INSTITUT FÜR TECHNOLOGIE
UND NACHHALTIGES PRODUKTMANAGEMENT
UMWELTSCHUTZ UND RESSOURCENÖKONOMIE

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A WORLD WIDE REVIEW OF THE COMMERCIAL PRODUCTION OF BIODIESEL – A technological, economic and ecological investigation based on case studies

BAND 41

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SCHRIFTENREIHE UMWELTSCHUTZ UND RESSOURCENÖKONOMIE

DES INSTITUTES FÜR TECHNOLOGIE UND NACHHALTIGES PRODUKTMANAGEMENT
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°C	Degree Celsius
€	Euro
a	Year (annum)
approx.	approximately
ASTM	American Society for Testing and Materials
BD	Biodiesel
CEN	European Committee for Standardization
CFC	Fluor-chlorinated hydrocarbons
CNG	Compressed natural gas
CO_2	Carbon dioxide
DG	General Directorate
e.g.	Example given
EPA	US Environmental Protection Agency
EU	The European Union
FAME	Fatty acid methyl ester
FFA	Free fatty acids
g	Gram
G	Giga
GATT	General Agreement on Tariffs and Trade
GHG	Greenhouse gas
h	hour
ha	Hectar
i.e.	That is (id est)
J	Joule
kg	Kilogram
l	Liter
LPG	Liquid petroleum gas
M	Mega
mill	Million
NO_x	Nitrogen oxides
PM	Particulate matter
ppm	Parts per million
R&D	Research and development
RME	Rapeseed oil methyl ester
SME	Sunflower methyl ester
t	Metric ton
t/a	Tons per year
UK	United Kingdom
ULSD	Ultra low sulphur diesel
US	The United States of America
VAT	Value-added-tax
VOC	Volatile organic compounds
VOME	Vegetable oil mehtyl ester

1. INTRODUCTION

As early as the beginning of the 20th century Rudolf Diesel proposed vegetable oil as fuel for his engine.[1] A short time later, before and during World War Two, vegetable oil was examined in "up-to-date" diesel engines. In 1940 first trials with vegetable oil methyl and ethyl esters were carried out in France and, at the same time, scientists in Belgium were using palm oil ethyl ester as a fuel for buses.[2] In 1973, the oil crisis refocused attention on and interest for local energy sources. In recent decades, research concerning and knowledge about the external benefits of renewable raw materials have intensified the efforts for sustainable energy sources. Biodiesel plays a major role in this field because of the world-wide research, development and deployment activities of this sustainable energy source.[3]
Due to this recent increased awareness and development, the objective of this thesis is to provide a world-wide review of the production of Biodiesel.
For the description of the Biodiesel scene a three-stage development is referred to:[4]

- Phase I consists of the very first ideas and thoughts of Biodiesel being used as a fuel until the actual adaptation of the ideas on the part of the decision makers who are then motivated to put these ideas into practice. The end of Phase I (= beginning of Phase II) is the political decision to invest money and other resources to Biodiesel research.
- Phase II is characterised by research efforts, pilot projects, setting of frame conditions and financially supported technical trials.
- Countries in Phase III show a Biodiesel economy based primarily on a feasible economic production, distribution and use of Biodiesel, and a self supportive Biodiesel economy.

[1] KNOTHE, G., DUNN, R.O., BAGBY, M.O.: Biodiesel: The Use of Vegetable Oils and Their Derivatives as Alternative Diesel Fuels, Oil Chemical Research, National Center for Agricultural Utilization Research, Agricultural Research Service, U.S. Department of Agriculture, Peoria IL 1996, Internet: http://www.biodiesel.org/resources/reportsdatabase/reports/gen/19961201_gen-162.pdf [6.9.2003]

[2] KÖRBITZ, W., Austrian Biofuels Institute, 14.2.2003

[3] ABI (Austrian Biofuels Institute): In response to the e-mail questionnaire sent by the author, Austria, Vienna 2002

[4] EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 41, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

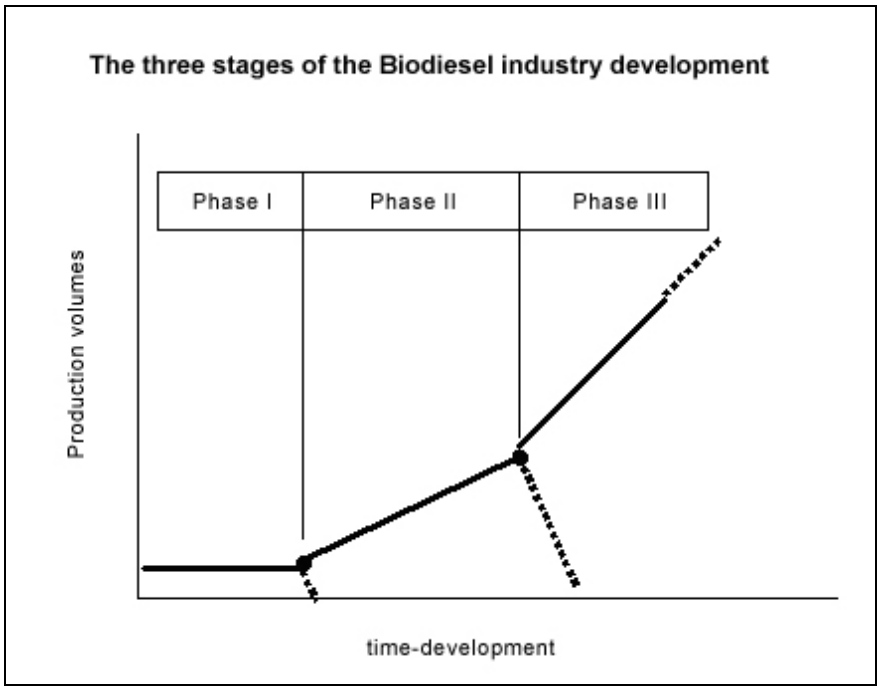


Fig. 1: The three stages of Biodiesel industry development

Source: EIBENSTEINER F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 41

This diploma thesis concentrates on 12 countries that have already entered Phase III. Country reports for these nations provide information on the history and the development of Biodiesel activities, on the legal framework, about existing and projected capacities, current production figures, feedstock used, quality standards and market issues including the main stakeholders of the national Biodiesel industry.

In order to give a global picture, a preliminary introduction regarding the nature (advantages, barriers) and the various applicabilities of Biodiesel, its sources (feedstock) as well as the environmental and economic background is provided.

2. BIODIESEL: BASIC FACTS

2.1 Definition of Biodiesel

Biodiesel is defined as the mono-alkyl esters of fatty acids derived from vegetable oils or animal fats. In simple terms, Biodiesel is the product you get when a vegetable oil or animal fat is chemically reacted with an alcohol to produce a new compound that is known as a fatty acid alkyl ester. A catalyst such as sodium or potassium hydroxide is required.[5] Glycerol is produced as a by-product. The approximate proportions of the reaction are:

100 l of oil + 10 l of methanol = 100 l of Biodiesel + 10 l of glycerol [6]

2.2 Demarcation

2.21 E-diesel

Ethanol (CH_3CH_2OH) is a liquid, biodegradable fuel produced from corn, barley or wheat which is fermented and distilled into a pure (200 proof) product. It has a higher octane rating than petrol but a lower Cetane rating than diesel.[7] It is generally used as a blend with petrol, but the use of additives has also enabled the development of ethanol-diesel blends (10% or 15% ethanol) that have shown some promise lately.[8]

2.22 Fossil diesel

Fossil diesel fuel is derived from petroleum through a refining process. The primary purpose of a petroleum refinery is to separate the complex mixture of hydrocarbons into usable products. Petroleum is separated into fractions whose distinguishing feature is their different boiling points. Tab. 1 shows the boiling point ranges corresponding to the various commercial fuels.

[5] Internet: http://www.me.iastate.edu/biodiesel/Pages/biodiesel1.html [5.9.2003]

[6] Internet: http://www.me.iastate.edu/biodiesel [4.1.2003]

[7] HOPKINSON L., SKINNER S.(Civic exchange, the Asia Foundation): Cleaner Vehicles and Fuels, The Way Forward; Hong Kong, 2001; via e-mail to the author, 2002

[8] Internet: http://www.me.iastate.edu/biodiesel [4.1.2003]

Product	Boiling Range (°C)
Liquid Petroleum Gas (LPG)	-40 - 0
Gasoline	30 - 200
Kerosene, Jet Fuel, Diesel	170 - 270
Furnace Oil	180 - 340
Lube Oils	340 - 540
Residual Oil	340 - 650
Asphalt	540 +
Petroleum Coke	Solid

Tab. 1: The boiling range of typical refinery products

Source: Internet: www.me.iastate.edu/biodiesel/Pages/bio16.html [6.9.2003]

As indicated in the table, kerosene, jet fuel (Jet A), and diesel fuel are the same fraction of petroleum. In most refineries, this fraction is straight run, that means, it is produced directly from compounds that were present in the crude petroleum.[9]

2.23 Crude vegetable oil

Attempts have been made to use raw oils in engines since at least 1900 when the Otto Company demonstrated the use of peanut oil in a diesel engine at the Paris Exhibition.[10]
Most experiments of this type have shown that diesel engines run on raw oils, but performance will degrade over time. After a period of several hundred hours, engine inspections show large amounts of fuel dilution of the lubricating oil, thus causing thickening and sludge formation. Piston rings are often damaged or broken because of excessive carbon deposits. Fuel-injection equipment can be coated with varnish deposits. The best experience when using raw oils in engines seems to come from indirect-injection engines using only 5-10% blends of the oil in diesel fuel.[11]

2.24 Ultra low sulphur diesel

Ultra Low Sulphur Diesel (ULSD) is fossil diesel that has been further treated in order to lower its sulphur content to less than 50ppm or 0,005%.
Significant refinery reconfigurations are needed in order to produce ULSD.[12]

[9] Internet: http://www.me.iastate.edu/biodiesel [4.1.2003]
[10] Internet: http://www.vegburner.co.uk/dieselengine.html [6.9.2003]
[11] Internet: http://www.me.iastate.edu/biodiesel/Pages/A.html [4.1.2003]
[12] MITZNER, M.: Ultra Low Sulphur Diesel Capabilities; Hydrocarbon Engineering, Farnham/Surrey March 2002, Internet: http://www.akzonobel-catalysts.com/html/catalystcourier/Courier48/c48_a2.htm [8.2.2003]

2.25 Fischer-Tropsch diesel

Fischer-Tropsch (F-T) diesel is a synthetic diesel fuel produced from natural gas, coal or biomass. It is colourless, odourless and low in toxic emissions.
Simplified the Fischer-Tropsch reaction is:[13]

$$CO + 2H_2 \rightarrow CH_2 + H_20$$

2.3 Production process

2.31 Transesterification

Biodiesel is made through a chemical process called transesterification whereby the glycerine is removed from the fat or vegetable oil. Biodiesel is thus an ester. If methanol is used in the production process it is a methyl ester; if ethanol is used it is an ethyl ester.[14]
For more than 50 years, patent literature has proposed many possibilities for transesterification process technology, including those made by Ballestra, BDI, Connemann, ENA-Biodiesel, Energea, Kirchfeld, Lurgi, IFP, Westfalia and others.[15]
Generally speaking there are three basic ways for the production of to methyl ester from oils and fats:[16]

