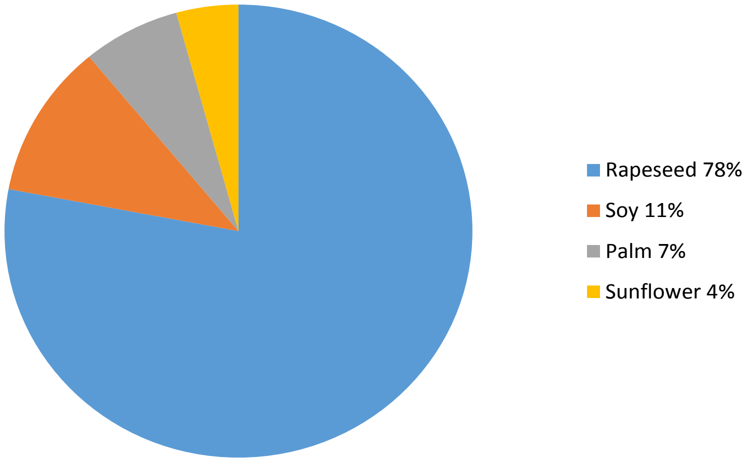

FIGURE 4: FEEDSTOCKS USED FOR BIODIESEL PRODUCTION IN FRANCE IN 2009

Source: Gagnepain, 2012.

Gagnepain (2012) analyzed the sources of biodiesel feedstock used in national production. In spite of difficulties in obtaining detailed data, it appears that between 2005 and 2006 the share of imported rapeseed feedstock increased significantly. A report by ADEME (2012) noted that from 2006, when the production of biodiesel in France rose sharply, an increasing proportion of oil "used in biodiesel production was imported, either directly as oil, or indirectly in the form of seed for producing oil." Imports have mainly come from Ukraine, Romania and Australia. Palm oil is imported from Malaysia and Indonesia, sometimes via other countries such as the Netherlands. Soy feedstock is mainly imported from Brazil and Argentina. The share of imported soy oil doubled from 40 to 80 per cent between 2005 and 2009, indicating that most of the soy feedstock used in biodiesel production has come from abroad. Finally, sunflower oil appears to be mainly from national production. In sum, Gagnepain (2012) estimates that nearly half of all the feedstock used in national biodiesel production has come from abroad. The share of imported feedstock that originated outside of the European Union might be as high as three-quarters. If the use of biofuels increasingly displaces the use of fossil fuels, relative amounts of additional feedstocks may need to be grown domestically or imported if domestic biofuel production increases.

Conclusions

Overall, biofuel consumption in France has contributed to some extent to diversifying the energy matrix in the transport sector and may thereby have increased energy security. The argument is more plausible for ethanol, which France produces in excess of its own needs and probably mostly from national feedstock. Biodiesel consumption, however, relies to a significant extent on imports, thereby providing less energy security benefit, given it relies on inputs from countries located significant distances from France. In addition, national biodiesel production has increasingly relied on imports of feedstock, mostly from outside of the European Union. In a liberalized trade environment this trend will likely continue, if France decides to increase its national biofuel consumption.

7.0 Renewable Energy Options

7.1 Purpose

To evaluate the costs of meeting EU renewable energy targets while reducing the role of food-based biofuels due to EU caps and increasing the contribution from other forms or renewable energy.

7.2 Renewable Energy Targets

The French NREAP anticipates the overall EU target of 23 per cent renewable energy in final energy consumption coming from the electricity, heating and cooling, and transport sectors. These sectors have the following sub-targets for the amount of renewable energy to be generated: 27 per cent of electricity (RES-E), 33 per cent of heating and cooling (RES-H&C) and 10.5 per cent of energy in transport (RES-T) (EREC, 2011, p. 48). The renewable energy generated as part of these sectoral sub-targets aggregated together results in 23 per cent of all final energy consumed coming from renewable sources (EREC, 2011, p.48).

France has projected a total of 36,121 TOE (420,087 gigawatt hours) of renewable energy generation in 2020, according to the NREAP (ECN, 2011). Dividing the 23 per cent renewable energy target in terms of energy sources, the majority of this is expected to be derived from electricity production (53 per cent) followed by heating and cooling (36 per cent), with a smaller contribution from transport (11 per cent). Figure 5 represents the contribution of each sector to the overall renewable energy target of 23 per cent.

