12 September 2005

Biofuels in France

1990 - 2005

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PREMIA report

This report has been produced under PREMIA contract number
TREN/04/FP6EN/S07.31083/503081

Summary

This report is written to append the literature and other information that is used in the European PREMIA project, which aims at assessing the effectiveness of measures to support the market introduction of alternative motor fuels. The report describes the initiatives related to biofuels in France since 1990, the organisations involved and the impact of their activities.

After the European CAP (Common Agricultural Policy) reform in the early 1990s, biofuels gained interest in France. The French government put a legislative framework and fiscal incentives for the production and use of biofuels in place, and the first significant quantities of biofuel were commercially produced in 1993. Two different types of biofuels are used in France: VOME (vegetable methyl oil ester) based on vegetable oil and ETBE (ethyl tertiary butyl ether) based on bio-ethanol. France chose to use all biofuels as a blending component in conventional gasoline and diesel fuel because that does not require vehicle modifications and the existing fuel distribution infrastructure can be used.

The three most important reasons for the French government to stimulate biofuels for transportation are employment in the agricultural sector, increasing energy independency and reducing the environmental impact of the transport sector. Biofuels are included in the governmental programme on mitigating climate change (‘plan climat’) and in the programme on stimulating the production and use of biofuels (‘plan biocarburants’). A system of authorised production quantities -that grants a reduction of the internal tax on petroleum products (TIPP) for automotive biofuels- has been established by the authorities to make biofuels commercially viable. There is also financial support for research on automotive biofuels on a national level.

Many different organisations are involved in the production, distribution and use of automotive biofuels. These organisations, their co-operation and partnerships are described in this report. The organisations include:

- public bodies like the government, governmental agencies and research institutes,
- the agricultural sector, biofuel producers and fuel distributors,
- the French automotive industry.

As a result of the activities of all organisations involved, the production of biofuels increased steadily during the 1990s. Around the year 2000 the growth stalled and since then annual biofuel production in France remained at a more or less constant level. The most important reason for the lack of growth seems to be that the authorised production level with the associated tax advantage remained constant after the year 2000. Today less than 1% of automotive fuel consumption in France consists of biofuels. However, the French government is dedicated to meet the objective of European Directive 2003/30/EC that prescribes the use of 5.75% biofuels in transportation in 2010, and it is scheduling the

required growth of authorised production capacity to reach this percentage. A first round of additional authorisation took place in spring 2005 and new biofuel production plants will be constructed the coming years. It is estimated that sufficient agricultural area is available in France to be self-supporting in automotive biofuels in 2010.

Other impacts of the activities on biofuels in France are:

- The use of biofuels instead of fossil fuels avoided about 0.9 million tons (Mt) of CO_2-equivalent emissions in 2004. In 2010 this figure is expected to be 7 Mt.
- By 2003, the use of biofuels in transportation had created or maintained 4300 jobs in the agricultural sector. When the 5.75% biofuels goal is achieved in 2010, this number of jobs is estimated to have increased to 25'000.

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1
Introduction

1.1
About this report

The purpose of this report is to append the literature and other information that is used in the European project PREMIA, which aims at assessing the effectiveness of measures to support the market introduction of alternative motor fuels, taking the national context of EU member states into account. This report on initiatives related to biofuels in France since 1990 is meant to contribute to the objectives of the PREMIA project by presenting:

- co-operation and partnerships between the agricultural sector, fuel producers, petrochemical companies and other stakeholders,
- accompanying measures by the French government and on a European level,
- the impact of these activities and measures.

This report is set up to be used as a reference manual. Different sections can be read individually; it is not necessary to read the whole report from A to Z. When applicable, the reader is guided to other sections that address the same topic. An extensive list of references is included as a guide to additional information on automotive biofuels in France.

This report starts by presenting a general overview of biofuels for automotive applications in France in section 1.2. The parties that are involved in this sector are described in chapter 2 and forms of co-operation between them are presented in chapter 3. Chapter 4 focuses on the legal framework in which the actors operate and chapter 5 presents the financial incentives to support their activities. The impact of these measures and activities on the automotive biofuel market and other aspects of society in France is the subject of chapter 6. The last chapter gives some remarks to put the results in a broader perspective.

Starting point for this report is that the reader possesses basic knowledge about conventional and alternative fuels, especially biofuels, and their application in vehicles. There is sufficient literature available on the technical aspects of producing and using biofuels and their impact on energy consumption and emissions, and general information of that kind is not duplicated here. This report concentrates on the situation in France. Its aim is to give a general picture. A limited number of individual biofuel projects is presented for illustration purposes.

1.2
Automotive biofuels in France

The agricultural sector in France is large and it has a long tradition. Biofuels have previously been used for specific applications in vehicle propulsion until the interest

faded away during the 1950s. After the European CAP (Common Agricultural Policy) reform in the early 1990s, interest in biofuels revived. A legislative framework and fiscal incentives were put in place and the first significant quantities of biofuels were commercially produced in 1993. France chose to use all biofuels as a blending component in conventional gasoline and diesel fuel because that does not require vehicle modifications and the existing fuel distribution infrastructure can be used. Besides its use in vehicles, blending of biofuels in domestic heating oil is also tax exempt.

Two different types of biofuels are used in France: VOME (vegetable methyl oil ester) based on vegetable oil and ETBE (ethyl tertiary butyl ether) based on bio-ethanol. They are used in the following blends:

- Up to 5% VOME blended in diesel fuel. This is allowed without special notification at the refuelling pump. About every other diesel car driver in France is using a fuel that contains this bio-component, but without being aware of it. Most of the VOME –or biodiesel- in France is produced from rapeseed and a small amount originates from sunflower oil.
- Under special agreements that have improving urban air quality as a background, 30% VOME in diesel fuel is used in captive fleets like city buses.
- Until 2004 it was not allowed to blend the alcohol bio-ethanol directly in conventional fuels. Bio-ethanol is converted into ETBE before it is blended in gasoline, to a maximum of 15%. Since 2004 direct blending of ethanol is allowed, but so far it occurs only on a very limited scale.

The use of some other biofuel options is currently being studied in France:

- A pilot project with urban buses fuelled with biogas is running in the city of Lille.
- Research institutes IFP and CEA are investigating biomass gasification to produce liquid biofuels via Fischer-Tropsch synthesis (BTL –biomass to liquid- fuels).
- To substitute the fossil fuel based component methyl in VOME, today VOEE (vegetable oil ethyl ester, where the ethyl is produced from bio-ethanol) is under consideration to obtain a 100% biomass based biodiesel.

It seems that there are no activities on other biofuels like bio-DME, bio-methanol and pure vegetable oils ongoing in France, or these activities would be confidential.

2
Organisations involved in biofuels

This chapter describes the most important organisations that are involved in the biofuel well-to-wheel chains in France. It starts with the public bodies in section 2.1. Section 2.2 focuses on biofuel producers and automotive fuel distributors. French vehicle manufacturers are addressed in section 2.3. In the last section some smaller players in the field are listed. One-to-one co-operation between the organisations described here is also included in this chapter. Chapter 3 focuses on partnerships between larger numbers of organisation and the bodies that have been set up for these partnerships.

2.1
Public bodies

2.1.1
The French government

The European CAP (Common Agricultural Policy) reform of 1992 had a major impact on the French agricultural sector. Mitigating the negative effects of the reform and stimulating the use of set-aside land for growing energy crops were the first motives for the French government to stimulate the production and use of biofuels. Therefore a set of legislative and financial measures was put in place in the early 1990s. In 1997 meeting the 2010 targets for greenhouse gas emissions of the Kyoto protocol became an extra driving force. More recently European Directive 2003/30/EC that requires 2% biofuel in 2005 and 5.75% biofuel substitute for in gasoline and diesel fuel by the year 2010 -aiming for reduced greenhouse gas emissions of the transport sector- became an important argument to stimulate the development of the biofuels market. During the last decade reducing oil dependency was also added to the list of driving forces. So today the development of bio-energy in France is important for agricultural, environmental and energy reasons.

The 'Plan climat' (climate plan) of the French government quantifies the goals for greenhouse gas emission reductions in all sectors of society. Biofuels in the transport sector should contribute by avoiding 7 Mt CO_2-equivalent greenhouse gas emissions in 2010 [50]. With this objective, also about 25'000 jobs are created or maintained [48]. The ambitions of the French government go further, in 2010 France should be ranked among the industrialised countries with the lowest greenhouse gas emissions and it should also have a top ranking for its innovative and competitive automotive industry [49].

Since the start of the governmental biofuel activities in the early nineties, different French ministries have been involved because the responsibilities of the ministries change over time. In 2003 for example, the ministry of agriculture, food, fishery and rural affaires, the ministry of economy, finances and industry, the ministry of ecology and sustainable development and the ministry of research and new technology were involved [6]. Today

the ‘Plan biocarburant’ (plan on biofuels) is the most important governmental programme for biofuels and the ministry of economy, finances and industry is responsible for this programme.

2.1.2
ADEME

The French Agency for the Environment and Energy Management ADEME (Agence de l'Environnement et de la Maîtrise de l'Energie) is the national public body promoting sustainable development under the supervision of the ministry of ecology and sustainable development, the ministry of research and the ministry of economy, finances and industry. ADEME acts in the fields of energy, air, noise, transport, waste, polluted sites and environmental management. The activities on automotive biofuels are conducted in two departments. Biofuel production falls under the ‘Département Bioressources’ and the end use in vehicles is addressed in the ‘Département Technologies des Transports’ [4]. The ADEME bioressources department is in charge of the management of the AGRICE programme on chemical and energy applications of agricultural products (see also section 3.1).

2.1.3
IFP - Institut Français du Pétrole

The French Petroleum Institute IFP (Institut Français du Pétrole) is a scientific research and industrial development, training and information services centre that is active in the oil and gas sector. IFP is also working on energy carriers that may substitute oil and gas. The activities cover all aspects of the oil and gas industry: exploration, production, refining, petrochemicals and use in engines [34]. Technologies that have been developed by IFP are commercialised through an organisation named ‘Axens’ [30].

Regarding biofuels for transportation, IFP is performing research and development work on production processes and it is investigating the impact of their use in engines. The focus is on reducing production costs, diversifying feedstock and developing processes to transform ethanol into gasoline components [30]. IFP is working on three different routes for the production of biofuels [33]:

- Vegetable oil methyl esters (VOME) from biomass,
- Ethanol and ETBE from biomass,
- Biomass to liquids (BTL) by means of Fischer-Tropsch synthesis.