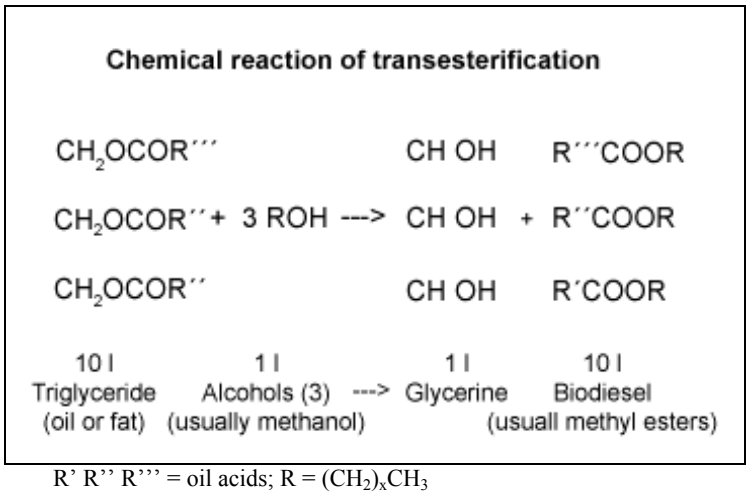
- Base catalyst transesterification of the oil (triglycerides) with methanol
- Directed acid catalyzed esterification of the free fatty acids (FFA) with methanol
- Conversion of the oil to FFA and then to methyl esters with acid catalysis

[13] Internet: http://www.sasolchevron.com/index2.html [8.2.2003]
[14] LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 24, via e-mail to the author
[15] Internet: http://www.biodiesel.de/biodiesel2000.htm#1 [8.2.2003]
[16] NBB (National Biodiesel Board): Biodiesel Production Technology Overview. Gen 004. Internet: http://www.biodiesel.org [10.9.2002]

The majority of the methyl esters produced today are produced using the base catalyzed reaction because it is the most economic for several reasons:[17]

- A low temperature (up to 65,5 °C) and ambient pressure (20 psi)
- It yields high conversion (98%) with minimal side reactions and reaction time
- It is the direct conversion to methyl ester with no intermediate steps
- Exotic materials of construction are not necessary

The chemical reaction is:



R' R'' R''' = oil acids; R = $(CH_2)_xCH_3$

Fig. 2: Chemical reaction of transesterification

Source: LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 24, via e-mail to the author

The chemistry of the exchange (several parallel acting reaction equilibria and phase balances) is described in Fig. 3, whereas Fig. 4 shows the flowchart of the processing steps needed.

[17] NBB (National Biodiesel Board): Biodiesel Production Technology Overview. Gen 004. Internet: http://www.biodiesel.org [10.9.2002]

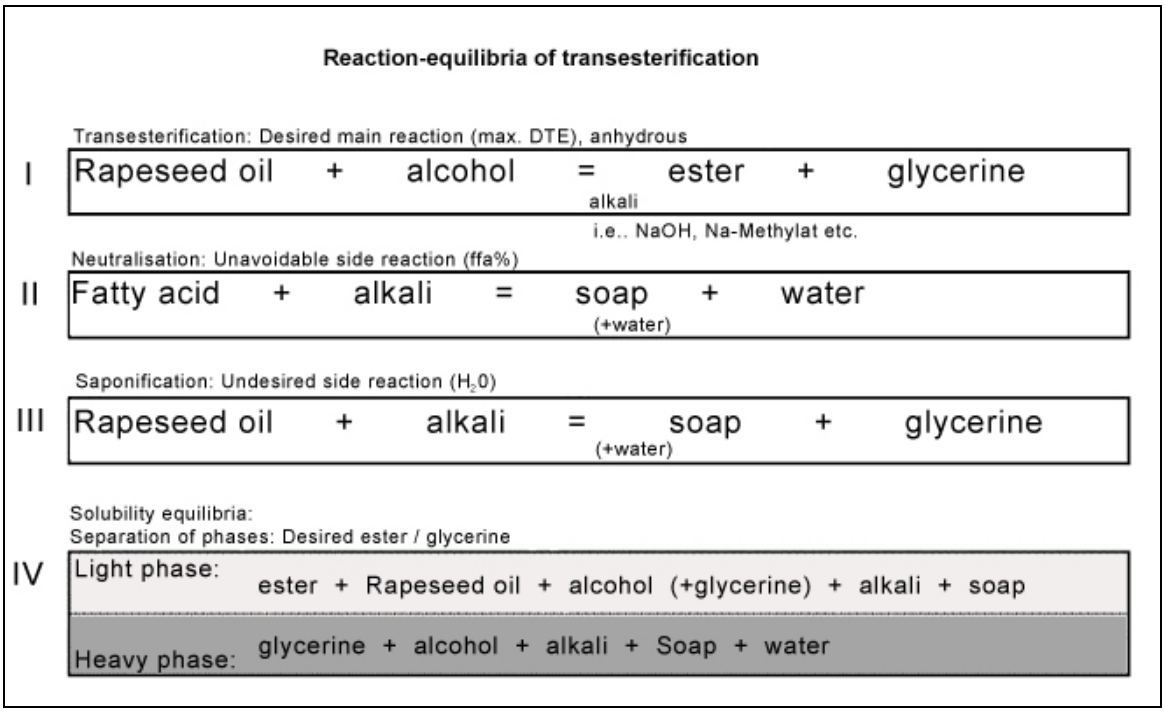


Fig. 3: Reaction- equilibria of transesterification

Source: Internet: http://www.biodiesel.de/biodiesel2000.htm#1 [10.10.2002]

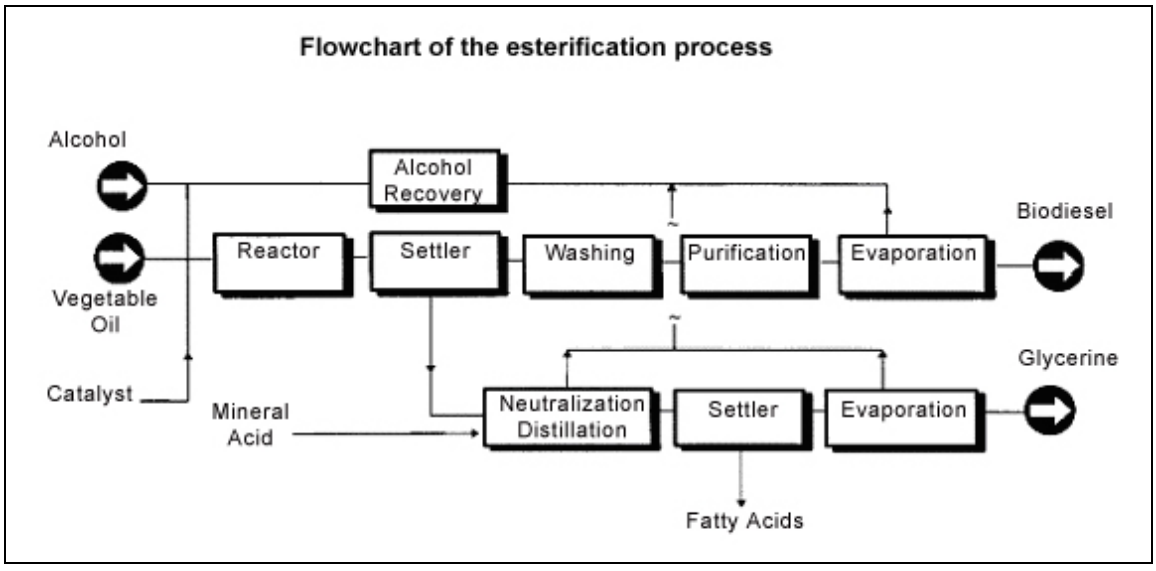


Fig. 4: Flowchart of the esterification process

Source: National Biodiesel Board production fact sheet, Internet: http://www.biodiesel.org [10.11.2002]

Fig. 5 illustrates the whole process chain for Biodiesel production with typical UK values for all the principal raw materials, products, co-products, by-products and waste products involved.

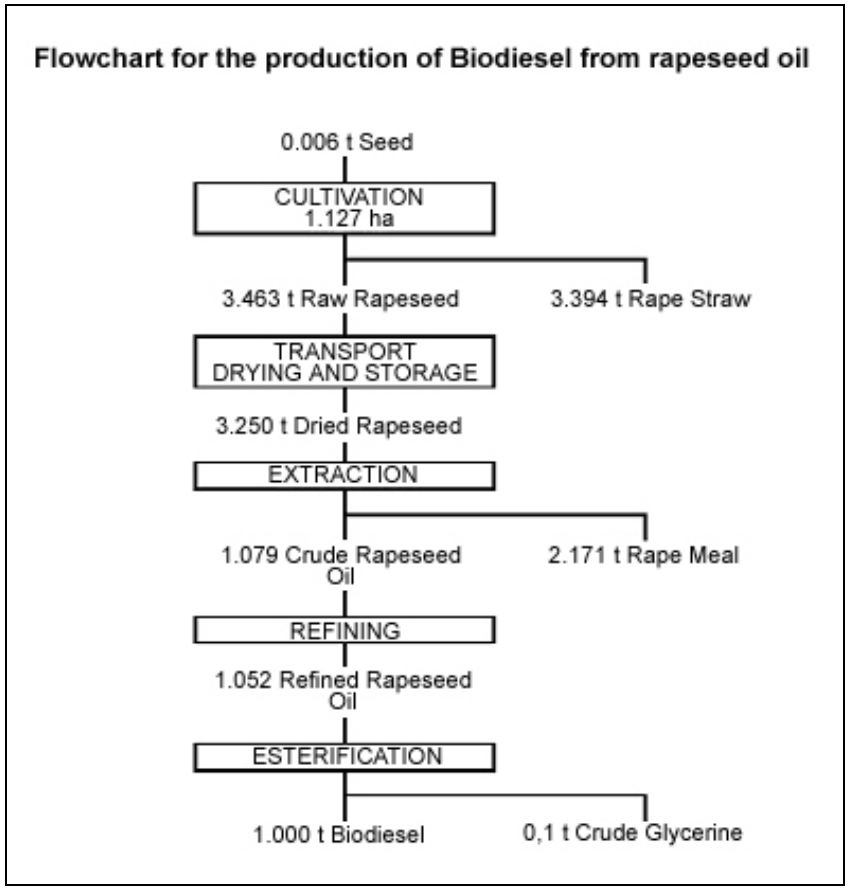


Fig. 5: Flowchart for the production of Biodiesel from oilseed rape in the UK

Source: MORTIMER, N.D.: Evaluation of the comparative energy, environmental and socio-economic costs and benefits of Biodiesel, Draft Report for the Department for Environment, Food and Rural Affairs, London 2002, p. 23

2.32 Feedstock

All vegetable oil and animal fats consist primarily of triglyceride molecules.
The properties of the triglyceride and the Biodiesel fuel are determined by the amounts of each fatty acid that are present in the molecules.[18]
Basically, a large amount of feedstock sources are available. Besides the traditional crops as rapeseed and sunflower they also include peanut, cottonseed, lard, linseed, tung, cocoa, hemp and palm.[19] Only the main feedstock sources actually being used in the commercial production of Biodiesel will be discussed in this study.