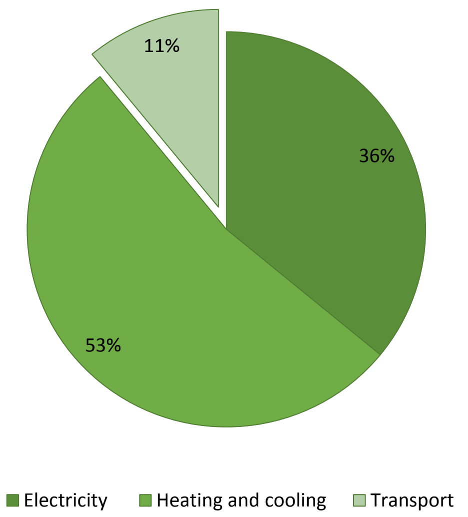

FIGURE 5: PROJECTED RENEWABLE ENERGY GENERATION IN FRANCE IN 2020

Source: ECN (2011).

Notes: Percentages are based on data extrapolations from France's NREAP plan and are subject to rounding reflecting any differences with other breakdowns.

In 2010, the majority of renewable energy (53 per cent) was generated in the form of heating and cooling, with the remainder being split between electricity and transport fuel, 34 per cent and 13 per cent respectively (ECN, 2011). France's NREAP anticipates similar percentages of renewables from electricity, heat and transport between 2010 and 2020.

The economic, social and environmental concerns around the production and consumption of biofuels raise the question of whether it would be possible to reach the target for the total generation of renewable energy without expanding the use of biofuels and instead increasing generation of renewable energy from electricity or heating and cooling.

7.3 Deployment of Renewable Energy in Transport Fuels in France

France's biofuel blending targets are ambitious and have resulted in France meeting its NREAP targets of renewable energy in transport. Figure 6 illustrates the amount of renewable energy consumed in the transport sector (RES-T) versus the NREAP targets. It shows that France is currently meeting renewable energy transport targets largely through the use of biofuels. If a cap on food-based biofuels is introduced, alternative renewable energy technologies will need to be scaled up to meet the RES-T target of 10.5 per cent of all energy in transport being renewable.

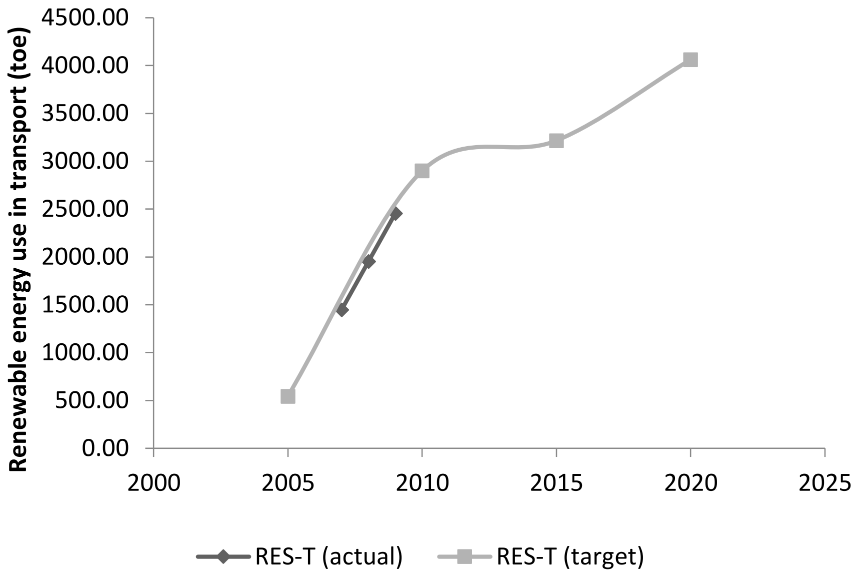

FIGURE 6: RENEWABLE ENERGY USE IN TRANSPORT

Source: ECN (2011).

7.3.1 Costs

At an economic level the cost implications of shifting from biofuels to other forms of renewable energy depend on the energy content and production costs of biofuels compared to other options. Data for biofuels production costs were taken from the IEA World Energy Outlook (IEA, 2012), and data for the cost of energy from renewables were taken from a recent IRENA report on generation costs (IRENA, 2012). Figure 7 shows a summary of this comparison.