These three routes are addressed in more detail below. The impact of these fuels -mostly blended in conventional fuels- on vehicle engine performance and emissions is also evaluated by IFP [34].

Vegetable oil methyl esters (biodiesel)

IFP launched a programme on the production of diesel fuel from vegetable oils in the early 1980s. This led to a discontinuous production process for rapeseed methyl esters (RME). In 1992 the first industrial unit using this process was built in Compiègne, with

an initial production capacity of 20'000 tons per year [33]. More recently, IFP has developed a continuous biodiesel production process that is commercialised under the name Esterfip-H™ by Axens. The fuel produced via this process meets the European FAME (fatty acid methyl esters) standard EN-14214 for use in diesel engines. The French company Diester Industrie will use this technology for its new biodiesel production plant in Sète. The Esterfip-H™ production process can use ethanol instead of methanol to produce a vegetable oil ethyl ester (VOEE). When using bio-ethanol instead of natural gas based methanol, it results in a biodiesel from only vegetable components. IFP has proven the use of VOEE in internal combustion engines. The production of biodiesel generates glycerine as a by-product. The world market of glycerine is already saturated, so IFP is currently seeking ways to convert glycerine in products that can be incorporated in the oil and gas product streams [30, 33].

Ethanol and ETBE

Since the early 1980s, IFP is investigating the feasibility and developing the process of producing ethanol from lignocellulosic feedstock like straw, cornstalks, wood residues and organic waste. The well-to-wheel fuel chain of ethanol that is produced from lignocellulosic feedstock has very low greenhouse gas emissions and the lignocellulosic route has the potential to become more economical than the conventional processes, and IFP's activities on this topic have accelerated recently. This work is done together with the French organisations INRA (Institut National de Recherche Agronomique) and CNRS (Centre National de la Recherche Scientifique) and with other, foreign partners [30, 33].

In Europe, maximum 5% ethanol may be blended into gasoline. However, in France ethanol is converted into ETBE (ethyl tertiary butyl ether) before it is incorporated into gasoline (up to 15%). IFP has developed the ETBE production process that is used by the French oil company Total [30, 33].

Biomass to liquids - BTL

In the biomass to liquids biofuel production route, the first step is biomass gasification and the second step is a Fisher-Tropsch synthesis to produce a liquid fuel. According to IFP, currently no industrial unit for biomass gasification exists, while the synthesis step is a well-known technology. Therefore IFP started a research and development programme on biomass gasification three years ago. In this programme IFP collaborates with the French research organisation CEA [13, 33].

2.2 Biofuel producers and distributors

This section starts with the biodiesel chain in subsections 2.2.1 - 2.2.3. The umbrella organisation PROLEA is described, followed by the largest biodiesel producer 'Diester Industrie' and other biodiesel producers. Then the bio-ethanol production chain is addressed in the CGB, AGPB, Tereos and 'other producers' subsections (2.2.4 -2.2.7).

This section concludes with subsections on fuel distributors Total and ‘others’ in subsections 2.2.8 and 2.2.9.

2.2.1
PROLEA

PROLEA (filière française des huiles et protéines végétales) covers the French chain for oils and vegetable proteins from feedstock production to industrial conversion. It was established in 1973 as a reaction to the American soy embargo. Fields of attention are the production of oil-producing and protein rich crops and their markets, both for food and non-food applications, and biodiesel (VOME) is included in the activities. PROLEA is founded on five organisations: FOP, CETIOM, ONIDOL, UNIP and SOFIPROTEOL [68]. These five organisations are briefly presented here.

- FOP - Fédération Française des Producteurs d'Oléagineux et de Protéagineux.
  The mission of the French federation of oil-producing and protein rich crop producers is to defend the interest of its 150’000 members towards the French and European authorities and international organisations like the WTO (World Trade Organisation). FOP helps to diversify the market of the products of its members, and contributed to the introduction of biodiesel in France. FOP helps farmers to collect the European support of 45 Euros per hectare for energy crops on set-aside land (see also section 5.3) [68].
- CETIOM - Centre Technique Interprofessionnel des Oléagineux Métropolitains.
  CETIOM is the French technical research organisation for the producers of oil-producing (oilseed) crops, established in 1957, with the goal to contribute to improving the economic competitiveness of oilseed products. It performs applied research in five directions: sustainable crop systems, new product evaluation, product quality and safety, strategic decision-making, and product innovation. Most of the work is on rapeseed, sunflower, soybeans, linseed and their derivatives, including biodiesel [14, 68].
- ONIDOL - Organisation Nationale Interprofessionnelle des Oléagineux.
  Since 1978 all the players in the oil-producing grain and fruits (rapeseed, sunflower, soy, olives, etc.) sector are represented by ONIDOL. It promotes the development and use of oil-producing crops and their derivates. ONIDOL co-ordinates and supports research in this field and it encourages agreements between the players in the production chain. Research and promotion focus on improving production and transformation processes, on diversification of production and on food and non-food applications of vegetable oils. Non-food applications of the vegetable oil are in the form of constituents of cleaning and lubricating products and as feedstock for the production of esters, including biodiesel. Among others, ONIDOL co-operates with CETIOM, IFP and INRA [33, 68].
- UNIP - Union Nationale Interprofessionnelle des Plantes riches en Protéines.
  This union focuses on plants that are rich in protein, so it does not play an important role in biofuels.

- SOFIPROTEOL - Etablissement financier de la filière des huiles et protéines végétales.
  SOFIPROTEOL is an organisation that manages the funds of all participants in PROLEA. It was established in 1983. SOFIPROTEOL covers a wide range of activities in the sector. It is important here to mention that it has a share of two thirds in Diester Industrie, a company that produces vegetable oil methyl esters for non-food and biodiesel applications [67, 68]. Diester Industrie is presented in the next subsection (2.2.2).

2.2.2 Diester Industrie

In 1987 the first experiments with vegetable oil methyl esters (VOME or biodiesel) started near Compiègne, in the North of France. By 1992 there was a pre-commercial production plant with a capacity of 20'000 tons per year, which was constructed in partnership with IFP. In 1993 Diester Industrie was created for the commercial production of biodiesel. The production capacity of the Compiègne plant has been extended in 1997 and in 2000. In 2004 it had an authorised production capacity of 83'500 tons annually. Diester Industrie opened two other biodiesel production plants and in 2004 its total authorised production capacity was 376'500 tons (see table 2.1). Before the end of 2005 a new production unit with an annual capacity of 160'000 tons is scheduled to be opened in Sète [30, 66, 67].

Table 2.1 Diester Industrie authorised production capacity in 2004 [67].

Location	tons / year
Compiègne (Venette)	83'500
Rouen (Grand-Couronne)	260'000
Boussens	33'000
Total	376'500

Diester Industrie is dominant on the French biodiesel market. It has been granted most of the total 2004 authorised production of 387'500 tons in France (see subsection 4.2.2 for more information on authorised production capacity). To meet the 5.75% biofuel requirement of European Directive 2003/30/EC for 2010, a large amount of additional biodiesel production capacity has to be constructed. Diester Industrie is aiming to remain the largest producer on the French market and schedules to have a total production capacity of approximately 960'000 tons by 2007-2008 [67]. Also on a European level Diester Industrie is a big player, it was the largest producer in the European Union in 2004 [23].

Diester Industry is for two thirds owned by SOFIPROTEOL and for one third by a group of holdings on behalf of the French farming co-operations that are active in oil-containing crops [30, 67].

2.2.3
Other biodiesel producers

Besides Diester Industrie, two other biodiesel (VOME) producers are authorised for the French market, but their role is very limited. These companies are Archer Daniels Midland Company (ADM) that has two production locations in Germany, and Novaol, which is a large French manufacturer that produces mainly for the German market and that has a small authorised production quantity for the French market [23, 29, 67].

Table 2.2 Biodiesel (VOME) authorised production capacity for the French market in 2004 [23, 29, 67].

Company	tons / year
Diester Industrie (total, France)	376'500
ADM (Hamburg, Germany)	5'000
ADM (Leer, Germany)	5'000
Novaol (Verdun, France)	1'000
Total	387'500

2.2.4
CGB - sugar beet planters

The general confederation of sugar beet planters CGB (Confédération Générale des planteurs de Betteraves) represents and defends the interest of the 35'000 French sugar beet planters towards political, industrial and administrative parties on a national and international level. It negotiates trade conditions, disseminates relevant information to its members and promotes new applications of sugar beets, including bio-ethanol and its application as automotive fuel [16].

CGB is actively lobbying for ethanol as a fuel by using the arguments of reducing energy dependency, meeting the Kyoto protocol goals on greenhouse gas emissions and the European goals on biofuel content in transportation fuels. It stresses that ethanol as a fuel can be profitable for the state when an appropriate tax regime is put in place and that it has a positive impact on employment in the agricultural sector. To meet the 2010 goal of European Directive 2003/30/EC, between 10% and 20% of the current area planted with sugar beets and 5% to 10% of the wheat surface is sufficient to produce the required amount of fuel ethanol, according to CGB [15].

CGB is strongly in favour of direct blending of ethanol in gasoline, instead of first converting it to ETBE. According to CGB direct blending is less costly, has a more favourable energy balance and is more effective against global warming [15, 16].

In the future ethanol might be used in combination with fuel cells. Therefore CGB is partner in a research project conducted by CNRS (Centre National de la Recherche Scientifique) that aims to develop a catalyst that enables an optimal production of hydrogen from ethanol [16].

2.2.5
AGPB - cereals producers

The general association of cereals producers (AGPB) represents the interests of the French cereals producers by expressing their needs and defending their positions towards national and European authorities. It works on safeguarding the European market position of the sector and on meeting the demands of society by the production of high quality cereals in a way that respects the environment. Additionally, it is continuously monitoring new options for the application of cereals, like in the paper industry, the chemical industry, the pharmacy, application in biodegradable materials, to produce bio-electricity and the use as (automotive) fuel [8]. According to their newsletter "Blé contact", AGPB is in favour of blending of pure bio-ethanol into gasoline, with the same arguments as CGB.

2.2.6
Tereos

Tereos is an international agro-industrial group that transforms sugar beet, sugar cane and wheat into sugar and ethanol. In France it has two plants that produce fuel ethanol from wheat and two distilleries for fuel ethanol production from sugar beet. Their authorised production capacity in France is 48'000 tons per year, which is about half of the total authorised quantity. The bio-ethanol that Tereos produces is converted into ETBE in the refineries of the French oil company Total. Anticipating an increasing bio-ethanol demand resulting from European Directive 2003/30/EC, Tereos envisages the construction of a new plant to produce 200'000 tons of ethanol from wheat and another plant that will produce annually 160'000 tons of ethanol from sugar beet [23, 85].