[18] Internet: http://www.me.iastate.edu/biodiesel [4.1.2003]
[19] KÖRBITZ, W., Austrian Biofuels Institute, 2.8.2002

2.321 Rapeseed

Rapeseed is a member of the *Brassica* family, which includes broccoli, cabbage, cauliflower, mustard, radish and turnip. Rapeseed oil crushed from 00-rapeseed (an improved variant of the original rapeseed, with less erucic acid and glucosinolate content) was the first type of vegetable oil used for transesterification and rather by chance this oil is highly suitable for production of quality Biodiesel: With a content of approx. 60 % monounsaturated oleic-fatty-acid and only approx. 6 % saturated fatty acids it shows both good stability and winter operability.[20]
Rapeseed contains approximately 22% protein and 40% oil, with modern breeds reaching 48 % oil content. Compared to soybeans, rapeseed has more than twice the oil content but a lower protein level.[21] The seed is crushed for the oil contained (the crushing process is essentially the same as that for soybeans), the by-product is a protein rich meal used by the intensive livestock industry.[22]

2.322 Soybean

Soybeans are a bushy, leguminous plant, *Glycine max*, native of South-East Asia that is grown for the beans, which are used widely in the food industry, for protein in cattle feed and for oil production.[23]
The beans typically contain about 18 - 20% oil, 40% protein, 17% cellulose, with the reminder containing sugar, ash, fibre and other components. Soybeans are the world's largest oilseed crop, with production at about 56% of the world's total oilseeds. The United States is the largest single producer of soybeans:[24]

Country	Production	Final stock
United States	77,12	6,94
Brasil	39	6,75
Argentina	26	5,9
China	15	4,29
WORLD	175,4	26,18

Tab. 2: World-wide soy production 2001 (in million t)

Source: Internet: http://www.sagpya.mecon.gov.ar/0-0/index/biodisel/Master.pdf p.24

[20] ABI (Austrian Biofuels Institute): „World-wide Trends in Production and Marketing of Biodiesel", ALTENER – Seminar "New Markets for Biodiesel in Modern Common Rail Diesel Engines" ,University for Technology in Graz, Graz 2000; via e-mail to the author

[21] LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 6 via e-mail to the author

[22] Internet: http://www.greenhouse.gov.au/transport/comparison/pubs/1ch4.pdf p.1 [1.2.2003]

[23] Internet: http://www.greenhouse.gov.au/transport/comparison/pubs/1ch4.pdf p.1 [1.2.2003]

[24] LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 3, via e-mail to the author

Soybeans are crushed and processed to separate the oil from the remainder of the plant. A typical crushing operation is depicted in Fig. 6:

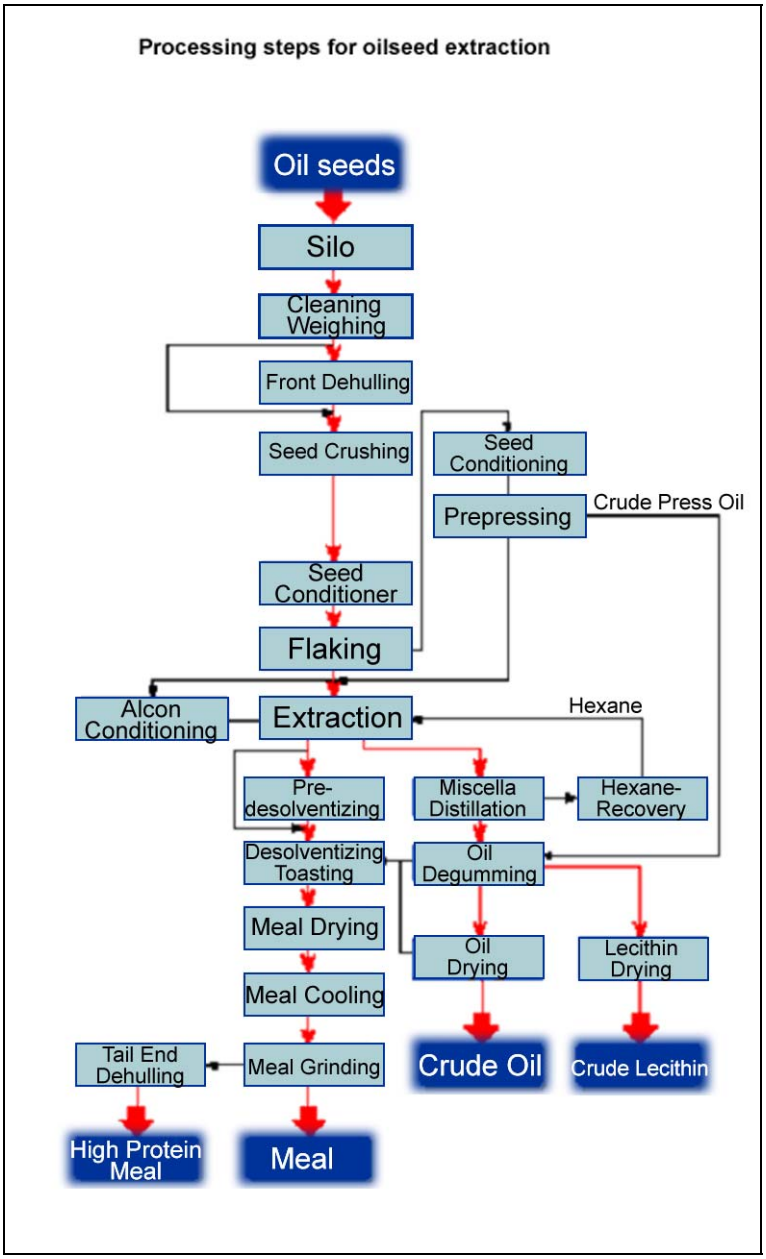


Fig. 6: Processing steps for oilseed extraction

Source: LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 5, via e-mail to the author

2.323 Beef tallow, lard

The rendering process recycles animal and poultry by-products, including bones, trim, fat, offal and feathers into a broad range of commercial tallow (animal/vegetable fat) and protein products (meat and bone, poultry, feather, blood, fish and porcine meals). Tallows are used in the manufacture of products such as cosmetics, soaps, shampoos, candles, lubricants, paints, tires, perfumes, textiles, plastics, inks, polishes, cleaners and solvents. Different grades of tallow are produced to meet the varying needs. They are also an important source of fatty acids and glycerine for the chemical industry.[25]

2.324 Recycled frying oil

Biodiesel made from recycled frying oil has come to be known as McDiesel, because one large source of waste cooking oil is McDonald's restaurants.[26]
The production of Biodiesel from recycled frying oil is cheaper than from other feedstock sources; its capacity is nevertheless limited and requires recycling infrastructure; therefore, its main application seems to be in congested areas.
Recycled frying oils are processed together with tallow by rendering[27] (e.g. Canada), or collected and processed separately (e.g. Austria, Germany) where they are considered special waste by law.

[25] LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 7, via e-mail to the author

[26] Internet: http://www.greenhouse.gov.au/transport/comparison/pubs/1ch4.pdf [14.12.2002]

[27] LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 8, via e-mail to the author

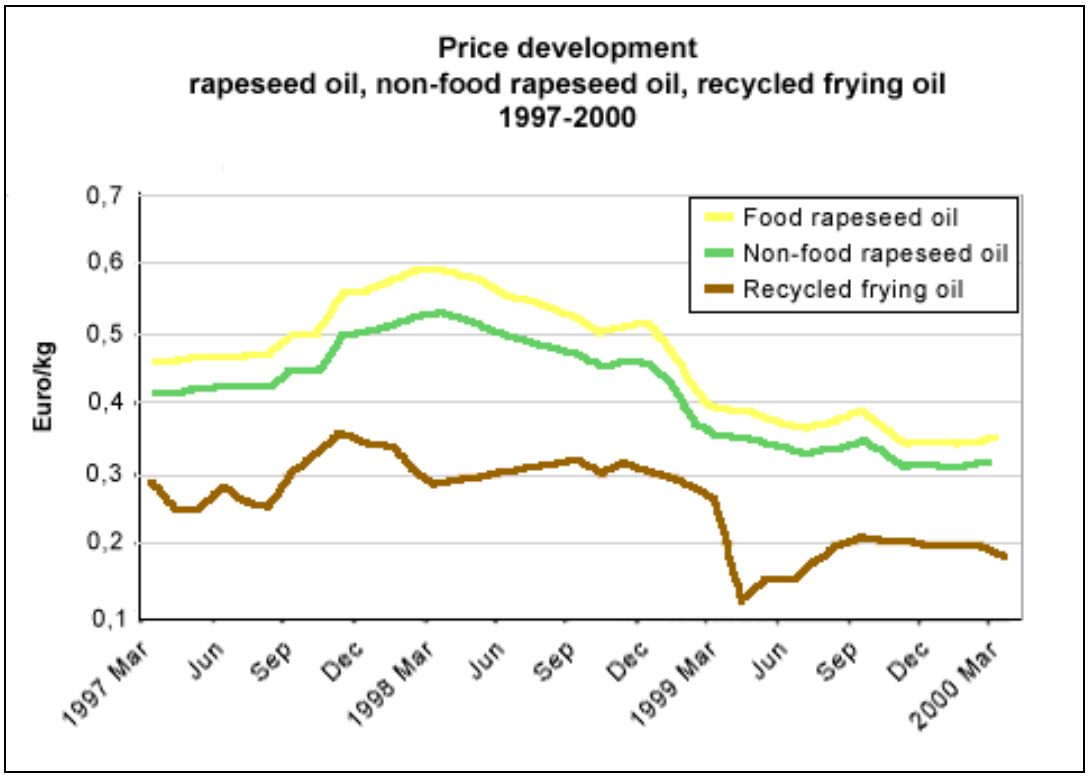


Fig. 7: Price comparison of food and non-food rape oil with recycled frying oil

Source: EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 18, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

2.4 Uses

There are many ways to use alkyl esters including use as solvents and as chemical intermediates for the formation of detergents. However, the application most interesting is as fuel. Fuel applications can be divided into three categories:[28]

- Pure Biodiesel (B100)

Biodiesel can be used in its pure form, also known as *neat* Biodiesel or B100. This is the approach that provides the most reduction in exhaust particulates, unburned hydrocarbons, and carbon monoxide. It is also the best way to use Biodiesel when its non-toxicity and biodegradability are important. Marine applications may be important for B100. Although neat Biodiesel would not be expected to cause any operational problems, its solvent properties are at their highest intensity and may cause problems with loosening of varnish deposits in fuel tanks and lines, degradation of fuel lines because some elastomers are not compatible with Biodiesel (such as BUNA rubbers), and cause paint removal near fuel fill ports.

[28] Internet: http://www.me.iastate.edu/biodiesel [4.1.2003]

- Blends (typically 20-50%)

Biodiesel will blend with petroleum-based diesel fuel in any proportion so it is common to use blends of 20 to 50% Biodiesel in 80 to 50% fossil diesel. Blends reduce the cost impact of Biodiesel while retaining some of the emissions reductions. Most of the these reductions appear to be proportional to the percentage of Biodiesel used.