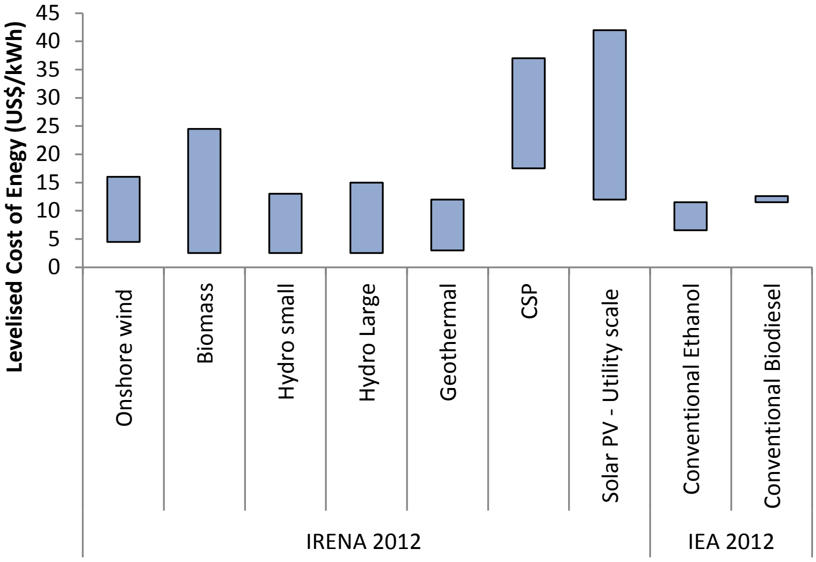

FIGURE 7: COSTS OF ENERGY GENERATION FROM VARIOUS RENEWABLE ENERGY TECHNOLOGIES, BIOFUELS AND PETROLEUM PRODUCTS

Source: IEA (2012), IRENA (2012), authors' calculations.

The levelized cost of energy (LCOE) is a measure of the total cost per unit of energy generated. It includes all the costs associated with production of energy, including the cost of investment, operations, maintenance and any inputs. LCOE provides a single value for cost of energy to allow comparison of technologies with different investment and operating costs. However, the comparison does not account for the usefulness of each of these forms of energy. Liquid fuels are easy to store and very energy dense but conversion to mechanical work has a lower efficiency than electric motors. Electricity must be consumed instantaneously (or stored chemically), which is currently expensive. Despite the shortcomings of LCOE, it provides a useful comparison of the cost of energy, particularly in the context of this comparison of the cost of meeting the EU target for renewable energy production.

The comparison presented in Figure 8 shows that the costs of biodiesel and conventional bioethanol are of a similar order of magnitude to other renewable energy technologies, although the midpoint of the ranges is higher than for some of the more widely deployed technologies, including wind and biomass. Data from IRENA are not available for offshore wind, a technology that is expected to expand considerably. However, other sources generally indicate that offshore wind is considerably more expensive than onshore wind (Mott Macdonald, 2011) and therefore is likely to be the same or more expensive than renewable energy from biofuels. However, the potential for future cost reductions is not the same for all technologies. PV costs have fallen at a rate of 15 to 24 per cent with each doubling in production since 2004 (Bazilian et al., 2013). The LCOE from wind power declined by a factor of three between 1980 and 2003, but rose between 2004 and 2009 before falling slightly in recent years. From 2013 to 2030 both PV and wind are projected to see further reductions in the LCOE (BNEF, 2013; Lantz, Wiser, & Hand, 2012). Conventional biofuels have a relatively low potential for cost reduction in part because so much of the cost is tied to the feedstock (IEA, 2011).

The cost of meeting a greater proportion of the renewable energy target from other (non-biofuel) sources if a cap on food-based biofuels is introduced will be dependent on the capacity to scale up cheaper renewable energy options. The support required to incentivize renewable energy production depends on the alternatives and end uses, so a direct comparison requires detailed analysis. Some easily deployable modular technologies, such as solar PV, are still relatively expensive in terms of investment costs. However, further expansion of renewable electricity may be limited by access to grid infrastructure, though this may be ameliorated by demand-side management and aggregation. Some NREAP plans have been developed on the basis of consideration of existing constraints, but further analysis would be required to establish the technical viability of replacing biofuels with other sources of renewable energy, though this remains an attractive option.