2.2.7
Other bio-ethanol producers

Cristal Union -a sugar and alcohol producing company- is another important player on the French market for bio-ethanol and also their production is converted into ETBE for inclusion in gasoline. Cristal Union applied for additional authorised bio-ethanol production capacity that are currently being granted by the French authorities [18, 23].

The Spanish ethanol producer Abengoa Bioenergía SA is not active on the French market yet, but its subsidiary AB Bioenergy France has now been authorised by the French

government to annually produce 40’000 tons of bio-ethanol from corn under tax exemption starting in 2007. This quantity is only part of the 180’000 tons that was requested by Abengoa in spring 2005. Abengoa will apply for additional authorisation in the new phase of authorisation that is scheduled for the second half of 2005 [1].

2.2.8
Total

The French oil company Total is the largest reseller of biodiesel (VOME) in France. In 2002, it purchased more than 70% of the authorised quantity and blended it in diesel fuel. 2% VOME was included in the automotive diesel fuel that it produced in its six French refineries. The percentage of VOME that Total is blending in its diesel fuel is increasing. Besides selling this diesel fuel containing a small percentage of biodiesel on the general market, Total is also supplying a diesel fuel containing up to 30% VOME to a number of captive fleets under a special governmental exemption system (see also section 3.2) [9, 87].

There are currently three ETBE (ethyl tertiary butyl ether) production plants operational in France and Total is managing all three of them. The first industrial ETBE production facility in France used to be a MTBE production plant in Feyzin, which was converted to ETBE production in 1993. This plant had a production capacity of 75’000 tons per year. In 1996 two other facilities were constructed, as a joint investment by Total, ethanol producers and the professional sector producing sugar beet and cereals. Today, combined production capacity of these three plants is 219’000 tons of ETBE per annum, which is the total authorised production quota for tax reduction (see subsection 4.2.2 for the principle of authorisation) [10, 21, 22].

According to CGB (representing the French sugar beet producers) and EurObserv’ER, Total is not in favour of pure blending of bio-ethanol in gasoline. One reason is that the vapour pressure of the base gasoline would have to be reduced to make the blend meet the European gasoline specifications. The other reason that is mentioned is that Total prefers to valorise the refinery by-product isobutylene by converting ethanol into ETBE. Total states that it is technically not so easy to blend ethanol directly in gasoline [9, 10, 16, 23].

Another way to incorporate ethanol in fossil fuels is using it to produce vegetable oil ethyl esters (VOEE). Total is working on this option and is approaching the industrial stage [9]. VOEE can be used for blending in diesel fuel, similar to VOME (vegetable oil methyl esters).

2.2.9
Other oil companies and fuel distributors

Total does not have a monopoly on the biofuels market in France, other oil companies and fuel distributors are including biofuel components in their products as well. However,

they do not advertise it currently. For example the websites of Shell France and BP France do not pay attention to biofuel components in their products on the French market. Also a French Shell brochure on new fuel compositions and the positive effects on the environment does not mention any biofuel component in the fuels [83].

Shell France was involved in blending VOME in diesel fuel from the start of these activities in France in the early 1990s. Shell supplied blends with up to 33% of ester to captive fleets and in 1994 it had a market share of about 50% in this segment. In that year a total number of 1700 vehicles were using this fuel blend in France [28].

Today, supermarket chains selling automotive fuels under their own name have a substantial market share in France. They do not advertise that there are bio-components included in their automotive fuels. For example Carrefour -the second largest automotive fuel distributor in France with a market share of 14% in gasoline and 9% in diesel fuel- has a policy to encourage the use of biofuels in areas where agricultural resources are available, but it does not give figures on the amount of bio-components in its fuels [12].

2.3 The French automotive industry

This section addresses the two big players in the French automotive industry, PSA Peugeot Citroën and Renault. Other, much smaller, French enterprises are active in the automotive sector, but they do not play an important role in biofuels.

2.3.1 PSA Peugeot Citroën

The PSA Peugeot Citroën group is a French manufacturer of cars and vans. The group emphasizes that reducing the environmental impact of the automotive industry is an important element in its activities. Therefore the group works on reducing the pollution of their production plants, it promotes recycling and it aims to produce clean vehicles. 'Clean vehicles' stands for reduced emissions of pollutants and greenhouse gases [44].

Reducing vehicular CO_2 emissions is an important reason for PSA to work on alternative energies. Different energy carriers meet different demands, so the group works on natural gas vehicles, electric vehicles, hybrid vehicles including ‘stop & start’ technology, fuel cells and biofuels. Actually biofuels receive the most attention [75]. Besides reducing CO_2 emissions, two other reasons for the focus on biofuels are reducing the dependency on fossil fuels and supporting the agricultural sector that may use set-aside land to produce energy crops [72].

Regarding biofuels PSA concentrates on biodiesel and on bio-ethanol, and based on more than 10 years of experience it prefers the use of bio-components in conventional fuels. The group strongly supports the use of ‘Diester 30’, a blend of 30% biodiesel and 70% fossil diesel fuel. Besides lowering the well-to-wheel CO_2 emissions, this fuel blend

reduces particulate emissions of direct injection diesel engines by 10% and up to 22% when used in HDI (common rail) diesel engines. PSA recommends the use of 8% to 12% of ETBE produced from bio-ethanol in the fuel for their gasoline vehicles, because it is an optimum between reducing pollutant emissions and increasing fuel consumption [70, 73].

Peugeot and Citroën diesel cars are warranted for diesel blends with up to 30% biodiesel, as long as this biodiesel meets the European specifications EN-14214 for fatty acid methyl esters (biodiesel) [44, 73]. Specifications for a maximum ethanol percentage in the fuel for their gasoline vehicles have not been found, but Peugeot and Citroën gasoline cars in Brazil are using a gasoline that contains an average ethanol percentage of 22% [74]. In Europe a maximum ethanol content of 5% is allowed in gasoline today. Based on the Brazilian experience, it is clear that the PSA group can supply vehicles that can run on gasoline with higher ethanol percentages.

Some examples of biofuel related activities of the PSA group are:

- The internal PSA group diesel vehicle fleet (about 800 vehicles) is running on 'Diester 30' (30% biodiesel in conventional diesel fuel) [44, 71].
- In 2003, PSA started co-operation with the Brazilian laboratory for the development of clean technologies 'Ladetel' to test the technical and environmental performances of a Peugeot 206 and a Citroën Xsara Picasso diesel car running on a blend of 30% ethyl ester (from soy oil and sugar cane based bio-ethanol) and 70% Brazilian 'Metropolitano' quality diesel fuel. These two vehicles together have now accumulated 100'000 km [74].
- Early 2004, Peugeot presented the 'Peugeot RC Cup Diester'. It is a race for one model of Peugeot cars, which use a fuel mix of 50% biodiesel and 50% fossil diesel fuel [74].
- November 2004 the PSA group announced that it will introduce fuel flexible versions of the Peugeot 206 and Citroën C3 on the Brazilian market in 2005. These cars can run on any blend of gasoline and ethanol, or in other words: the ethanol percentage in the gasoline can be between 0% and 100% [73].

In 2002 the PSA group joined the French 'club des villes Diester', now named 'Partenaires Diester' to co-operate with other organisations and exchange experiences on biodiesel [74]. More information on this co-operation can be found in section 3.2.

2.3.2 Renault

Currently Renault prioritises design and safety of its cars, because that is what their customers are looking for. Regarding alternative propulsion such as hybrids and alternative fuels like biofuels, Renault follows the market. It is not a pioneer on these topics [84]. The Renault website informs about the environmental impact of their production plants, but biofuels are not addressed [79].

The Swedish ethanol producing company SEKAB mentioned in 2003 on its website that all model years of the Renaults Clio 19, Espace, Laguna, Mégane and Twingo were allowed to use up to 15% ethanol in their gasoline [82].

Renault heavy-duty vehicles have been used in tests with fuel blends of 30% biodiesel in conventional diesel. Also Renault buses in captive fleets are running on this fuel. Today 'Renault bus' is incorporated in the Irisbus group and some French cities are using these buses running on the 30% biodiesel blend.

2.4 Other organisations

Organisations that are not addressed in the previous sections and that play a significant but smaller role in the production of energy crops and/or biofuels are listed here in alphabetic order.

ADECA Association pour le Développement des Carburants Agricoles (Association for the development of agricultural fuels). The objective of ADECA is to promote the use of biofuels from agricultural origin, like ethanol and biodiesel. It is an intermediary between organisations of agricultural producers (sugar beet, cereals, corn, potatoes, oil containing crops) and organisations that collect, transform and distribute these products [2].

CEA CEA is a French technological research organisation funded by the government. It works in the fields of energy, defence, and technologies for the information technology sector and the health sector. CEA co-operates with IFP on developing biomass gasification processes that are part of a BTL (Biomass to liquids) fuel chain [13, 33].

CNRS Centre National de la Recherche Scientifique (French National Centre for Scientific Research). CNRS is a public research organisation working on a wide range of topics. Part of its activities are structured in interdisciplinary programs that address the needs of society, including biotechnologies and the environment.

INRA Institut National de la Recherche Agronomique (National Institute for Agricultural Research). The activities of this institute cover all aspects of the agricultural sector, including non-food application of agricultural products. The work on biofuels includes the economic aspects of this fuel chain.

ITB Institut Technique française de la Betterave industrielle (French Technical Industrial Sugar beet Institute). ITB is an interprofessional association comprising the different partners in the sugar beet sector, including sugar beet

growers, sugar manufacturers and alcohol manufacturers. The objective of ITB is to contribute to improving the economics of sugar beet growing and to increase the industrial use of sugar beet products, by stimulating research and supplying information to the sector [35].

SNPAA Syndicat National des Producteurs d'Alcool Agricole (national syndicate of producers of alcohol from agricultural feedstock). This organisation is looking after the interests of the alcohol producers, including the application of bio-ethanol as a fuel for transportation.

3
Co-operation and partnerships

The fact that biofuels are only used in blends with conventional fuels in France means that producers of energy crops, enterprises that convert the crops into biofuels and oil companies that produce and distribute automotive fuels are co-operating to make this happen. Additionally, the automotive industry must confirm that these fuel blends may be used in their vehicles and research organisations help in optimising the different stages in the well-to-wheel fuel chain. Last but not least, the government has put a regulatory and fiscal framework in place to make the biofuel chains viable for all parties involved. The previous chapter has already indicated how the different organisations that are involved interact with each other. This kind of co-operation is well known in many sectors in society and does not need further explanation here. Therefore this chapter concentrates on two organisations that have been especially set up for co-operation on the development of biofuels for transport in France: 'AGRICE' that is focusing on research and 'Partenaires Diester' promoting the use of biodiesel. Some examples of financial co-operation are presented in section 5.5.