- As an additive, 1-2% (B02)

Tests for lubricity have shown that Biodiesel is a very effective lubricity enhancer. Even as little as 0,25% can have a measurable impact and 1-2% is enough to convert a very poor lubricity fuel into an acceptable fuel. Although these levels are too low to have any impact on the Cetane number of the fuel or the emissions from the engine, the lubricity provides a significant advantage at a modest cost.

2.5 Advantages of Biodiesel use

Biodiesel is renewable, non-toxic, and biodegradable. Depending on the audience, these may or may not be strong advantages. While Biodiesel is definitely renewable, the fact that it cannot displace a significant fraction of our current petroleum-based fuel consumption means that it does not really allow us to make much progress toward a sustainable energy supply. Non-toxicity and biodegradability are useful characteristics but they are only significant when the fuel is used in its pure form (B100) as is common in Germany and Austria. For the 20% and lower blends that are common in the United States, the diesel fuel portion of the blend determines the toxicity and biodegradability. Biodiesel does provide a reduction in harmful emissions (SO_x, CO, HC, PM, soot, PAHs, as well as NO_x in optimised Diesel engines) as well as in net CO_2 emissions. Although the amount of CO_2 emitted from the exhaust pipe per kilowatt of power is essentially the same as for petroleum diesel fuel, the carbon was originally removed from the atmosphere so there is little net change in atmospheric carbon dioxide.[29]
It is obvious that Biodiesel is not going to completely replace petroleum-based diesel fuel in the near future. If all of the vegetable oil and animal fat were used to produce Biodiesel, we could only replace about 15% of the current demand for on-highway diesel fuel.[30]
Nevertheless, in addition to Biodiesel´s characteristics already mentioned, there are good arguments to concern about these 15%; the most prominent will be presented in more detail in the following pages.

[29] Internet: http://www.me.iastate.edu/biodiesel/ [10.1.2003]
[30] Internet: http://www.me.iastate.edu/biodiesel/ [10.1.2003]

It should be mentioned that technical, economic and environmental factors are not sufficient to fully explain the use or non-use of a given fuel; other factors such as

- sociological and cultural aspects
- organisational aspects
- institutional, structural and political aspects

would have to be investigated[31], but they were partly neglected as this would have gone beyond the scope of this work.

2.51 Supply security

Biodiesel decreases the country's dependence on imported petroleum, a necessity in view of diminishing reserves of fossil energy sources.

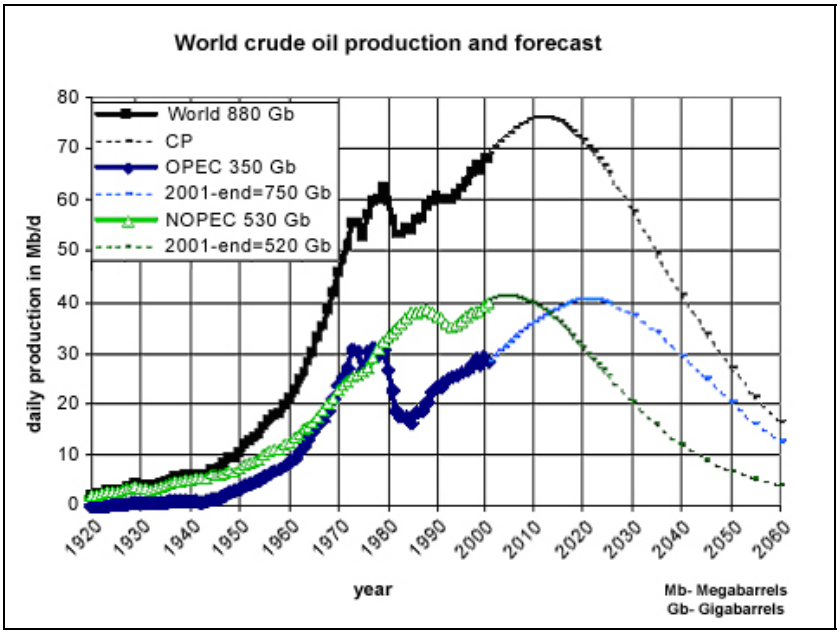


Fig. 8: World conventional crude oil production and forecast 1920-2060

Source: LAHERRERE, J.: Hydrocarbons Resources, Forecast of oil and gas supply to 2050, Petrotech 2003, New Delhi 2003 Internet: http://www.hubbertpeak.com/laherrere/Petrotech090103.pdf [8.2.2003]

Obviously, this reason should not be overemphasized since the percentage of the country's fuel supply that can be replaced with Biodiesel will be small. Taken the situation of Europe with an anticipated annual growth of the transport sector of 2 percent[32] and a maximum 8 percent substitution by biofuels, the positive effects gained are offset by the growth in the use of fossil fuels in less than four years.[33]

[31] KÖRBITZ, W., Austrian Biofuels Institute, 10.10.2002

[32] European Commission: “Green Paper on Security of Supply” , COM (2000) 769

[33] JONK, G.: Background paper 18-03-2002, On the use of biofuels for transport, Internet: http://www.eeb.org/publication/EEB-Biofuels-background-18-03-02.pdf [20.12.2002]

2.52 Environmental aspects

Biodiesel is renewable and does not contribute to global warming due to its closed carbon cycle. Because the primary feedstock for Biodiesel is a biologically-based oil or fat, which can be grown season after season, Biodiesel is renewable. And, since the carbon in the fuel was originally removed from the air by plants, there is no net increase in carbon dioxide levels.[34]

2.521 Energy balance

The energy output for Biodiesel from rape seed (the oil share only is considered) is about 4 to 5 times the input. If the whole plant is considered, the output is 7,4 times the input.[35,36]

2.522 CO_2 reduction potential

The CO_2 reduction potential of RME (rape methyl ester, i.e. Biodiesel made from rapeseed oil) is considered to be 1,2 kg CO_2/kg of substituted fossil diesel. Additionally by-product credits could be achieved. If the use of rape seed press cake as animal food is considered, 0,7 kg CO_2/kg substituted diesel could be calculated. For substitution of synthetic glycerol 0,8 kg CO_2/kg substituted diesel can be included.
The whole CO_2 advantage compared with fossil diesel would be 3,66 kg CO_2/kg substituted diesel if rape straw burning, Biodiesel, animal food and glycerol are considered.[37]
Other studies[38] calculate the avoided CO_2 to 3,2 kg/l substituted fossil diesel.

2.523 Emissions

In 2002 the US Environmental Protection Agency (EPA) published a fact sheet on Biodiesel. They noted that the actual emission impact of the use of Biodiesel varies from engine to engine. Their summary of the emissions impact, relative to fossil diesel fuel, for B20 and B100 for an engine that takes full advantage of the fuel's clean burning properties are shown in the following table.

34 Internet: http://www.me.iastate.edu/biodiesel/ [10.1.2003]
35 UBA Berlin: Ökologische Bilanz von Rapsöl bzw. Rapsölmethylester als Ersatz von Dieselkraftstoff, Berlin 1993
36 CONNEMANN, J., FISCHER, J.: Biodiesel in Europe 1998, International liquid biofuels congress, Curitiba Parana Brazil, July 19 - 22 1998
37 EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 31, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]
38 SCHÖPE, M.: Economic aspects of Biodiesel production in Germany; 2nd European Motor Biofuels Forum, Graz 1996

	B100	B20
Carbon Monoxide	-50%	-10%
Particulate Matter	-70%	-15%
Total Hydrocarbons	-40%	-10%
Sulfate emissions	-100%	-20%
Nitrogen Oxides	+9%	+2%
Methane	No change	No change

Tab. 3: EPA emission assessment (B100, B20 compared to fossil diesel)

Source: LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 42, via e-mail to the author

NO_x can increase with the use of Biodiesel. The reason for the NO_x increase is still an area of active research, but it is at least partially due to injection timing advances associated with property differences between Biodiesel and petroleum.[39] A substantial reduction of NO_x (up to -23 %) can be achieved by a 5° delayed injection adjustment.[40]

2.524 Greenhouse gas (GHG) balance

2.5241 B2

The blend B2 is of interest primarily because of its lubricity properties. The greenhouse gas benefits for this blend are very modest at 1% for the vegetable oils and 1,7% for the animal fat case.

[39] Internet: http://www.me.iastate.edu/biodiesel/ [10.1.2003]

[40] KÖRBITZ, W.: Biodiesel- Environmental and Macroeconomic Benefits, Vienna 1998, p. 3, via e-mail to the author

	Diesel Fuel	Biodiesel (Rape)	Biodiesel (Soy)	Biodiesel (Animal Fat)
	G/mile	G/mile	G/mile	G/mile
Vehicle operation	1.701,5	1.700,3	1.700,3	1.700,3
C in end-use fuel from CO_2 in air	0	(32,0)	(32,0)	(32,0)
Net vehicle operation	1.701,5	1.668,3	1.668,3	1.668,3
Fuel dispensing	2,4	2,4	2,4	2,4
Fuel storage and distribution	27,8	28,0	27,9	27,9
Fuel production	183,0	184,1	185,9	190,6
Feedstock transport	4,6	5,0	5,6	5,5
Feedstock and fertilizer production	233,3	240,7	243,7	228,8
Land use changes and cultivation	0	7,8	36,3	0,0
CH_4 and CO_2 leaks and flares	71,1	69,7	69,7	69,7
Emissions displaced by co-products	0,0	-12,1	-45,5	-11,5
Sub total (fuel cycle)	2.223,7	2.194,0	2.194,3	2.181,7
% changes (fuel cycle)	--	-1,3	-1,3	-1,8
Vehicle assembly and transport	19,1	16,0	16,0	16,0
Materials in vehicles	69,6	59,4	59,4	59,4
Grand total	2.312,4	2.269,5	2.269,8	2.257,1
% changes (grand total)	**--**	**-1,2**	**-1,2**	**-1,8**

Tab. 4: Lifecycle GHG emissions for 2% Biodiesel

Source: Source: LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 45, via e-mail to the author

2.5242 B20

The B20 blend is the one that has been used the most in the United States. It offers some significant benefits in terms of exhaust emissions and greenhouse gas benefits. The lifecycle GHG emissions for the three fuels are shown in the following table. The reductions in greenhouse gas emissions range from 10 to 17,3%.

	Diesel Fuel	Biodiesel (Rape)	Biodiesel (Soy)	Biodiesel (Animal Fat)
	G/mile	G/mile	G/mile	G/mile
Vehicle operation	1.701,5	1.700,4	1.700,4	1.700,4
C in end-use fuel from CO_2 in air	0	(322,4)	(322,4)	(322,4)
Net vehicle operation	1.701,5	1.378,0	1.378,0	1.378,0
Fuel dispensing	2,4	2,5	2,5	2,5
Fuel storage and distribution	27,8	29,4	28,6	28,6
Fuel production	183,0	194,8	212,7	259,7
Feedstock transport	4,6	8,8	15,0	13,5
Feedstock and fertilizer production	233,3	308,3	337,7	188,3
Land use changes and cultivation	0	78,8	366,0	0,0
CH_4 and CO_2 leaks and flares	71,1	57,4	57,4	57,4
Emissions displaced by co-products	0,0	(121,6)	(458,5)	(116,2)
Sub total (fuel cycle)	2.223,7	1.936,4	1.939,3	1.811,8
% changes (fuel cycle)	--	-12,9	-12,8	-18,5
Vehicle assembly and transport	19,1	19,1	19,1	19,1
Materials in vehicles	69,6	69,6	69,6	69,6
Grand total	2.312,4	2.025,1	2.028,0	1.900,5
% changes (grand total)	**--**	**-12,4**	**-12,3**	**-17,8**

Tab. 5: Lifecycle GHG emissions for 20% Biodiesel

Source: LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 48, via e-mail to the author

2.5243 B100

The approach of using pure Biodiesel (B100) maximizes the environmental benefits, but also creates the largest issues for engine manufacturer acceptance of the fuel and the cold weather properties. The greenhouse gas reductions range from 51,1% for the soy Biodiesel to 88,9% for the tallow Biodiesel.