7.3.2 Subsidies

As a preliminary indication of the costs of reducing the use of biofuels and increasing the use of other renewables, the estimate of total support for biofuels developed as part of this study was compared with 2011 estimates for support to France's key renewable energy technologies, divided by the electrical output in that year (CEER, 2011). It should be noted this analysis is for just one year, and support policies for renewable energies are revised regularly and may decrease over time due to policy changes.

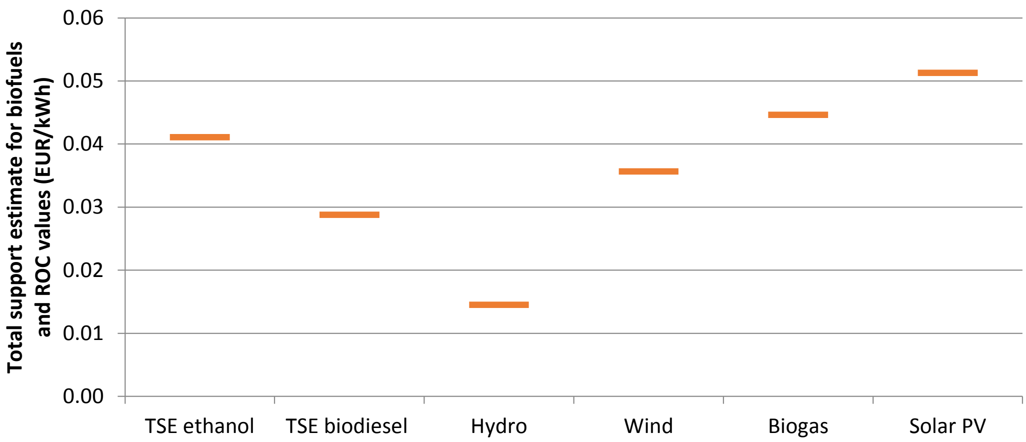

FIGURE 8: COMPARISON BETWEEN TSE ESTIMATE FOR BIOFUELS AND SUBSIDIES

Source: CEER (2013, p. 52); Subsidies to hydropower, wind, biogas and solar PV, divided by electrical output.
†Subsidy estimates for renewable energy technologies (hydropower, wind, biogas and solar PV) are assessed based principally on the level of feed-in tariffs supporting electricity production.

Figure 8 shows that the support to biofuels is about equal to wind power, one of the key renewable technologies considered cheaper than more costly technologies such as PV. The cost for biodiesel, which is the largest source of biodiesel subsidies, is very close to the cost for biogas. This analysis includes only one source of support for renewable electricity production and so is likely to be an underestimate. These findings indicate that while the subsidies to biofuels and renewable electricity are of similar orders of magnitude, the reduction in biofuel consumption and a corresponding increase in other sources of renewable energy may increase, or at least not reduce, the cost of meeting the 2020 renewable energy targets. Without detailed analysis and understanding of subsidies to electricity production it is difficult to understand the magnitude of this change.

While the impact on costs is uncertain, this cannot be considered in isolation. A key goal of the 2020 renewable targets is to realize environmental benefits through the deployment of renewable energy technologies. The concern around the environmental impacts of some biofuels may undermine this objective. A shift towards technologies with widely proven environmental credentials would reduce the cost of environmental benefits, including emissions reductions, if not the absolute cost of meeting the renewable energy targets.

7.3.3 Other Options for the Transport Target

If the level of renewable energy from biofuels into the transport sector was reduced to 5 per cent (based on the cap on food-based biofuels), this would leave a shortfall of 5.5 per cent (based on the transport sector's contribution of renewable energy towards the overall 23 per cent renewable energy target) of the renewable energy target, which would then need to be found from other sources.

The selection of areas in which targets could be increased would require further assessment but could include an increase in other transport technologies such as hydrogen or electric cars running on renewable electricity, though it is clear there are a number of challenges to scaling up some renewable technologies from currently low levels. Increases in renewable energy from heating and cooling may also have to be examined. If it is possible to increase renewable electricity generation from the most competitive technologies, notably onshore wind, then the cost increase may be small. However, if additional generation were to come from more expensive technologies, such as offshore wind or PV, the cost of subsidies and deployment costs may increase. However, an increase in costs may be considered acceptable if the environmental, economic and social impacts are promising.