3.1
AGRICE

Following the CAP-reform (European Common Agricultural Policy) in the early 1990s, the scientific interest group AGRICE (Agriculture for Chemistry and Energy) was created in 1994 to work on new prospects for agricultural products in the chemistry and energy sector, in a context of protecting the environment and reducing energy dependency. Four ministries, different research organisations, agricultural professional interest groups and industry are partners in AGRICE. The French Agency for the Environment and Energy ADEME is managing AGRICE and its programmes [19, 76]. Box 3.1 gives an overview of the partners that co-operate in AGRICE.

Box 3.1
Partners in AGRICE
[19, 76]

Ministries	Research organisations	Agricultural organisations	Industry
Agriculture	CEA	AGPB	Arkema
Environment	CNRS	CGB	Bayer CropScience
Industry	IFP	ONIDOL	Cerestar
Research	INRA		Limagrain
			Rhodia
			Total

AGRICE is involved in projects on biomolecules and biomaterials for chemistry and on biocombustibles and biofuels for the energy sector. The work on biofuels includes vegetable oils, esters, ethanol and ethers. During its first years of operation, the emphasis of AGRICE support was on biofuels. Today more than 50% of the support is directed towards chemistry [6, 19].

AGRICE carries out four different activities:

1) Research.
   Supporting research on bioproducts is the most important objective. AGRICE can supply 33% of a research project budget. Research topics include reducing dependency on fossil resources, preserving health and environment, and encouraging industrial innovation. The AGRICE activities on research have contributed to the introduction of biofuels for automotive propulsion by optimising processes, validating their application in modern engine technologies, studying the environmental impact and finding applications for by-products.
2) Co-ordination.
   AGRICE has structured the research on bioproducts in France and contributes to finding strategic directions for the focus of new research activities.
3) Information exchange.
4) Participating in European programmes on renewable feedstock and biofuels [19, 60].

According to AGRICE the first generation of biofuels -produced from reserves in plants- has reached a stage of maturity. Therefore AGRICE now focuses on the second generation of biofuels -produced from lignocellulose- and the use of ethanol in fuel cells [19, 43].

3.2 Partenaires Diester

The word ‘diester’ is a contraction of the words ‘diesel’ and ‘ester’. In France it is mostly used for a blend of 30% VOME (vegetable oil methyl ester, or biodiesel) and 70% fossil diesel fuel, although sometimes it also is used for pure biodiesel.

The partnership ‘Partenaires Diester’ was founded in 1994 when 17 communities formed a network -to exchange information and experiences on using diester- named ‘Club des Villes Diester’ (club of diester towns). In 2003 the name was changed to ‘Partenaires Diester’ (diester partners) and it became possible for enterprises to become members, while before that was only possible for communities and public transportation organisations. Industry and public bodies can support the initiative by becoming associate member. An overview of current members is shown in box 3.2 [61, 62].

Box 3.2
Partenaires Diester
Status 2004 [61]

Members			**Associated members**
Towns, agglomerations and public transportation companies			**Agriculture**
Agen	Evreux	Orléans	Diester Industrie
Albi	Grand-Couronne	Paloise	Novaol
Alençon	Grenoble	Paris	Sofiproteol
Amiens	Le Havre	RATP	**Automotive**
Angoulème	Laon	La Rochelle	Irisbus
Bergerac	Montauban	Rouen	PSA Peugeot Citroën
Epernay	Nancy	Sarreguemines	**Oil company**
Enterprises			Total
Champagne Céréales		Groupe Moncassin	**Public bodies**
Groupe Daniel		Sita Dectra	ADEME
			IFP

To finance its activities, there is a membership fee for participating in Partenaires Diester. It is between 850 and 1000 Euros per year, depending on circumstances of the member. All enterprises and all communities with more than 100'000 inhabitants for example pay 1000 Euros. Partenaires Diester is housed in the Prolea office in Paris [61, 68].

The use of 30% VOME (biodiesel) in conventional diesel fuel is considered a technical and environmental optimum for the use of biodiesel. It does not require modifications to the fuel distribution infrastructure or to the vehicles and it reduces well-to-wheel CO_2 emissions and engine-out particulate emissions. To improve air quality in urban areas, the French government allows the use of 30% VOME in diesel fuel for captive fleets under special agreements.

The Partenaires Diester members operate vehicle fleets that are running on diester (30% biodiesel). The partnership has three types of objectives:

- Form a platform to exchange information on using diesel fuel with a biodiesel content above 5% (5% is allowed in France without any special notification), and typically being 30% biodiesel.
- Promote diester, its technical qualities and its ecological advantages among operators of captive fleets.
- Represent the members towards the French and European authorities [61].

Already for some years it is mentioned that more than 4000 vehicles are running on diester (the 30% biodiesel blend) and together have covered more than 200 million kilometres [61]. In November 2004, the PSA group alone had about 800 vehicles of their internal vehicle fleet running on this fuel [44, 71].

4
Legal framework

This chapter describes the legal framework for automotive biofuels in France. First the European rules -to which France as a member country has to adhere- are presented. Next the French legal framework is described. Financial measures to support the legal framework are addressed in chapter 5.

4.1
Europe

In 1992, the Council of the European Union decided on a major reform of the Common Agricultural Policy (CAP), in an effort to eliminate unbalance in the market of agricultural products. Farmers were requested to set-aside land and in return would be financially compensated, to decrease food production. To avoid the negative impact that set-aside land has on ecosystems and landscapes, article 7.4 of the Council's Regulation no. 1765/92 enables farmers to use set-aside land for non-food crops [92]. Biofuels are

Box 4.1
Selection of recent European Directives and Regulations on biofuels

Directive 98/70/EC	Directive relating to the quality of petrol and diesel fuels and amending Council Directive 93/12/EEC. It includes the specification of ethanol and ether (including ETBE) content in gasoline.
Directive 2003/17/EC	Directive amending Directive 98/70/EC relating to the quality of petrol and diesel fuels. Among others, in this Directive the Commission is encouraged to consider modifications in gasoline specifications (EN 228) for blends of bio-ethanol and gasoline and to bring forward proposals for biofuel specifications.
Directive 2003/30/EC	Directive on the promotion of the use of biofuels or other renewable fuels for transport. This is the directive that specifies the reference values for the percentages of biofuels that should substitute gasoline and diesel fuel for transportation. On an energy basis, these values are 2% in the year 2005 and 5.75% in the year 2010.
Directive 2003/96/EC	Directive on restructuring the Community framework for the taxation of energy products and electricity. This directive allows total or partial tax exemptions for fuels from renewable resources, including biomass.
Regulation 1782/2003	Regulation establishing common rules for direct support schemes under the common agricultural policy and establishing certain support schemes for farmers and amending miscellaneous EC Regulations. This regulation includes a chapter that describes that an aid of 45 Euros per hectare per year can be granted under certain conditions, for areas sown under energy crops.

one possible type of products from these crops. This CAP reform triggered the development of biofuels in Europe and in France. Since then, European agricultural and energy policies have developed and recent European Directives are related to incorporating a certain percentage of biofuels in gasoline and diesel, and to allow member countries to reduce taxes on the bio-component to compensate for the higher costs. The most important Directives and Regulations regarding automotive biofuels are presented in box 4.1.

The European Committee for Standardization (CEN) produces European standards on a wide range of topics. The application of these standards is not mandatory, but they are often used as a basis for legislation. The European Commission for example may use these standards for inclusion in its Directives. The European standards (EN) on automotive fuel specifications relevant for biofuels are currently:

- EN-228 Automotive fuels - Unleaded petrol - Requirements and test methods,
- EN-590 Automotive fuels - Diesel - Requirements and test methods,
- EN-14214 Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods.

Recently CEN started discussing a mandate to develop a standard on bio-ethanol with the European Commission.

France is a member of CEN, so it replaces its own national standards by CEN standards without modification, as soon as a CEN standard is published [78].

4.2 France

Initially, sustaining employment in the agricultural sector and its related industries was the driving force for the French government to develop a legal framework that stimulates the use of biofuels. Reducing dependency on fossil fuel imports and environmental reasons became additional motives later. Recently the European requirements to use 2% biofuels in transportation in 2005 and 5.75% in 2010 were added to the list of drivers for the legal framework on biofuels in France. More information on the motives of the French government can be found in subsection 2.1.1.

The following subsections give more detailed information about the legal framework for biofuels in France. It starts with the measures that were taken during the past fifteen years. Next are the system of authorised quantities, national programmes and fiscal measures.

4.2.1 History

This subsection presents a brief history of the past fifteen years of biofuel legislation in France.

The major reform of the European Common Agricultural Policy (CAP) in 1992 that lead to set-aside agricultural land had a negative impact on the agricultural sector and related industries in France. Faced with the consequences of the CAP reform, the French government chose to stimulate industrial use of set-aside land by creating a regulatory and fiscal framework to encourage the development of biofuels for automotive and domestic applications. Two ways of support were established: financial incentives for the production of biofuels and stimulating research to improve the competitiveness of biofuels or to assess the economic and technical interest for non-food use of agricultural products. In 1994 the scientific interest group AGRICE was established to co-ordinate the research work [76]. (More information on AGRICE can be found in section 3.1.)

From the beginning, France has focused on the use of biofuels as a blending component in conventional fuels. Vegetable oil methyl esters (VOME) can be blended in diesel fuel. The distribution of diesel fuel containing 5% VOME without posting the biofuel content on the pump is authorised in France since April 1st, 1994 [76, 91]. Today, the use of 5% VOME in diesel fuel on the public market for automotive use is allowed, and up to 30% VOME in diesel fuel may be used in captive vehicle fleets under special arrangements. Ethanol can be blended in gasoline directly or it can be converted into ETBE (ethyl tertiary butyl ether) before blending. In the early nineties ETBE was already accepted as the best means of using ethanol in France [40]. Up to 15% ETBE may be blended in gasoline. European specifications allow a maximum ethanol content of 5% in gasoline, but in France direct blending was not practiced.

European Directive 92/81/EEC in 1992 allowed a defiscalisation for pilot projects on biofuels. France allowed a tax exemption of 100% for biodiesel and 80% for bio-ethanol during the 1990s. This measure lead to such a high production level of biofuels (about 420'000 tons in 2000) that France was confronted with protests from Europe. The production level was considered too high for pilot projects as meant by the Directive. The result was that the EU prohibited further subsidy measures for France [24, 80, 86, 92].