	Diesel Fuel	Biodiesel (Rape)	Biodiesel (Soy)	Biodiesel (Animal Fat)
(1 mile= 621,4 m)	G/mile	G/mile	G/mile	G/mile
Vehicle operation	1.701,5	1.696,0	1.696,0	1.696,0
C in end-use fuel from CO_2 in air	0	(1.673,0)	(1.673,0)	(1.673,0)
Net vehicle operation	1.701,5	23,0	23,0	23,0
Fuel dispensing	2,4	2,6	2,6	2,6
Fuel storage and distribution	27,8	36,3	31,6	31,6
Fuel production	183,0	244,2	337,2	581,3
Feedstock transport	4,6	26,5	58,4	50,7
Feedstock and fertilizer production	233,3	622,3	774,9	0,0
Land use changes and cultivation	0	409,2	1.899,4	0,0
CH_4 and CO_2 leaks and flares	71,1	0,0	0,0	0,0
C in end-use fuel from CO_2 in air	0	(1.673,0)	(1.673,0)	(1.673,0)
Emissions displaced by co-products	0,0	(630,9)	(2.379,2)	(603,2)
Sub total (fuel cycle)	2,223.7	73,1	748,0	86,1
% changes (fuel cycle)	--	-67,0	-66,4	-96,1
Vehicle assembly and transport	19,1	22,9	22,9	22,9
Materials in vehicles	69,6	82,4	82,4	82,4
Grand total	2.312,4	838,4	853,3	191,4
% changes (grand total)	**--**	**-63,7**	**-63,1**	**-91,7**

Tab. 6: Lifecycle GHG emissions for 100% Biodiesel

Source: LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 51, via e-mail to the author

2.525 Eco –balance

In addition to the CO_2 aspect, eco-balances also consider parameters like fertiliser, N_2O, water pollution, NO_x, VOC, etc. When assessing RME, six categories are considered to have high relevance:[41]

- Finite primary energy
- Greenhouse effect
- Ozone depletion
- Acidification
- Eutrophication
- Human and ecotoxicity

[41] EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 32, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

Difficulties arise through the comparison of different environmental aspects - for example: how much is one kg of CO_2 reduction compared with the influence of stratospheric ozone depletion? Finite primary energy, greenhouse effect and human and eco-toxicity are in favour of RME. Two of the three environmental impact categories that are clearly in favour of RME are also considered to be of high to very high ecological importance. Two of the three categories that are unfavourable for RME (e.g. eutrophication and acidification) have a medium ecological relevance. Only the potential for depletion of stratospheric ozone from N_20 emissions is considered to be a disadvantage for RME with high to very high ecological importance. However, the specific contribution of N_20 to the stratospheric ozone depletion depends non-linearly on the reactivities of CFCs and is, therefore, difficult to establish[42].

2.53 Economic aspects

Although the use of Biodiesel may provide significant environmental advantages (pollutant emissions) when compared to the combustion of fossil fuels, the effective use of Biodiesel will depend on a large extent on its economic feasibility.

2.531 Micro-economic aspects

The profitability of Biodiesel production depends on various factors:

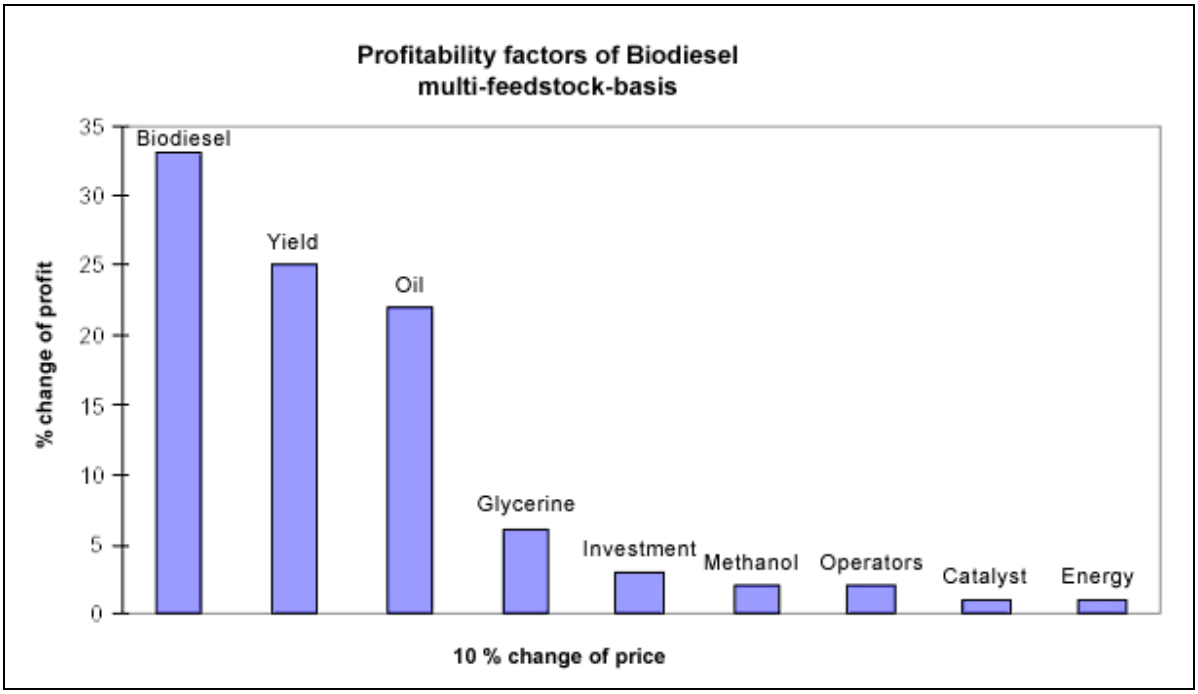


Fig. 9: Profitability factors of Biodiesel on a multi-feedstock-basis

Source: AUSTRIAN BIOFUELS INSTITUTE (ABI): World-wide Trends in Production and Marketing of Biodiesel; presented at the ALTENER – Seminar "New Markets for Biodiesel in Modern Common Rail Diesel Engines", University for Technology Graz, Graz 2000

[42] FRANKE, B., REINHARDT, G.: Environmental impacts of Biodiesel use; IFEU; Heidelberg 1998

The following chapter will highlight the three most crucial components: Biodiesel price, yield (or conversion rate) and the oil price. Moreover a scenario analysis concerning the optimum plant size and location will show the extent and limits of the economies of scale attainable.

2.5311 Final price

The diesel price is a critical factor in the feasibility of Biodiesel. It basically depends on three parameters:

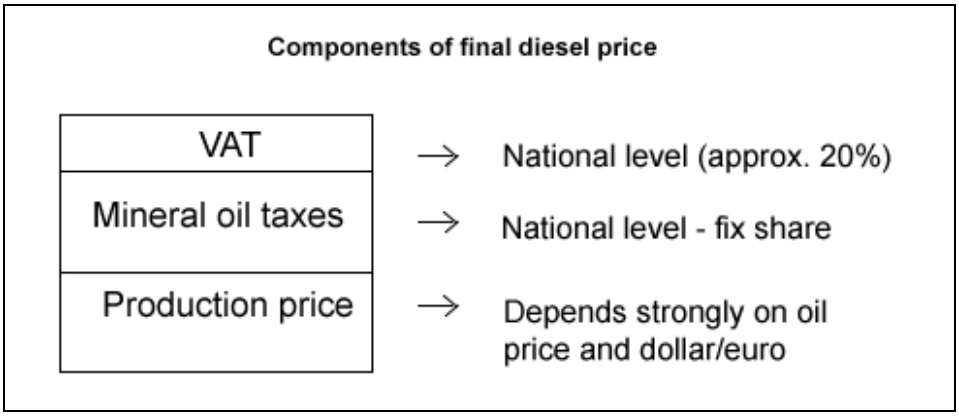


Fig. 10: Components of final diesel price

Source: EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 21, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

Alternate uses for soybean oil and even animal fats and recycled frying oils keep their price at a level where they cannot compete directly against fossil diesel fuel. Some type of government subsidies are necessary for the industry to develop. These subsidies, primarily in the form of tax waivers, have been responsible for the rapid growth of Biodiesel use in Europe. In various European countries, the price of Biodiesel is actually less than for petroleum diesel fuel (e.g. see Fig. 11 below).

Fig. 11: Fossil diesel – Biodiesel price gap, Germany 2002

Source: Internet: http://www.me.iastate.edu/biodiesel/ [10.10.2002]

A state mandate requiring the use of a minimum Biodiesel blend in all fuels sold for use is another type of subsidy: it removes price as an issue since the fuel suppliers will have to pay whatever is necessary to get the Biodiesel they need for blending.[43]

2.5312 Production costs

In the early days, Biodiesel producers were satisfied when achieving a transesterification rate (yield) of approx. 85 - 95 % thus leaving quite a volume of potential feedstock as waste in the glycerine phase. However, yield is the second biggest factor affecting profitability, i.e. a 10% decline of yield reduces profitability by approx. 25 %. It is therefore crucial to transfer any potential molecule into a fatty-acid-methyl-ester; this includes all the triglycerides and Free-Fatty-Acids (FFA). A modern and profitable process technology today is able to achieve a 100 % yield without any expensive losses.[44]

2.5313 Feedstock costs

The high price of Biodiesel's oil feedstock is the major obstacle to market development. As the selling price of Biodiesel must exceed the feedstock cost to cover processing, packaging, transportation, distribution and profit, it is highly sensitive to any widening of the fossil oil-vegetable oil price gap:[45]

[43] Internet: http://www.me.iastate.edu/biodiesel/ [10.10.2002]

[44] AUSTRIAN BIOFUELS INSTITUTE (ABI): World-wide Trends in Production and Marketing of Biodiesel; presented at the ALTENER – Seminar "New Markets for Biodiesel in Modern Common Rail Diesel Engines", University for Technology in Graz, Graz 2000

[45] KÖRBITZ, W.: 8 key trends in the production of Biodiesel world-wide, presentation, Vienna 2002, via e-mail to the author