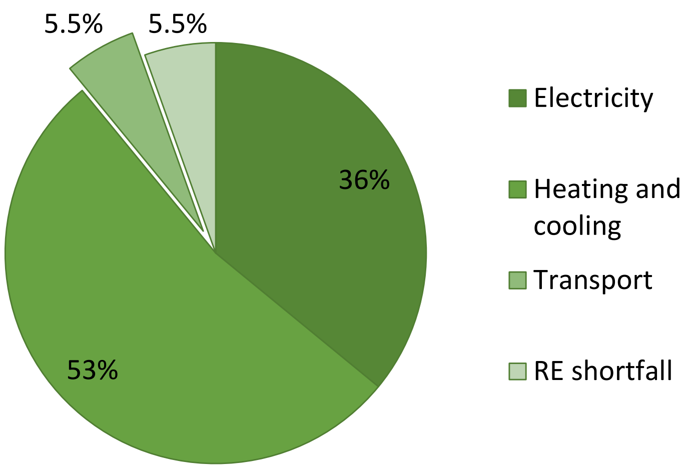

FIGURE 9: 2020 RENEWABLES TARGET WITH BIOFUELS RESTRICTED TO 5 PER CENT AND THE SHORTFALL TO BE FOUND FROM OTHER SOURCES

Source: ECN (2011); authors' calculations.

7.4 Conclusions

If the role of food crop–based biofuels in meeting France's renewable energy transport target is capped, the cost of scaling up other technologies in its place will be dependent on a range of factors, including the availability of renewable resources, financial and non-financial barriers which may hamper greater deployment, as well as the learning potential of specific technologies to reduce investment costs and subsidy levels. Given the complexity of factors affecting the ability to bring forward renewable energy technologies, this analysis does not recommend scaling up or substituting specific renewable technologies over others. However, in the context of binding EU targets for renewable energy use, it recommends government policy should support the use of low-carbon technologies which can deliver greenhouse gas savings up to and beyond 2020 targets.

8.0 Policy Recommendations

The recommendations that can be drawn from this study suggest that it is advisable for French policy-makers, along with those at the national government levels, to recognize the following:

- **Biofuel blending targets are a significant intervention in the liquid fuels transport market.** The French government should ensure blending targets can be adjusted to be consistent with a food-based biofuel cap were this proposed piece of legislation to be successful at the EU level.
- **In terms of greenhouse gas emission accounting of biofuels, if the French government included ILUC as part of its accounting approach**, it would be applying a precautionary approach, and it would ensure that public money does not support biofuels which increase carbon dioxide emissions.
- **Under most scenarios biodiesel is an expensive method for abating emissions and can in some circumstances result in net emission increases compared to fossil fuels. Biofuel support policies should differentiate between conventional and second-generation biofuels, bioethanol and biodiesel, and ideally between feedstock**, such as used cooking oil (UCO) and palm oil, given the varying environmental performance of fuels and production processes.
- **Think in the longer-term and phase out support to conventional biofuels.** The French biodiesel and ethanol sector is facing increasing challenges due to poor market conditions and heightened competition. The French government and biofuels industry could use this as a window of opportunity to rationalize conventional biofuel support policies.
- **Monitoring and regularly publishing support figures for biofuels, as well as all forms of energy (including fossil-fuel and nuclear), is important in improving the transparency of public policy making.**
- **The French government could consider improving its official government statistics on the number and types of jobs generated by biofuels policies further, in particular by providing information on** indirect and direct jobs created in France given the variety of employment estimates and methodologies used. This would provide better information on how many jobs within the French economy have been created by the biofuels sector.

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Appendix A: Breakdown of Biofuel Production Plants in France