In the late nineties the growth of biofuel production in France stalled and during the first years of the new millennium total biofuel production roughly stayed at a constant level, while other European countries showed increasing production. The ethanol sector explains the French situation by stating that the French government blocked new developments [10]. Another factor that might play a role is that France, together with Italy, has been imposed to a maximum limit for their annual biofuel production by the EU [86]. In 2004 the 'Conseil Économique et Social' (CES, the French Economic and Social Council) records that France used to be a driver of bioproduct development but it is losing

that role. CES states that there still is a large potential but it is not sufficiently exploited. The political will to stimulate bioproduct developments is there, but France seems not to be able to construct an appropriate political-administrative framework. The different ministries that are involved seem to be waiting for each other to start acting. Therefore CES proposes to establish a 'light' task force that co-ordinates the activities [7, 63].

The requirements of European Directive 2003/30/EC on biofuel use for transportation (2% in 2005 and 5.75% in 2010) have made biofuel activities in France gain new momentum. The European goals are included in the 'Law on energy policies 2005' and the state is taking measures to support the construction of new biofuel production capacity. On September 7, 2004, the prime minister presented the first phase of the 'plan biocarburants' (biofuel plan) to triple biofuel production between 2004 and 2007. In a second phase more production capacity will be built to meet the European goal on biofuels for 2010 [7, 39, 48, 51].

4.2.2
Authorised production quantities

To benefit from tax reductions, biofuel production must be authorised by the public authorities. Only the production of biofuels that will be blended in conventional fuels is authorised in France. In 1992 defiscalisation was possible for a total amount of 160'000 tons of biofuels, produced in pilot projects [80]. Today, the allotted quotas are for commercial production of biofuels. In 2004 the annual production of 317'500 tons of biodiesel (VOME), 199'000 tons of ETBE and 12'000 tons of ethanol - a total of 528'500 tons- was authorised. Remember that 2004 was the first year that pure ethanol was authorised as a blending component for gasoline [26, 57]. Authorised production quantities in recent years and plans for the years to come are shown in figures 4.1 and 4.2 in the next subsection.

4.2.3
National programmes

Concrete activities to achieve the goals of the French government are described in national programmes that are called 'plan'. In recent years, three plans have been published on clean vehicles, sustainable transport, reducing greenhouse gas emissions and biofuels. Their implications for biofuels in transportation are described below.

- Plan 'véhicules propres' (15 September 2003).
  The clean vehicles plan is aiming at sustainable transport. It focuses on road vehicles and includes reducing energy consumption and pollutant emissions, reducing greenhouse gas emissions such as CO_2 and refrigerants from air-conditioning systems (HFCs), and reducing noise production. Clean vehicles according to this plan are: electric vehicles, LPG (liquefied petroleum gas) vehicles, natural gas vehicles, hybrid vehicles and fuel cell vehicles. Vehicles running on biofuels are not mentioned in the clean vehicles plan [49].

- Plan ‘climat’ (22 July 2004).
  The climate plan of the French government aims to come up with clear actions to meet the Kyoto protocol goals regarding greenhouse gas emissions for the year 2010. It not only addresses CO_2 emissions from fossil fuel combustion, but for example also methane emissions and greenhouse gas emissions from air-conditioning systems are included. The type of actions that are described are diverse and include reducing energy consumption, informing and educating the public and stimulating research. The chapter on sustainable transport contains sections on: reducing the greenhouse gas emissions from road vehicles, improving the efficiency of urban transport, developing low CO_2 emitting transport modes like rail, and stimulating vehicle research. One of the ways to reduce vehicular greenhouse gas emissions that is mentioned is the use of biofuels. Even though the percentages of biofuels specified in European Directive 2003/30/EC are indicative, the climate plan states that France is committed to meet the 5.75% goal for the year 2010. Implementing the Directive should reduce the CO_2 emissions from road transport by 7 Mt CO_2-equivalent [50, 51].
- Plan ‘biocarburants’ (7 September 2004).
  The plan for biofuels in transportation makes one of the actions to reduce greenhouse gas emissions of the climate plan concrete. The biofuels plan describes measures to implement European Directive 2003/30/EC. It serves three purposes for France: reducing greenhouse gas emissions from the transportation sector, increasing energy independency and stimulating the agricultural sector. The ministry of economy, finances and industry is responsible for the implementation of the biofuels plan. On 7 September 2004, the prime minister presented the first phase of the ‘plan biocarburant’ for the period 2005 - 2007. In this first phase it is scheduled to authorise the production of an additional 480’000 tons of biodiesel (VOME) and a combined 320’000 tons for bio-ethanol in its pure form and in the form of ETBE. Early 2005 the government distributed a call for proposals to build this production capacity. In May

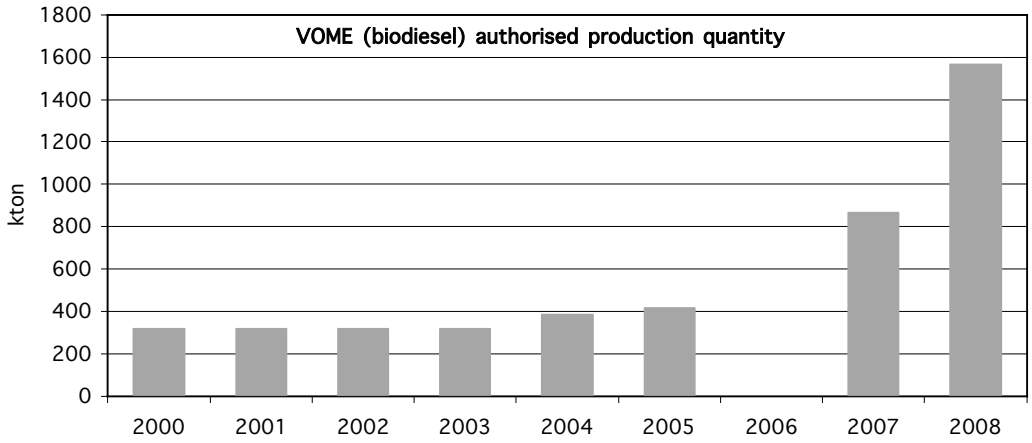

Fig. 4.1 Current and future authorised VOME production quantities [26, 57, 93]. There is no intermediate goal for 2006.

2005 the authorisations were granted and the new facilities should be operational in 2007. The first phase will triple the authorised production capacity of 2004.
The second phase of the plan biocarburants sets intermediate goals for production capacity in 2008, to be able to meet the 5.75% biofuel goal for the year 2010. In the second half of 2005, a call for an additional 700'000 tons of biodiesel and 250'000 tons of bio-ethanol will be distributed by the government [36, 45, 48, 50, 51].

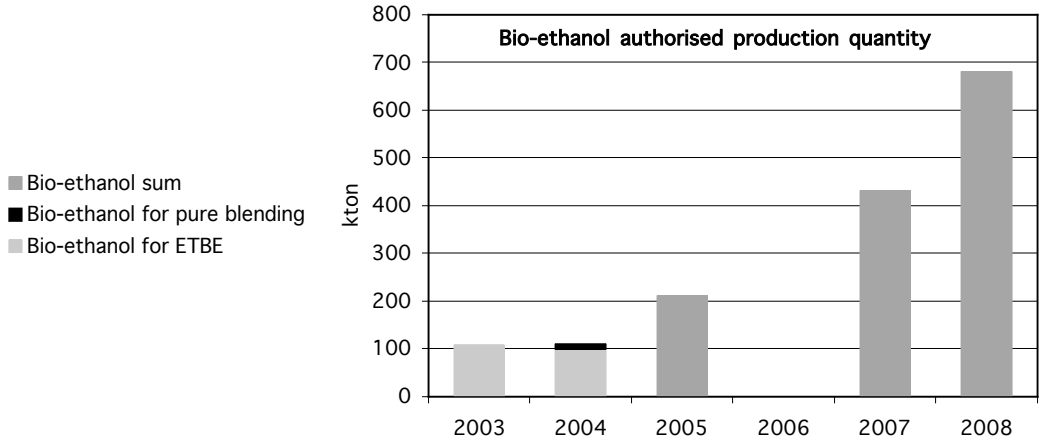

Fig. 4.2 Current and future authorised bio-ethanol production quantities [57]. There is no intermediate goal for 2006.

4.2.4
Fiscal measures

Starting in 1992, biofuels were exempt from the internal tax on petroleum products (TIPP). Later during the nineties the full exempt was changed to a system with a TIPP reduction for biofuels of which the amount is specified per hectolitre or per ton. The amount of the TIPP reduction is reconsidered annually. This tax reduction is applicable to the use of biofuels for transportation and for domestic heating. The TIPP reduction is available for the authorised amounts of biofuels. When larger quantities are produced, the surplus does not profit from this tax reduction.

Per January 1st, 2005, a general tax on polluting activities (TGAP) is put on gasoline and diesel fuel. However, eventual biofuel components in these fuels are exempted from this tax.

More information on the fiscal measure to stimulate the use of biofuels for transportation in France can be found in section 5.1 on tax reduction.

5
Financial incentives

This chapter first describes financial incentives on a national level: tax reduction and support for research, investments and bio-energy production. The last section of this chapter presents some examples of local support.

5.1
Tax reduction

In the early 1990s when the option of growing energy crops on set-aside land emerged and biofuels became an option, it was clear in Europe that industrial development of a biofuel sector would require a stable support programme. Therefore the French government was committed to establish a stable regime of tax incentives to help biofuels take off [40]. The French internal tax on petroleum products (TIPP) was an important instrument. During the nineties, biofuels were granted a TIPP exempt of 100% for biodiesel (VOME) in diesel fuel and 80% for bio-ethanol incorporated as ETBE in gasoline [86, 92]. After new European regulations came into force, biofuels are now granted a partial tax-exempt for the TIPP, of which the amount is annually revised by the government to take economic developments into account [26, 57]. Recent figures are presented in table 5.1. The maximum amount of biofuels that is eligible to the TIPP reduction is the amount that is authorised by the French authorities (see section 4.2). The TIPP exemption for the new authorised biofuel production facilities that will be built during the period 2005 - 2007 will be valid for six years. It will be between 33 and 38 Euros per hectolitre, depending on the product [47].

Table 5.1 Reduction of internal tax on petroleum products (TIPP) for biofuels, in Euros per hectolitre [52, 53, 57].