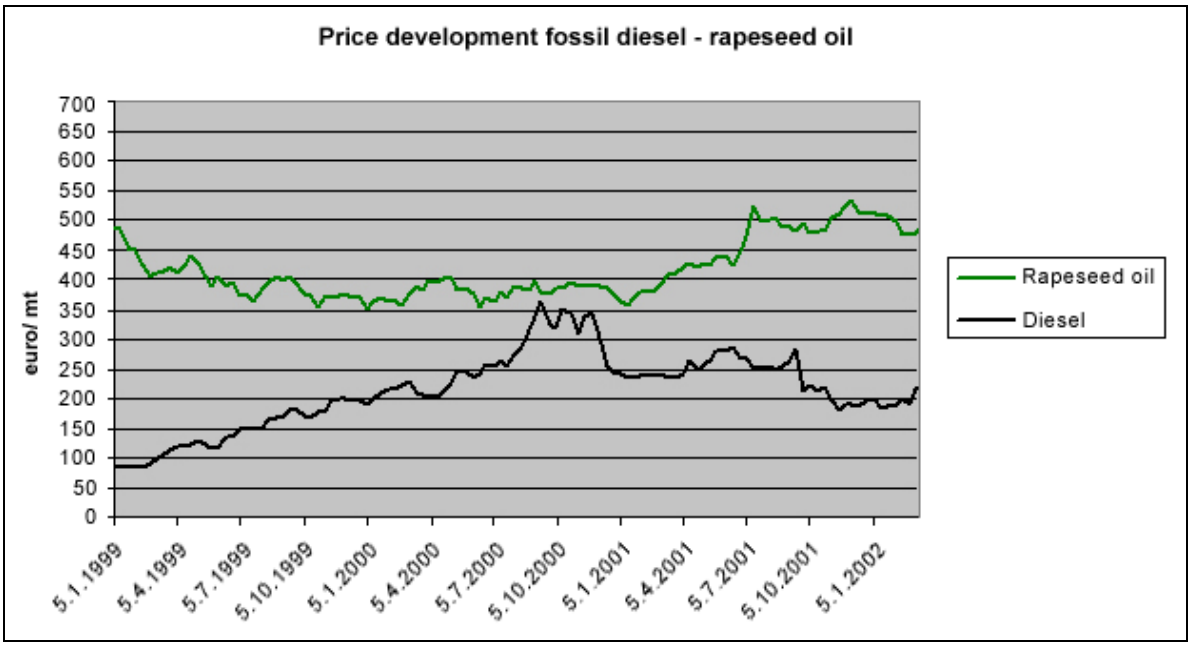


Fig. 12: Gasoil, rapeoil price development 1999 – 2002 (diesel (IPE), rapeoil (FDM) month +3)

Source: KÖRBITZ, W.: 8 key trends in the production of Biodiesel world-wide, presentation, Vienna 2002, via e-mail to the author

The second half of 2000 was a profitable one for the Biodiesel industry; on August 24th 2000, for the first time ever in history, crude fossil oil was even more expensive than vegetable oil on world markets.[46]

The most promising approach to lowering the price is to use other, less expensive feedstocks to provide a portion of the Biodiesel supply. These other feedstocks could include spoiled soybeans, beef and pork tallow, recycled restaurant frying oils and by-products , such as soapstock, from other processes involving vegetable oils. While the quantities of these feedstocks are not sufficient to supply a large market, they can be used as blending agents to lower the overall costs.[47]

[46] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 5

[47] LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 85, via e-mail to the author

2.5314 Scenario analysis: optimum plant size and location

An economic comparison was calculated by CONNEMANN and FISCHER in 1998. They compared six different plants[48]:

Plant		**A**	**B**	**C**	**D**	**E**	**F**
Process		batch	batch	cont	batch	cont	cont
Investment	Mio €	1,5	10,2	1,3	12,8	25,5	10,2
Capacity	**t/a**	**2.000**	**15.000**	**8.000**	**75.000**	**125.000**	**80.000**
daily cap	t/d	10	50	20	200	350	250
Oil Quality		ref.deg	ref.deg	crude/ref	ref.deg	ref.deg	crude/ref
Glyc.prep	Content %	60	80/99,5	80	90	92	80/99,7
Personnel		3	8	6	15	20	12
Veg.Oil, ref.deg.		2.100	15.600	8.240	77.250	131.250	82.400
in % of		105%	104%	103%	103%	105%	103%
Biodiesel	t/a	2.000	15.000	8.000	75.000	125.000	75.000
Glycerol	99,5/80/60	0	1.295	783	7.339	12.469	6.953
%of oil. Ref.deg		0%	8%	10%	10%	10%	8%
Fatty acids	80%	80	480	192	1800	5000	1800
Electr. 0,08 €/kWh	kWh/t	105	75	40	60	60	30
Steam 15 €/t	kg/t	650	650	300	600	1200	350
Methanol0,15/0,13 €/kg	kg/t	156	120	120	120	115	115
Catalyst 43/92 €/kg	kg/t	14	10	4	4	3	4
Phosp. acid 38 €/kg	kg/t	43	43	10	10	10	10
Adsorbant 0,6 €/kg	kg/t	0	0	5	0	0	5
Depreciation (10 y)	€/t	77	68	16	17	20	14
Interest 8% (1/2)	€/t	31	27	6	7	8	5
Personnel (40.000 €/p)	€/t	61	22	31	8	7	6
Methanol	€/t	24	18	16	16	15	15
Energy+Chemicals	€/t	48	42	18	22	30	18
Maint 3 %	€/t	23	20	5	5	6	4
Overheads	€/t	38	10	8	5	5	5
Total operating costs	€/t	301	208	99	80	91	67
-Glycerol 637/306 €/t	€/t	0	55	30	30	31	55
-Fatty acids 280 €/t	€/t	11	9	7	7	11	6
+Loss of oil 460 €/t	€/t	23	18	14	14	23	14
Surcharge on oil base	**€/t**	**313**	**162**	**77**	**57**	**73**	**19**

Tab. 7: Profit margin calculation for 6 existing Biodiesel production plants

Source: CONNEMANN, J., FISCHER, J.; Biodiesel in Europe 1998; International liquid biofuels congress, Curitiba, Brazil

[48] CONNEMANN, J., FISCHER, J.; Biodiesel in Europe 1998; International liquid biofuels congress, Curitiba Parana Brazil - July 19 - 22 1998

The production costs varied greatly according to plant scale and process. In Tab. 8 some scenarios for different plant sizes and oil price levels were calculated:

	Rape oil price €/kg	**Conversion costs** €/kg	**Biodiesel price** €/kg
Small scale, high raw material price	0,6	0,2	**0,8**
Small scale, low raw material price	0,3	0,2	**0,5**
Large scale, high raw material price	0,6	0,05	**0,65**
Large scale, low raw material price	0,3	0,05	**0,35**

Tab. 8: Scenarios for Biodiesel production

Source: EIBENSTEINER F., DANNER H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 28, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

The comparison for the scenario shows a final price range of 0,35 €/kg to 0,8 €/kg.
The table above shows very well why many small scale plants (e.g. in Austria) shut down in the period of high feedstock prices in 1998: The production costs for Biodiesel (apart from marketing, logistics, storage, blending and transport costs) exceeded by far the pump price of fossil diesel.
The affects of the different costs to these economies of scale are shown in Fig. 13.

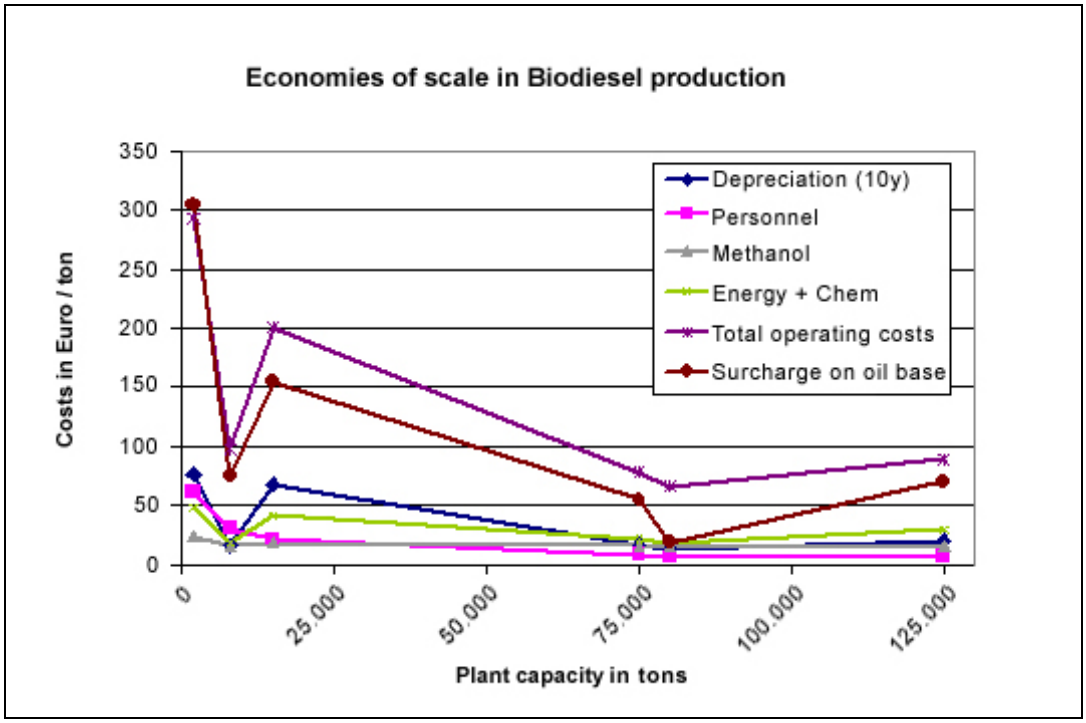


Fig. 13: Economies of scale in Biodiesel production

Source: EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels, July 2000, p. 20, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

It thus appears that large scale plants are more efficient (quality, product marketing, etc.) up to a certain size where the logistics for raw material acquisition become more expensive. Small scale production units seem to be the more profitable for recycled frying oil collection only.[49]

2.532 Macro-economic aspects

- Import balance

The substitution of fossil sources by renewable, locally produced energy results in an improved trade balance.[50]

- Employment

Studies in Germany show that about 15 jobs per 1.000 t of Biodiesel (5 direct, 10 indirect) are created.[51]

- Taxes

Detaxation causes losses of tax income. For full detaxation, the loss of taxes accounts to 0,3 to 1,05 Euro/l of substituted fossil diesel (depending on the national fuel tax level and the national VAT level).
A mandatory 2% blending of fossil diesel with Biodiesel in Austria would cause a direct tax loss of more than 20 million € per year.[52] Part of this would be compensated by additional income taxes and reinvestment profits, but the net fiscal effects remain negative.

- Subsidies

The subsidies for rape seed cultivation could also be used for more efficient CO_2 reducing activities like private house insulation or other energy saving activities. That is one argument against RME[53]. Comparisons between different strategies are necessary but often used to kill one strategy with the result that both are not realised. The question should not be: "either this activity or the other", but both activities should be realised.[54]

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[49] EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 4, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002

[50] EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 33, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

[51] SCHÖPE, M.; Economic aspects of Biodiesel production in Germany, 2nd European Motor Biofuels Forum, Graz 1996

[52] EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 23, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

[53] KIRCHNER, P., BURGSTALLER, B.: Welche Auswirkungen hat eine verpflichtende Beimischung von Biodiesel im Ausmaß von 2% zum mineralischen Diesel?; Ed. by Kammer für Arbeiter und Angestellte; Vienna 1999

[54] EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 33, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

2.533 Macro-economic assessment of a national Biodiesel industry

The macro-economic effects of a national Biodiesel industry in Ireland (with an anticipated production volume of 30.000 t/a) have been investigated. The main macro-economic effects are summarised in Fig. 14.