COMPANY	LOCATION	CAPACITY (MILLION LITRES)	YEAR OF FIRST OPERATION	CAPEX (MILLION €)	TYPE
Tereos	Artenay	40	1928	NA	ethanol
Tereos	Provins	15	operational	NA	ethanol
Tereos	Lillers	80	2006	NA	ethanol
Tereos	Morains	40	operational	NA	ethanol
Tereos	Lillebonne	250	2007	215	ethanol
Tereos	Origny	300	2009	NA	ethanol
Cristanol	Arcis sur Aube	150	1986	385	ethanol
Cristanol I	Bazancourt	150	2007	between 217-250	ethanol
Cristanol II	Bezancourt	200	2008		ethanol
Cristanol	Deulep (St. Gilles)	40	2005	NA	ethanol
Soufflet (SMBE)- Saint Louis Sucre	Eppeville	90	1920	NA	ethanol
CropEnergies AG	Ryssen	100	2008	NA	ethanol
AB Bioenergy France	Lacq	250	2007	200	ethanol
Roquette (Beinheim)	Beinheim	150	2008	35	ethanol
Diester Industrie	Grand-Couronne II	283	2008	NA	biodiesel
Diester Industrie	Compiegne	113.2	2005	NA	biodiesel
Diester Industrie	Sete	226.4	2006	NA	biodiesel
Diester Industrie	Montoir/St-Nazaire	283	2007	NA	biodiesel
Diester Industrie	Le Meriot	283	2007	NA	biodiesel
Diester Industrie	Bordeaux/Bassens	283	2008	NA	biodiesel
DSM	Lesterm	38	2010	NA	biodiesel
Bionergy (Sica)	La Rochelle	11.32	2008	NA	biodiesel
Bionergy (Sica)	La Rochelle	56.6	2009	NA	biodiesel
Futurol	Pomacle	180	2011	74	biodiesel
Cognis	Boussens	45.28	2002	NA	biodiesel
Ecomotion (Saria)	Le Havre	84.9	2010	40	biodiesel
INEOS Enterprises France SAS	Baleycourt (Verdun)	260.36	2008	70	biodiesel

Appendix B: Energy-Based Excise Tax Calculations

The following tables indicate the rate at which ethanol and biodiesel are exempted from excise taxes on an energetic basis relative to petrol and diesel substitutes.

Ethanol

When adjusted for energy content, ethanol is taxed higher per energy unit than petrol. Therefore, the loss of fiscal revenues turns into a net gain for the government. The excise tax on petrol of €0.61 per litre can be converted to a tax rate of €0.019 per megajoule. The effective tax rate for ethanol is €0.022 per megajoule.

TABLE B1: EXCISE TAX EXEMPTIONS FOR ETHANOL IN FRANCE, ADJUSTED FOR ENERGY CONTENT (2011)

ETHANOL				
Quantities (million MJ)	Excise tax on Petrol (€/MJ)	Actual excise tax ethanol (€/MJ)	Exemption (€/MJ)	Loss of fiscal revenues (million€)
17,257	0.019	0.022	-0.003	-53

Sources: consumption: SOeS (2013); excise tax rate petrol: Ministry of Ecology (2013), loss of fiscal revenue: authors' calculations.

Biodiesel

The excise tax on diesel of €0.43 per litre can be converted to a tax rate adjusted for energy content of €0.011 per megajoule than its fossil-fuel equivalent with €0.012 per megajoule. Albeit lower, this excise tax reduction leads to a loss of fiscal revenues of around €91 million.

TABLE B2: EXCISE TAX EXEMPTIONS FOR BIODIESEL IN FRANCE, ADJUSTED FOR ENERGY CONTENT (2011)

BIODIESEL AND PURE PLANT OIL				
Quantities (million litres)	Excise tax on diesel (€/MJ)	Actual excise tax biodiesel (€/MJ)	Exemption (€/MJ)	Loss of fiscal revenues (million €)
64,843	0.012	0.011	0.001	91

Sources: consumption: SOeS (2013); excise tax rate petrol: Ministry of Ecology (2013), loss of fiscal revenue: authors' calculations.

Appendix C: Research and Development for Advanced Biofuels

This section provides a basic overview of France's R&D programs. The European Union and member states foster R&D activities in the field of advanced biofuels via various programs; these programs are directed at R&D into advanced biofuels (in contrast to first-generation biofuels) from non-edible feedstocks such as wood, straw and algae.

European Commission–funded projects listed in Table C1 generally involve a consortium of organizations often spread across a large number of countries which share the total value of the project funding (often only a smaller portion of the overall project funding is directed to activities within a particular country, such as France)[23]. French Government–funded projects will, however, have a French focus. The project funding can also be divided between non-biofuel research concerning energy or agricultural applications[24].

This study has identified the nine research and development projects listed in Table C1 below. They represent contributions from public funds of about €310 million France supports several projects through its support agency for small and medium enterprises, Oséo, and through the French Environment and Energy Management Agency (ADEME).