Reduction in Euro/hl	2003	2004	2005
VOME in diesel fuel	35	33	33
Bio-ethanol for ETBE in gasoline	38	38	38
Bio-ethanol in gasoline	0	37	37

For comparison, the current TIPP on fossil fuels is mentioned here. It is 58.92 Euros/hl for unleaded gasoline, 41.69 Euros/hl for automotive diesel fuel used in private vehicles and 39.19 Euros/hl for automotive diesel fuel in professional transportation applications [55]. This means for example that the TIPP on the VOME component in diesel fuel in 2005 is 8.69 Euros/hl and 6.19 Euros/hl respectively.

In France there is a general tax on pollutant activities (TGAP), sometimes called ‘ecotax’. Since January 1st, 2005, resellers of automotive fuels are imposed TGAP on the amount of fuels that they sell. The TGAP is based on the selling price of the fuels, before VAT (value added tax). The tax rate is 1.2% in 2005 and will increase annually until it has

reached 5.75% in the year 2010, according to the schedule that is shown in table 5.2. The TGAP tax rate is diminished by the percentage of energy content (based on the lower calorific value) of biofuel that is present in the fuel sold, for:

- VOME in diesel fuel,
- bio-ethanol incorporated in the form of ETBE in gasoline,
- pure bio-ethanol that is blended in gasoline [17, 38, 57].

This means that for example the net TGAP in 2010 is zero for an automotive fuel containing 5.75% biofuel.

Table 5.2 TGAP (ecotax) rate on automotive fuels. This rate is diminished by the rate of biofuel content (based on lower calorific value) of the fuel [38].

	2005	2006	2007	2008	2009	2010
TGAP	1.2 %	1.5 %	3.0 %	4.0 %	5.0 %	5.75 %

It is unlikely that biofuels will have substituted 2% of gasoline and diesel fuel in France by the end of 2005. The TGAP reduction for the biofuel component in automotive fuels is meant to contribute to make France meet the 5.75% goal for biofuels in 2010 of European Directive 2003/30/EC. The TGAP rate corresponds to the desired percentage of biofuels in automotive fuels during the coming years [23].

5.2 Support for research

Besides granting tax reduction for biofuel production, the French state financially supports research on new applications of biomass (new bioproducts) including biofuels. AGRICE (see section 3.1) is the organisation that co-ordinates this research and that finances projects with public money that is provided via ADEME. Detailed figures are available for the period from 1994 when AGRICE was created until 2002 and these are shown in table 5.3 with an emphasis on biofuels for vehicles. During this period AGRICE supported a total number of 220 projects with 19.8 million Euros, which was about 30% of the total project costs. 52 projects were related to automotive biofuels and the grants for these projects formed a quarter of the total support.

In 2004 the total number of projects had risen to 291 and the total ADEME grants supplied by AGRICE had increased to 27 million Euros. The total project budget was 82 million Euros in 2004, so these projects received 33% support of public money. At the start of AGRICE the emphasis of its activities was on biofuels. Today, generally more than 50% of the support is for chemistry [19].

Table 5.3 Project support by AGRICE 1994-2002 [5]. (Figures may not add up due to rounding.)

Sector	Topic	No. of projects	Project costs	
			Total budget [M-Euros]	ADEME grants [M-Euros]
Biomaterials		**41**	**10.7**	**3.6**
Biomolecules		**104**	**29.8**	**9.4**
Liquid biofuels for vehicles	Biodiesel, oils	16	6.8	1.9
	Ethanol, ether	18	4.9	1.5
	Marketable by-products	10	2.1	0.8
	Technical/economic studies	8	1.1	0.6
	Subtotal	**52**	**15.0**	**4.8**
Other biofuels		**23**	**9.0**	**2.1**
	Total	**220**	**64.5**	**19.8**

M-Euros = million Euros

5.3 Investment support

During the data collection for this report, no investment support programmes have been found. It seems that on a national level there is no investment support for automotive biofuels available. For example the two ETBE production plants that were constructed in 1996 (see subsection 2.2.8) did not receive any public funding. They were joint investments of the oil company Total, ethanol producers and the professional sector producing sugar beet and cereals [10]. However, on a regional or local level investment support may be granted and there is a wide range of options. Such support may be for any element in the well-to-wheel biofuel chain, it may have many different backgrounds -like increasing employment, environmental reasons, regional or local development, stimulating new outlets for existing production, etcetera- and it will be depending on geographical location and circumstances. Presenting an overview of all regional and local support in France is outside the scope of this report. However, section 5.5 gives examples of local bodies that invest in biofuels.

5.4 Support for bio-energy production

In line with European Regulation 1782/2003 and the Common Agricultural Policy of the European Union, French farmers can ask for 45 Euros per hectare support for growing certain energy crops.

5.5
Examples of local support

There are many regional and local activities that receive financial support from 'Régions' and/or local authorities. They are typically co-operations between farmers producing energy crops, enterprises that convert the crops into biofuel, and sometimes fleet owners that purchase the fuel. Also many cities have programs on improving urban air quality and as part of their measures they may be stimulating the use of biofuels in urban fleets like city buses and municipal service vehicles. Describing all these initiatives in France is not possible here. To give an impression of the activities over time and to show projects on different biofuels, three examples of urban bus fleets are presented here, one about the past (Tours), one that is ongoing today (Paris - RATP), and one that is currently being set up (Lille).

Tours

The city of Tours started experimenting with clean vehicles in 1987, before the CAP reform. It included electric vehicles in the municipal fleet and it started using ethanol as a fuel. By 1994 sixty cars and vans of the municipal services were running on a blend of 5% ethanol in gasoline. Besides that, in 1987 four buses running on pure ethanol were put into service. In 1994 these four buses together had covered 1 million kilometres without technical problems. The ethanol buses had no particulate emissions and the NO_x and CO_2 emissions were lower than for diesel buses. An investment between 40'000 and 100'000 French Francs (FF) (between 6'100 and 15'250 Euros) per engine was necessary to convert it from diesel to ethanol operation. On a per litre basis, the price of ethanol was 2.5 times the price of diesel fuel and on top of that the volumetric fuel consumption of the ethanol buses was 1.84 times that of diesel buses. Initially, the city of Tours subsidised these projects with 700'000 FF (about 107'000 Euros) per year. By 1994 subsidies had dropped to 250'000 FF (38'000 Euros).

In 1994 Tours was scheduling to increase the number of ethanol buses annually, but only if two conditions were met:

- The energy efficiency of ethanol engines had to increase.
- The price of ethanol fuel had to go down.

It appears that at least one of these conditions was not met, because in 1999 the first LPG buses entered into service and in 2000 it was decided that from then onwards all new buses would be using LPG [81, 89].

Paris - RATP

The public transport company in Paris (RATP) started in 1998 with a 'clean bus' programme. Besides technical measures like particulate filters in the exhaust of diesel buses, the programme included the use of alternative fuels. At the completion of the programme in 2003, 110 buses were using either natural gas or LPG and about 60 buses were running on Diester (30% VOME blended in fossil diesel fuel). For example the

Région île-de-France and the city of Paris were financial partners in the clean bus programme [77].

Lille

The first natural gas bus was introduced in the city of Lille in 1994. Since then the city has developed its objectives regarding clean urban public transport and it is now aiming for a bus fleet consisting only of natural gas and biogas buses. One sewage treatment plant producing biogas is already operational in Lille and another one is under construction. Today four buses are running on biogas and this number is scheduled to increase during the coming years. The city of Lille is investing in the biogas bus activities, together with regional partner 'Conseil régional du Nord-Pas-de-Calais' and with European support under the Trendsetter programme [37, 64, 90].

6
Impact assessment

Many different parties are active in the biofuel sector and the activities of each of them influence the others. It is their joint effort that makes the biofuel market develop and therefore it is impossible to identify the individual impact of one specific measure or activity. This chapter presents the joint impact of all the activities from the parties that are described in the previous chapters. It starts with the amount of biofuels that is actually produced because that is the prime objective of all activities. Next, the impact on the issues that are the actual drivers to develop biofuels - energy, environment and employment - is presented. Then the impact on the governmental budget is estimated and finally the impact on other topics is addressed briefly.

6.1
Production of biofuels

France has a rich agricultural history and it ranks among the European countries with the highest agricultural production quantities. Already at the end of the nineteenth and at the beginning of the twentieth century France was producing biofuels. In the early 1990s there was excess capacity for feedstock production and conversion, and the possibility to produce bio-energy as foreseen in the new European Common Agricultural Policy offered new opportunities for the agricultural sector. The agro-industry and the oil companies started co-operating on production and distribution of biofuels and lobbied together for financial support by the authorities. In 1993 the production of biofuels on an industrial scale started in France. Between 1993 and 1996 a number of biofuel production plants were put into service. After that, granting of new production authorisations stalled and the production of biofuels stabilised [11, 16, 41, 54, 86]. Today, biofuel production capacity is scheduled to increase substantially in the coming years to meet the requirements of European Directive 2003/30/EC (see subsection 4.2.3).

VOME

In France, the vegetable oil to produce biodiesel (VOME) is predominantly produced from rapeseed and to a minor extent it is stemming from sunflower oil. The first industrial biodiesel unit, which produced rapeseed methyl ester (RME), was built in Compiègne in 1992 and had an initial capacity of 20’000 tons per year. In 2004, the authorised production capacity of this unit had increased to 83’500 tons per year. Initially the outlet for VOME was targeted at public transport vehicle fleets, which may be allowed to use up to 30% VOME blended in their diesel fuel. Shell France had invested in this application and was market leader in 1993-94 with a market share of approximately 50%. The French oil company Total was then a niche player with a market share below 3%. Today the biodiesel market has expanded to include other vehicles as well, and biodiesel may be blended up to 5% in diesel fuel that is available at public refuelling stations. In 2004 Total purchased almost 75% of the French VOME output [28, 33, 67, 88].

During the nineties the agricultural sector learned by experience to improve rapeseed production, which resulted for example in better herbicide management, in reduced amounts of fertilizer used to grow the crop, and in a better ratio between the energy content of the ester and the energy consumption of the agricultural production. About 90% of the VOME that is produced today is used in automotive diesel fuel; the rest is used in domestic fuel oil. Figure 6.1 presents the annual VOME production in France since 1992. In 2004 the actual production was below the authorised quantity of 387'500 tons [64, 69].