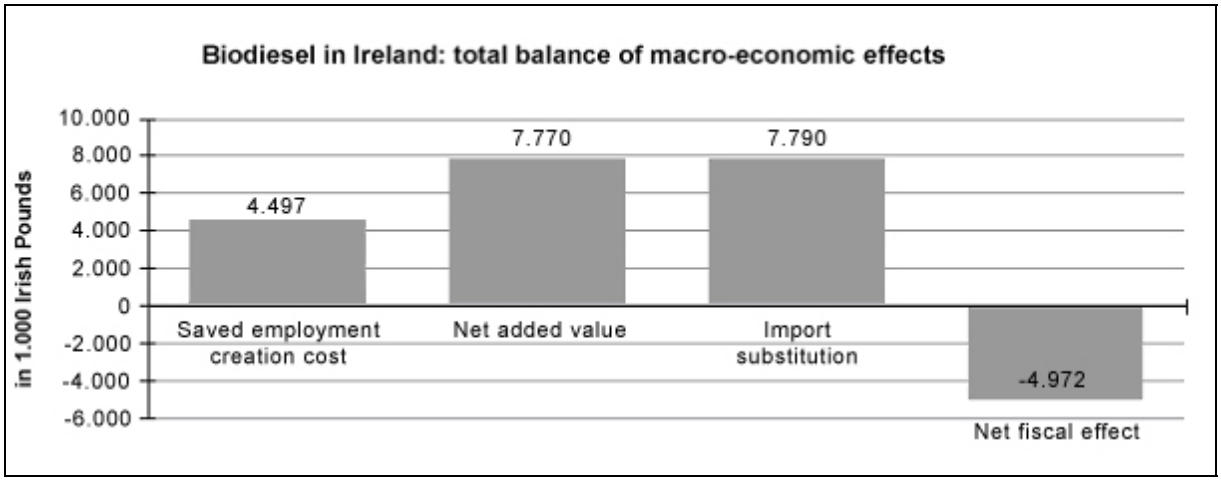

Fig. 14: Biodiesel in Ireland: total balance of macro-economic effects (in 1.000 IRP)

Source: KÖRBITZ, W.: Biodiesel- Environmental and Macroeconomic Benefits, Vienna 1998, p.8, via e-mail to the author

Domestic production of Biodiesel reduces costs for energy imports at the same time as it saves protein meal imports. Furthermore, the effect on the national gross product is positive due to a better valorisation of domestic resources.
Biodiesel saves employment creation cost for 324 persons (assuming 30.000 t of Biodiesel production) thus saving the state budget 5,7 million € (4,5 million Irish £ (IRP)).
Assuming full detaxation the total balance ends up with a benefit for the state budget of approx. 19 million € (15 million Irish £ (IRP)).

2.54 Agriculture

Biodiesel provides a market for excess production of vegetable oils and animal fats which will have positive income effects on farmers. The animal by-products industry also has a problem with more supply than the current market can absorb. This is compounded by the potential for even greater restrictions on the use of animal fats in animal feeds because of concerns about the spread of BSE (Mad Cow Disease).[55]

2.55 Biodiesel fuel properties

Biodiesel's primary advantages lie in its effect on emissions, Cetane number, its flash point, and its lubricity. While we already discussed the emission properties before, we

[55] Internet: http://www.me.iastate.edu/biodiesel/ [10.10.2002]

will concentrate on the other three points and Biodiesel's characteristics of rapid biological degradability and non-toxicity.

2.551 Cetane number

The Cetane number is an indication of a fuels readiness to autoignite after it has been injected into the diesel engine. Diesel fuel for use in on-highway engines is required to have a Cetane number of 40 or higher. Since a higher Cetane number translates into higher fuel costs, most refiners keep the Cetane number of their diesel fuels between 40 and 45. Current research shows that Biodiesel's higher Cetane number (generally between 46 and 60 depending on the feedstocks used to make the Biodiesel) shortens the ignition delay. Biodiesel's lower volatility also tends to reduce the rate at which fuel is prepared to burn during the ignition delay period. These two factors contribute to improved combustion characteristics (more gradual start of combustion) than occurs with fossil diesel fuel.[56]

Type of Biodiesel	Heat of Combustion (in MJ/kg)	Cetane No.
Methyl Soybean	39,8	46,2
Ethyl Soybean	40,0	48,2
Butyl Soybean	40,7	51,7
Methyl Sunflower	39,8	47,0
Methyl Peanut	-	54,0
Methyl Rapeseed	40,1	-
Ethyl Rapeseed	41,4	-

Tab. 9: Cetane number and energy content for Biodiesel fuels

Source: Internet: http://www.me.iastate.edu/biodiesel/ [10.10.2002]

2.552 Flashpoint

The flashpoint of a fuel is the temperature at which the vapours above the fuel become flammable. Petroleum-based diesel fuels have flash points of 50°C to 80°C, so they are considered to be intrinsically safe. Biodiesel has a flash point that is considerably higher than fossil diesel fuel (above 160°C). This means that the fire hazard associated with transportation, storage and utilization of Biodiesel is much less than with other commonly used fuels.[57]

2.553 Lubricity

Lubricity can be defined as: "The property of a lubricant that causes a difference in friction under conditions of boundary lubrication when all the known factors except

[56] Internet: http://www.me.iastate.edu/biodiesel/Pages/biodiesel8.html [10.2.2003]
[57] Internet: http://www.me.iastate.edu/biodiesel/ [10.10.2002]

the lubricant itself are the same. The lower the friction, the higher the lubricity. "[58]
In the case of diesel fuel, the fuel acts as a lubricant for the finely fitting parts in the diesel fuel injection system. There is general agreement that the severe hydrotreating process used by petroleum refineries to remove sulphur (as demanded by recent regulations world-wide) results in lower fuel lubricity.[59]
Pure Biodiesel and high level blends have excellent lubricity; the addition of small amounts of Biodiesel (0,25% to 2%) to diesel fuel has a dramatic effect on the lubricity of that fuel. Fig. 15 shows the results of the SLBOCLE test method for lubricity measurement. The higher the number the better the fuel lubricity. As little as 1% Biodiesel could change the diesel fuel from an unacceptable level to an acceptable one.

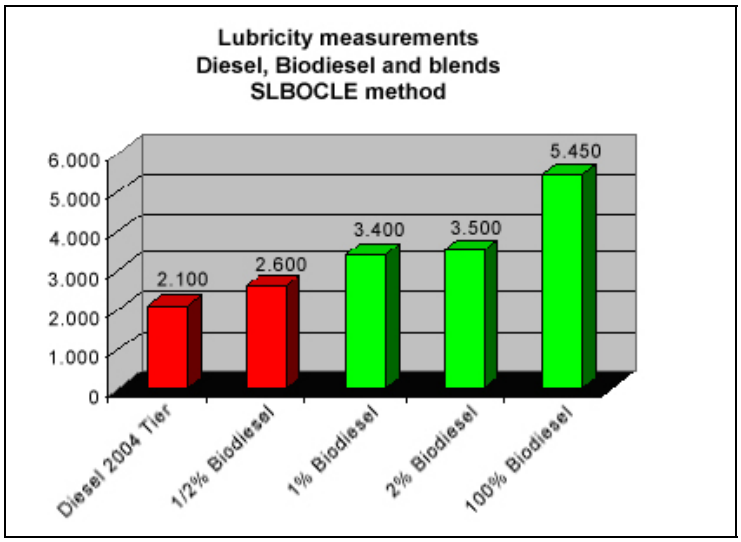

Fig. 15: Lubricity measurements (SLBOCLE) for Diesel, Biodiesel and blends

Source: Internet: http://www.me.iastate.edu/biodiesel/ [5.1.2003]

2.554 Biodegradability

The degradation of a compound through microbial activity in soils is called the biodegradability. According to the standard test the result for Biodiesel is that more than 95 % are degraded after 21 days, fossil Diesel about 72 % after 21 days.[60] Dextrose (a test sugar used as the positive control when testing biodegradability) degraded at the same rate. Blending Biodiesel with diesel fuel accelerates its biodegradability. For example, blends of 20 percent Biodiesel and 80 percent diesel fuel degrade twice as fast as fossil diesel alone.[61]

[58] http://www.me.iastate.edu/biodiesel/Pages/bio23.html [7.9.2003]
[59] Internet: http://www.me.iastate.edu/biodiesel/ [10.10.2002]
[60] ABI (Austrian Biofuels Institute): Statement on the situation of the Biodiesel sector, Vienna 2002, via e-mail to the author, p. 2
[61] LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 82, via e-mail to the author

2.555 Toxicity

Biodiesel is considered non-toxic. By comparison, table salt (NaCl) is nearly 10 times more toxic. A 24-hr. human patch test indicated that undiluted Biodiesel produced very mild irritation. The irritation was less than the result produced by a 4 percent soap and water solution.
A 96-hr. lethal concentration for bluegill of Biodiesel grade methyl esters was greater than 1.000 mg/l. Lethal concentrations at these levels are generally deemed "insignificant" according to NIOSH (National Institute for Occupational Safety and Health) guidelines in its *Registry of the Toxic Effects of Chemical Substances.*[62]

2.56 Quality standards

In the early days of developing Biodiesel, it quickly became obvious that it would be of utmost importance to win the confidence of diesel engine producers (see 2.57) as stakeholders in this project. A working group was set up within the Austrian Standardisation Institute and the first Biodiesel fuel standard was issued already in 1991 as ON C 1190[63] for RME. This was the basis for numerous diesel engine warranties issued by all key tractor companies.[64]
This first standard was followed by the already sophisticated ON C 1191[65] for FAME or Fatty-acid-methyl-ester in July 1997. This was as a successful attempt to define the quality of a fuel not by its feedstock source but by what was filled into the tank. Later in 1997 the DIN E 51606[66] (as well for FAME) was published in Germany, while other national standards were established in the CSSR, France, Italy, Sweden and the USA. This was the necessary basis to build customer confidence, to obtain warranties from many diesel engine manufacturers and injection pump producers, to provide transport reliability and to create a positive image in the market place.[67]
The most recent development is the completion of a CEN-draft standard for Biodiesel with validity all over Europe. This work is still in progress and a final CEN-standard will be published by mid 2003 under the new code of EN 14214.[68]

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[62] LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 81, via e-mail to the author

[63] OENORM C 1190 : ON C 1190, Kraftstoffe - Dieselmotoren; Rapsmethylester; vorläufige Anforderungen. (rapeseed methyl ester - Requirements), edited by the Austrian Standards Institute, Vienna 1.1.1995

[64] KÖRBITZ, W.: New Trends in Developing Biodiesel, presentation at Asia Bio-Fuels, Singapore April 2002, via e-mail to the author

[65] OENORM C 1191 : Kraftstoffe - Dieselmotoren; Fettsäuremethylester; Anforderungen. (Fatty acid methyl ester - Requirements), edited by the Austrian Standards Institute, Vienna 1.7.1997

[66] DIN E 51606 : Fat and oil derivatives, standard for fatty-acid-mehtyl-ester (FAME), edited by the German Institute for Standardization, Berlin 1997

[67] KÖRBITZ, W.: New Trends in Developing Biodiesel, presentation at Asia Bio-Fuels, Singapore, April 2002, via e-mail to the author

[68] EN 14214, Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods, edited by the European Committee for Standardization and the national Standardization Institutes, to be published in November 2003

2.57 Engine warranties

Historically it was intended to produce Biodiesel in a kind of closed-loop from agricultural products for the agricultural machinery, mainly tractors. Hence the first warranties issued were given for tractors or combines only (e.g. Same, Steyr, John Deere, Massey-Ferguson, Lindner, Mercedes-Benz, etc.).[69]
With the development of more sophisticated marketing strategies, the focus was also extended to other diesel-driven vehicles such as busses in the public transport fleets of cities, taxi fleets, the marine sector and private cars.[70]
A further extension was achieved by obtaining warranties for the new generation of modern, high-pressure fuel injection systems such as the common-rail systems (e.g. Mercedes-Benz, Peugeot, Volkswagen).[71] A short summary of the existing diesel vehicle warranties for Biodiesel operation is provided in chapter 5.33.