On the other hand, the public funding contributions represent low estimates, as funding information is not readily available for all projects. In addition, there may be further projects which benefit from public funding.

TABLE C1: FRENCH-RELATED R&D PROJECTS FOR ADVANCED BIOFUELS

PROJECT NAME	DURATION	PUBLIC FUND CONTRIBUTION (MILLION €)	COORDINATOR	DESCRIPTION	SOURCE
BIOCORE	03/2008 - 02/2014	14	France (Coordinator)	This EC-funded project researches how different types of biomass such as rice straw, birch wood and hardwood can be converted into the molecular building blocks that are required to make chemicals, fuels, polymers and other materials	http://ec.europa.eu/research/infocentre/article_en.cfm?id=/research/star/index_en.cfm?p=ss-biocore&calledby=infocentre&item=Countries&artid=25813&caller=SuccessStories
BABETHANOL	05/2009 - 04/2013	3	Institut National Polytechnique de Toulouse	The EC-funded BABETHANOL project proposes solutions for a more sustainable approach to second-generation renewable ethanol based on a moderate, environmental-friendly and integrated transformation process that should be applicable to an expanded range of lignocellulosic feedstocks.	http://cordis.europa.eu/projects/rcn/91093_en.html
UPM Stracel BTL	2015-2020	170	UPM	Construction and operation of a second-generation Biomass-to-Liquid (BtL) plant on the Strasbourg site of the UPM Group. The project is based on the application of novel pressurized oxygen blown biomass gasification technology. The funding comes from the EU's NER300 program and was announced in December 2012.	http://ec.europa.eu/clima/news/docs/c_2012_9432_en.pdf

[23] R&D project funding can also be divided across non-biofuel related research activities involving energy or agricultural applications. In addition to the EC funding these projects receive financial contributions from the private sector.
[24] In addition to the EC funding these projects receive public and non-government financial contributions.

Projet Syndièse	2009-2017	?	Commissariat à l'énergie atomique et aux énergies alternatives (CEA)	Demonstration project on second-generation biofuels that aims to prove the technical and economic feasibility of a complete Biomass-to-Liquid (BtL) production chain. As the first project worldwide, it aims to introduce hydrogen into the processes to optimize efficiency.	http://www.cea.fr/energie/biocarburants-de-2eme-generation-le-projet-syn-108933
FUTUROL	2011-2020	Total budget 76,4; French state support of 29.9	PROCETHOL 2G Consortium (involves 11 project partners from R&D, industry and finance)	The Futurol project's primary goal is to develop and validate a so-called "second-generation" bioprocess for ethanol production by using lignocellulose (sourced from agricultural & forestry by-products and/or dedicated energy crops) as a feedstock. Futurol has received funding from the French state innovation agency OSEO.	http://projet-futurol.com/
BioTFueL	2010-2017	Total budget 112, of which 33.3 in public funding	Bionext (including TOTAL, IFP and SOFIPROTEOL)	BioTfueL aims to develop by 2017 a complete industrial production chain for second-generation biofuels using a wide range of biomass resources, in order to produce high-quality biodiesel and biokerosene.	http://www2.ademe.fr/servlet/doc?id=82653&view=standard
GAYA	2010-2016	Total budget: 47, of which at least 19 public funding	GDF-Suez	The GAYA project aims to demonstrate the technical, environmental, economic and social viability of second-generation biomethane (gaseous biofuel). 11 industrial and university partners are involved in research and in the set-up of an industrial-scale thermochemical production chain in Lyon.	www.projetgaya.com
DEINOL	2009-2014	Total budget: 21.4, of which 8.9 public funding	Deinove	DEINOL is a collaborative R&D programme involving ethanol producer TEREOS. It receives funding from the French state innovation agency OSEO. DEINOL aims to develop an integrated production system for second- and third-generation bioethanol.	http://www.deinove.com/en/programmes-applications/deinol
GreenStars		Total budget 160, of which approx. 20% (32) public funding	INRA with 45 partners	GreenStars aims to develop an entire industrial value chain for biofuels (and co-products) produced from micro-algae. It brings together 45 public and private actors.	http://www.inria.fr/centre/sophia/actualites/greenstars-biocarburants-et-micro-algues

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