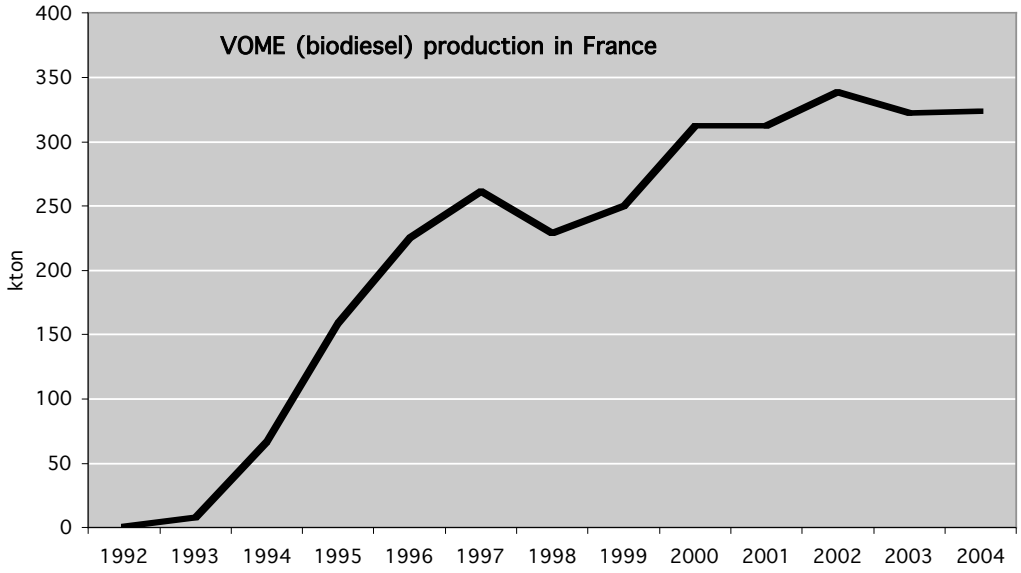

Fig. 6.1 VOME production in France, for the French market. In 2004 the total production was higher than what is shown here but that fraction has been exported, predominantly to Germany and Italy [54, 56, 57].

Bio-ethanol

The use of bio-ethanol as a fuel has a long history in France. It was for example used as a fuel during the second world war and after that until the 1960s. After some decades of absence, it came back in the form of ETBE (ethyl tertiary butyl ether) on the fuel market in 1992, following the CAP reform that allowed growing energy crops on set aside land. To convert the ethanol into ETBE, an existing MTBE production facility was modified in the early nineties. Later two other ETBE production units were constructed, as a joint investment of Total and the sugar beet and wheat sectors [10, 41, 42].

From 1992 until 1998, bio-ethanol production in France increased steadily. Since then, the production remained at a more or less constant level (see figure 6.2). The 2003 dip in production can for a large part be explained by the drought in France that year, which affected the yield per hectare of sugar beet and cereal crops. Today, 70% of the bio-

ethanol production in France stems from sugar beet and 30% originates from wheat [15, 22]. The last few years, bio-ethanol production is about 10% below the authorised quota.

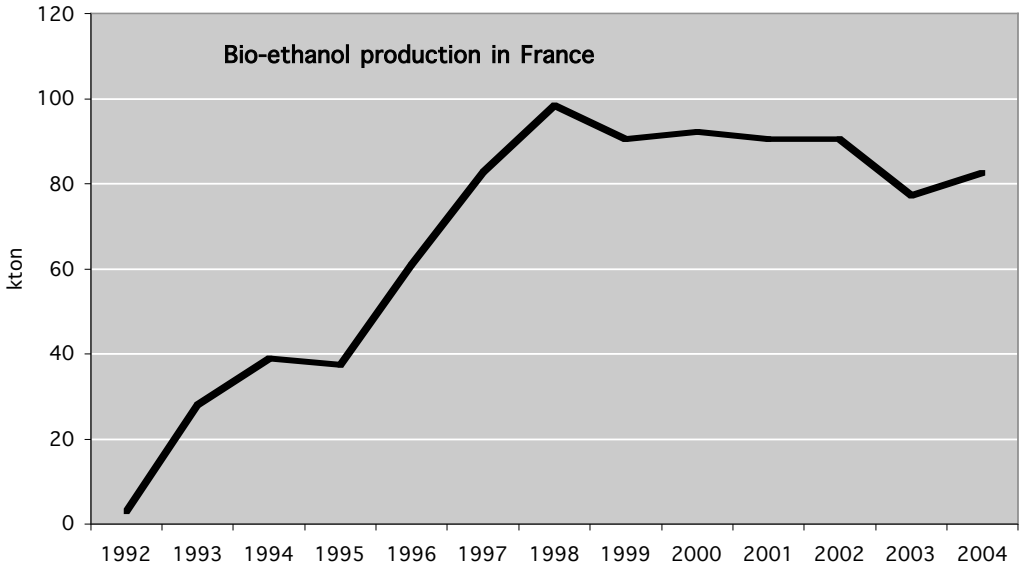

Fig. 6.2 Bio-ethanol production in France, for the production of ETBE. In 2004, 0.7 ktons of bio-ethanol for pure blending in gasoline are included in the production figure [54, 57].

6.2 The share of biofuels in transportation fuels

Biodiesel (VOME) may be blended up to 5% in diesel fuel in France. Under special arrangements, blending up to 30% of VOME in diesel fuel is allowed for captive vehicle fleets like city buses. In 1999 4000 vehicles were running on a mixture of diesel with 30% VOME in France and these vehicles had then covered over 200 million kilometres. Today 7 out of 13 French refineries are blending VOME into diesel fuel at a rate between 2% and 5%. It means that every other diesel vehicle is using a fuel that contains a bio-component. The oil company Total is the largest player on the biodiesel market in France. In 2004 it purchased close to 75% of the authorised quantity to incorporate it at a level of 2% in its diesel fuel produced in six French refineries [31, 59, 62, 88].

Since the introduction of biofuels in the early 1990s in France, bio-ethanol has always been converted to ETBE before it is blended in gasoline, to avoid problems with phase separation in the presence of water and with the vapour pressure of the fuel. ETBE is currently manufactured in three different production units in France. It may be blended up to 15% in gasoline. Since January 1st, 2004, pure ethanol may be blended in gasoline in France, but so far this is hardly done. In 2004 700 tons of bio-ethanol were put on the market for direct blending [57].

Table 6.1 presents the level of biofuels incorporated in conventional fuels for 2003 and 2004. It shows that the level of bio-ethanol derivates in gasoline increases and the level of VOME in diesel fuel tends to decrease. For gasoline this can be explained by the annual decrease in gasoline consumption, combined with a slight increase of bio-ethanol production. Diesel fuel consumption is increasing annually and because the VOME production volume hardly changed between 2003 and 2004, the share of the bio-component in diesel decreased.

Table 6.1 Share of bio-components in conventional fuels on the French market, based on lower calorific value [57].

	2003	2004
Bio-component in diesel fuel	0.94 %	0.93 %
Bio-component in gasoline	0.53 %	0.58 %

Given the share of biofuels that is presented in table 6.1 and the trends in fuel consumption of road transport, it is unlikely that the European goal of 2% biofuel by the end of 2005 will be met in France. However, the French authorities are eager to meet the 5.75% goal in 2010 and therefore a steep increase in authorised biofuel production quantity is scheduled for the coming years (see section 4.2.3). The share of biofuels in the gasoline and diesel market until 2010 is expected to increase with the same percentages as the TGAP (ecotax) during this period (see table 5.2).

6.3 Energy

Reducing energy dependency is one of the main drivers to use biofuels. ADEME and the Direction of Energy Resources and Minerals (DIREM) published a report on energy balances and greenhouse gas emissions of biofuel production chains in France in December 2002 [3]. This report was produced by Ecobilan, a division of Price-Waterhouse-Coopers. The Ecobilan report can be considered to be the standard reference for France and today still many statements regarding the impact of biofuels are based on the data in this report. Regarding energy balances, the report presents the energy content of different biofuels when they are made available at distribution depots and before blending in conventional fuels, compared to the non-renewable energy input to produce these biofuels. Production includes agricultural activities, the conversion of crop to fuel, and transportation of the fuel to storage depots. The figures are shown in table 6.2. The coming years an improvement of about 10% may be expected for VOME. When large ethanol production units will be used in the future, the energy ratio for ethanol is expected to increase in the order of 30% to 40%.

Table 6.2 Energy in biofuel / non-renewable energy input ratio for biofuels in France, for biofuels made available at distribution depots before blending in conventional fuels [3].

	Energy ratio
VOME from rapeseed (RME)	2.99
VOME from sunflower oil (SME)	3.16
Ethanol from wheat	2.05
Ethanol from sugar beet	2.05
ETBE from wheat	1.02
ETBE from sugar beet	1.02

In 2004, the total amount of biofuels that substituted gasoline and diesel fuel was below 1%. More details about biofuel content are shown in table 6.1.

6.4 Emissions

Because crops absorb CO_2 from the atmosphere during their growth, using biofuels reduces well-to-wheel CO_2 emissions substantially compared to fossil fuels. The net well-to-wheel CO_2 emissions of biofuels are not zero when fossil fuels are used in agriculture and for the conversion of the crop into a fuel. CO_2 is an important greenhouse gas and therefore using biofuels contributes significantly to reducing greenhouse gas emissions from the transport sector. The Ecobilan report that is mentioned in the section on energy (6.3) also compares well-to-wheel greenhouse gas emissions from biofuel chains and fossil fuels for the French situation. Starting points are that all energy input is in the form of non-renewable energy and the use in vehicles is assumed to result in complete

Table 6.3 Well-to-wheel greenhouse gas emissions in France.

	g CO_2-eq/kg [3]	Reduction compared to fossil counterpart (g/kg)
Diesel fuel	3390	--
VOME from rapeseed (RME)	888	2502
VOME from sunflower oil (SME)	745	2645
Gasoline	3650	--
Ethanol from wheat	922	2728
Ethanol from sugar beet	902	2748
MTBE from fossil feedstock	3130	--
ETBE from wheat	2530	600
ETBE from sugar beet	2522	608

g CO_2-eq/kg grams of CO_2-equivalent per kg

combustion of the fuel. CO_2, CH_4 and N_2O are the greenhouse gases that are included in this study, with weighing factors of respectively 1, 23 and 296 gram of CO_2-equivalent emissions per kg [3]. The Ecobilan figures are presented in table 6.3. The differences between the biofuel component and the fossil component that it substitutes have been added in this table for comparison. VOME substitutes diesel fuel, ethanol substitutes gasoline and ETBE substitutes MTBE (methyl tertiary butyl ether). Note that the figures are on a per-kilogram basis.

Using the data from table 6.3 a first -very rough- estimate of the impact of biofuels on greenhouse gas emissions can be made.

- VOME instead of diesel fuel.
  From the data in the table it can be concluded that using one ton of RME (the share of SME in France is very small) instead of one ton of diesel fuel avoids 2.5 tons of CO_2-equivalent greenhouse gas emissions. Neglecting the differences in combustion value and density between RME and diesel fuel, assuming vehicular fuel consumption is the same for both fuels (in France only blends of 5% or 30% VOME in diesel fuel are used), and considering that approximately 324'000 tons of VOME were produced in 2004, it can be calculated that the avoided CO_2-equivalent greenhouse gas emissions from using VOME instead of diesel fuel were in the order of 800'000 tons in 2004.
- ETBE from bio-ethanol instead of MTBE in gasoline.
  About 82'000 tons of bio-ethanol were produced in France in 2004. This amount was converted in approximately 162'000 tons of ETBE [57]. The table shows that using one ton of ETBE instead of one ton of MTBE avoids 0.6 tons of CO_2-equivalent greenhouse gas emissions. Neglecting the differences in combustion value and density between ETBE and MTBE, assuming ETBE substitutes the same amount of MTBE in the blend with gasoline, and assuming that vehicular fuel consumption is the same for both cases, it can be calculated that using bio-ETBE instead of fossil fuel based MTBE in French gasoline avoided about 97'000 tons of CO_2-equivalent greenhouse gas emissions in 2004.

Adding up the results it can be concluded that using less than 1% biofuel components in gasoline and diesel fuel in France avoided an amount in the order of 900'000 tons (0.9 Mt) of CO_2-equivalent greenhouse gas emissions in 2004.

When the European goal of 5.75% biofuels in 2010 is met, this will result in an annual saving of 7 Mt CO_2-equivalent greenhouse gas emissions for France [50].

Blending 30% VOME in diesel fuel is a way of using biofuel that is typical for France. About thirty captive fleets are authorised to use this fuel blend. Using this blend instead of pure diesel fuel reduces greenhouse gas emissions of these vehicles by approximately 22%. Other vehicle emission components are also affected. Engine-out particulate emissions for the blend are lower for example, because the sulphur content of VOME is negligible. However, this advantage will decrease in the future with increasingly stringent limits for sulphur content in fossil diesel fuel. Further, the introduction of the exhaust

particulate filter makes the difference in vehicle particulate emissions for both fuels negligible. Vehicular NO_x emissions and other pollutants for pure diesel fuel and the blend with 30% VOME are also very similar [30, 65].

6.5 Employment

Besides reducing greenhouse gas emissions and reducing energy dependency, the third reason to stimulate the use of biofuels is employment in the agricultural sector. According to the French ministry of agriculture, food, fishery and rural affaires about 60'000 farmers are active in producing biofuels. By 2003, the biofuel sector had created or maintained a total of 4300 jobs, of which 90% is related to biodiesel. The rest is related to the bio-ethanol chain [46]. ADEME mentions very similar figures in a January 2005 report: 3780 jobs in the biodiesel sector and 472 jobs for bio-ethanol [64].

A new biodiesel production plant with an annual production capacity of 160'000 tons that is under construction in Sète should lead to the creation of about thirty direct jobs [22].

When the 5.75% biofuel goal of European Directive 2003/30/EC has been achieved in 2010, in total 25'000 jobs will have been created or maintained, according to the French authorities [48].

6.6 Governmental budget

The financial balance for the government regarding biofuels predominantly consists of the following elements. There is a loss of tax revenues in the short term because of the TIPP (internal tax on petroleum products) reduction for biofuels. On the other side, agricultural activities generate tax income for the government (VAT) and social contributions [40]. There are also many indirect effects, like reduced oil imports and changes in trade balance because by-products of biofuel production can be used as cattle fodder, so the necessary imports are reduced and maybe by-products can even be exported. Through their taxation, this kind of activities all influence the governmental finances. The loss of tax revenues from the TIPP reduction for biofuels is estimated below. Quantifying the influence of the other aspects on the governmental financial balance is a complex matter and it is beyond the scope of this report.

When biofuels took off in the early 1990s, the government's authorisations for tax exemption represented 130 million French Francs, or 19.8 million Euros [40].

The loss of tax revenues today can be calculated by multiplying the produced quantity of biofuels by the TIPP exemption. Because the production quantities are given on a mass basis and the TIPP reduction is given on a volumetric basis, the mass of biofuels must first be divided by their density. Using data from the French ministry of economy,

finances and industry as input, a total loss of tax revenues of 160.4 million Euros for the French government in 2004 can be estimated. This is shown in table 6.4.

Table 6.4 Estimated loss of income for the French government in 2004, due to the TIPP reduction for biofuels. Production, density and TIPP reduction figures are taken from [57].

2004	Production	Density	TIPP reduction	Loss in income
Unit	kton	ton/m^3	Euro/m^3	Million Euro
Calculation	(1)	(2)	(3)	((1) / (2)) * (3)
VOME in diesel fuel	323.7	0.883	330	121.0
Bio-ethanol for ETBE in gasoline	81.8	0.794	380	39.1
Bio-ethanol in gasoline	0.7	0.794	370	0.3
Total				**160.4**

The quantities of biofuels produced in 2004 are below the authorised quantities, so the total production is indeed eligible to tax exempt.

6.7 Other impacts

Production and use of biofuels has an impact on more topics than have been addressed in the sections above. Some examples are presented here.

- Agricultural area.
  In 2003, the total area occupied by bio-crops in France was 320'000 hectares. This included 300'000 ha dedicated to VOME production and 20'000 ha for bio-ethanol. It is expected that in France sufficient agricultural land is available to meet the 2010 goal of European Directive 2003/30/EC. The estimated area that is required for biofuel production in 2010 is between 1.5 and 2 million hectares [25, 46]. However, the general director of Diester Industrie is not certain if sufficient conversion capacity to produce biodiesel can be built before 2010 [58].
- By-products and trade balance.
  Remainders of energy crops after extracting biofuel can be used as cattle fodder and for example glycerine is a by-product of VOME production. This means that locally produced biofuels do not only reduce the import of oil products, they also reduce the need to import animal food and glycerine.
- Public acceptance.
  Biofuels are blended in conventional fuels in France. Gasoline may contain up to 15% bio-ETBE and diesel fuel may contain up to 5% VOME. Because these quantities of bio-components do not need to be signposted at the pump most people are not aware that they are using a certain amount of biofuel and public acceptance is not an issue.

- Research.
  The interest in biofuels has triggered research on ethanol production from lignocellulosic feedstock, because that production route is one of the best for biofuels regarding greenhouse gas emissions, and it has the potential to become more economic than conventional production processes. IFP is conducting research in this area, together with the national research institutes INRA and CNRS. Another option is gasification of biomass, followed by a Fischer-Tropsch synthesis to obtain a liquid fuel. Also this BTL production route is being investigated in France [30, 32].

7
Epilogue

The use of biofuels for transportation has its own dynamics. In the early 1990s France was a leading country in Europe regarding biofuels. France was the largest biofuel producer and it had the highest number of pilot projects [27]. However, annual production quantities levelled off at the end of the decade and in the new millennium Germany passed France regarding annual biodiesel production and Spain now produces more bio-ethanol.

It is unlikely that by December 31, 2005 there will be 2% biofuels in French transportation fuels, as prescribed in European Directive 2003/30/EC. Today however, politicians are dedicated to make France meet the 2010 goal of the Directive, being a 5.75% share of biofuels in transportation. There is sufficient agricultural area available to make France self-supporting regarding biofuels for transport in 2010.

What generally holds for biofuels also holds for France: biofuels are a product of nature and as such their annual production is variable. The drought in 2003 was an important reason for the dip in bio-ethanol production that year. Mid August 2005 the French government prohibited further irrigation of cornfields, due to a lack of water caused by another drought. Raising corn for bio-ethanol production would suffer from such a measure.

The price of the oil barrel may also be expected to affect the development of the biofuels for transportation market. In November 2004, Maurice Dohy, director of AGRICE, and the French minister of ecology and sustainable development, Serge Lepeltier, estimated that bioproducts like biofuels would be cost-effective when the oil price would be above 45 to 50 US$ per barrel [19, 36]. Under the conditions of the first week of September 2005, biofuels without the TIPP tax reduction would be cost-effective at a crude oil price from 60 to 70 US$ per barrel [20]. After some months of steady increase, at the time of writing –September 2005- the price of the oil barrel is now in the 60 - 70 US$ range. It will be very interesting to see how the market and policy makers are going to respond to this development. The lights seem to be turning green for green fuels.

Abbreviations

ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie
ADECA	Association pour le Développement des Carburants Agricoles
AGRICE	Agriculture pour la Chimie et l'Energie
AGPB	Association Générale des Producteurs de Blé et autres céréales
BTL	Biomass to liquids
CAP	Common Agricultural Policy (of the European Union)
CEN	European Committee for Standardization
CES	Conseil Économique et Social
CETIOM	Centre Technique Interprofessionnel des Oléagineux Métropolitains
CGB	Confédération Générale des planteurs de Betteraves
CH_4	methane
CNRS	Centre National de la Recherche Scientifique
CO_2	Carbon dioxide
DIREM	Direction des Ressources Énergétiques et Minérales
ETBE	Ethyl Tertiary Butyl Ether
EU	European Union
FAME	Fatty Acid Methyl Ester
FF	French Franc
FOP	Fédération Française des Producteurs d'Oléagineux et de Protéagineux
ha	hectare
HFC	Hydrofluorocarbon
hl	hectolitre
IFP	Institut Français du Pétrole
INRA	Institut National de la Recherche Agronomique
ITB	Institut Technique française de la Betterave industrielle
kton	kilo ton (thousand tons)
LPG	Liquefied Petroleum Gas
Mt	Mega ton (million tons)
MTBE	Methyl Tertiary Butyl Ether
NO_x	Nitrogen Oxides
N_2O	Nitrous Oxide
ONIDOL	Organisation Nationale Interprofessionnelle des Oléagineux
RME	Rapeseed Methyl Ester
SME	Sunflower Methyl Ester
SNPAA	Syndicat National des Producteurs d'Alcool Agricole
TGAP	Taxe Générale sur les Activiés Pollutantes
TIPP	Taxe Intérieure sur les Produits Pétroliers
UNIP	Union Nationale Interprofessionnelle des Plantes riches en Protéines
VAT	Value Added Tax
VOEE	Vegetable Oil Ethyl Ester

VOME	Vegetable Oil Methyl Ester
WTO	World Trade Organisation

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