2.6 Concerns/ barriers

As previously described, Biodiesel lowers emissions, raises the fuel's Cetane number and flashpoint, and has excellent lubricity. It also has the attractive advantage that it can be used directly in diesel engines without modifications. However, Biodiesel has some drawbacks as well.
Despite cost considerations there are other issues that consumers should be aware of. These include cold flow properties, stability, energy content, elevated NO_x levels and material compatibility. The issues not yet reviewed are discussed below.

2.61 Cold flow

At low temperatures, Biodiesel will gel or crystallize into a solid mass that cannot be filtered or pumped. The engine cannot run at these temperatures. This is not a new problem for diesel engine operators. Petroleum-based diesel fuel also gels but at temperatures that are lower than for Biodiesel.[72]
Tab. 10 shows data for the cold flow properties of Biodiesel and blends of Biodiesel with fossil diesel fuel.
The cloud point is the temperature at which crystals first start to form in the fuel and the pour point is the lowest temperature at which the fuel will still pour from a container. The cold filter plugging point (CFPP) is the lowest temperature at which a certain volume of fuel can be drawn through a metal screen filter. It usually correlates well with the lowest temperature that an engine can operate at.[73]

[69] ABI (Austrian Biofuels Institute): Statement on the situation of the Biodiesel sector, via e-mail to the author, 2002, p. 2
[70] KÖRBITZ, W.: New Trends in Developing Biodiesel, presentation at Asia Bio-Fuels, Singapore 2002, via e-mail to the author
[71] ABI (Austrian Biofuels Institute): Statement on the situation of the Biodiesel sector, via e-mail to the author, 2002, p. 2
[72] Internet: http://www.me.iastate.edu/biodiesel/Pages/biodiesel16.html [6.9.2003]
[73] Internet: http://www.me.iastate.edu/biodiesel/Pages/biodiesel9.html [6.9.2003]

	Cloud Point (oC)	Pour Point (oC)	CFPP (oC)
Soy Methyl Esters (soy)	0	-3,9	-5,6
Recycled frying oil Methyl Esters (RFO)	8,9	7,2	8,9
Low Sulfur Diesel Fuel (US standard #1)	-47,8	-56,7	< -34,4
with 2% Soy	-42,8	-51,1	< -34,4
with 5% Soy	-35,6	-48,3	< -34,4
with 2% RFO	-38,9	-51,1	< -34,4
with 5% RFO	-28,3	-51,1	-32,2

Tab. 10: Cold flow characteristics of Biodiesel blends

Source: Internet: http://www.me.iastate.edu/biodiesel/ according to Williams Laboratory Services

2.62 Fuel stability

A fuel is considered unstable when it undergoes chemical changes that produce undesirable consequences such as deposits, acidity or a bad smell. There are three different types of stability commonly described in technical literature: thermal stability, oxidative stability and storage stability. Vegetable oils are generally more susceptible to oxidative attack because they are less saturated, that is, they contain more carbon-carbon double bonds. The short chain acids can be volatile thus causing a foul smell and a lowering of the flashpoint. Polymerization can cause an increase in viscosity and the formation of insoluble sediments and varnish deposits. Highly saturated fuels, such as those made from tallow, are very resistant to oxidation and have high Cetane numbers. However, they tend to have poor cold flow properties, often starting to crystallize at temperatures as high as 10-15 degrees C. Unsaturated fuels, such as those made from soybean oil will generally stay liquid at temperatures down to 0 degree C.[74]

2.63 Fuel energy content

As can be seen in the Tab. 11 Biodiesel has a lower energy content (lower heating value) than fossil diesel fuel. On a weight basis, the energy level is 13% less. Since Biodiesel is more dense than fossil diesel fuel, the energy content is only 8% less.
Since diesel engines will inject equal volumes of fuel, most diesel engine operators see a power loss of about 8%. In some cases, the power loss may be even less than this. Biodiesel's higher viscosity can decrease the amount of fuel that leaks past the plungers in the diesel fuel injection pump.

[74] Internet: http://www.me.iastate.edu/biodiesel/Pages/bio22.html [4.1.2003]

Fuel	Density	Caloric value		Energy efficiency
	g / cm^3	MJ / kg	MJ / dm^3	%
Diesel	0,83	42,90	35,60	38,20
Biodiesel	0,88	37,20	32,90	40,70
Variation		**-13 %**	**-8%**	**+7%**

Tab. 11: Comparison of Diesel/Biodiesel energy content and energy efficiency

Source: ABI (Austrian Biofuels Institute): In response to the questionnaire sent by the author, Austria, Vienna 2003

2.64 Material compatibility

Biodiesel interacts differently with materials than diesel fuel. Some metals have a catalytic effect on the Biodiesel oxidation process. Contact with these materials should be avoided, particularly in long-term storage. Copper and copper-containing alloys such as brass and bronze should be avoided. Lead, tin, and zinc are also cited as having some incompatibility with Biodiesel.[75]
Blends of B20 or less do not seem to cause problems within a reasonable time period. With higher level blends, users should be aware of the elastomer materials that are used in their diesel engine fuel system. While most modern diesel engines use steel lines for the entire fuel distribution system, older engines and those repaired with non-OEM parts may contain incompatible materials. Older pumps may also contain elastomer diaphragms, seals and o-rings. These are usually made from viton but if they are made from nitrile or natural rubbers, they will deteriorate on contact with high levels of Biodiesel.[76]

2.7 History

At the Paris Exposition in 1900, Dr. Rudolf Diesel ran a prototype of his engine using groundnut oil.[77] In 1911 he was quoted as saying: "The diesel engine can be fed with vegetable oils and would help considerably in the development of agriculture of the countries which will use it".[78]
Initially, diesel engines were designed and developed to be dual-fuel engines. Indeed, it is believed that KHD Deutz engine manufacturers, Germany, warranted their original engines for operation with vegetable oils.[79] The practice of developing dual-

[75] TYSON, K. S.: Biodiesel Handling and Use Guidelines, in: NREL - National Renewable Energy Laboratory, Report No. TP-580-30004, Golden CO USA September 2001, Internet: http://www.nrel.gov/docs/fy01osti/30004.pdf [5.9.2003]
[76] Internet: http://www.me.iastate.edu/biodiesel/Pages/bio25.html [26.11.2002]
[77] BABFO (Britisch Association for Bio Fuels and Oils): The Fuel Story, Internet: http://www.biodiesel.co.uk/fuel_story.htm [7.9.2003]
[78] Internet: http://www.regional.org.au/au/gcirc/6/214.htm#P39_14008 [23.11.2002]
[79] HARWOOD, H.: Oleochemicals as a fuel; Mechanical and economic feasibility. Journal of the American Oil Chemists Society, Champaign Illinois, (1984) 2, p. 315 f

fuel engines continued; in 1937, a Belgian patent that described the use of ethyl esters of palm oil was filed.[80]
In the 1940s, an abundance of petroleum supplies at a low cost tipped the fuel supply balance in favour of fossil diesel fuel.[81]
Not much was done until the late 1970s and early 1980s, when concerns about high petroleum prices motivated extensive experimentation with fats and oils as alternative fuels.[82]
The early 1980s saw research programs in various countries world-wide (including Austria, South Africa and the USA),[83] and in 1985 (in Silberberg), Biodiesel fuel was finally produced commercially for the first time.[84]

[80] Internet: http://www.me.iastate.edu/biodiesel/ [29.11.2002]
[81] Internet: http://www.regional.org.au/au/gcirc/6/214.htm#P39_14008 [23.11.2002]
[82] Internet: http://www.me.iastate.edu/biodiesel/ [29.11.2002]
[83] ABI (Austrian Biofuels Institute): In response to the questionnaire sent by the author, Austria, Vienna 2003
[84] ABI (Austrian Biofuels Institute): World-wide Trends in Production and Marketing of Biodiesel; presented at the ALTENER – Seminar “New Markets for Biodiesel in Modern Common Rail Diesel Engines”, University for Technology in Graz, Graz 22 May 2000

3. METHODOLOGY

The vast majority of the country reports in chapter 4 of this thesis serve as a basis for a report by the Liquid Biofuels Task of IEA Bioenergy[85]. This report, an update of the 1997 "Report of the commercial production of Biodiesel world-wide" is due to be published in October 2003.
The author worked in close co-operation with Mr. Werner Körbitz of the Austrian Biofuels Institute (ABI), who was commissioned by Mr. Manfred Wörgetter of the Federal Institute of Agricultural Engineering (being the Task Country representative and Biodiesel subtask leader of the IEA Bioenergy Task) to publish the World Report in 1997 as well as in 2003.

The objective of the survey was to interview a maximum number of stakeholders involved in the Biodiesel sector world-wide.The survey upon which this thesis is partially based was conducted from July 2002 until February 2003. In total, nearly 330 participants provided their input in one way or another.

In order to reach producers, multipliers and stakeholders from around the world and make participation convenient, the survey was mainly conducted over the Internet. Background for the survey design was provided by (1) Alexander Krenn (Platypus Media design) who was responsible for the technical implementation of the database and (2) Werner Körbitz (ABI-Austrian Biofuels Institute) who surveyed this audience in 1997 with a questionnaire developped in co-operation with the "Jetzt"-team of the Sociology Department at the University of Vienna.

The empirical research for this study took a multi-faceted approach. The results from a range of research methods were merged to create a more solid and comprehensive representation than could be expected from the utilisation of just one method. Among these methods were an e-mail questionnaire, unstructured interviews by e-mail, web site content analysis as well as the creation of an online database of Biodiesel producers.

3.1 E-mail questionnaire

- Purpose: getting an overall picture of the Biodiesel industry in the country analyzed.
- Target population: multipliers, stakeholders
- Survey period: 1/7/02 through 10/2/03
- Survey methods: e-mail-based questionnaire
- Sample size: 280 valid responses from 1.180 recipients
- Language: English, German, Spanish, Portuguese, French

[85] Under the leadership of the US Department of Energy the Liquid Biofuels Task conducts information exchange and analyses activities to aid governments, policy makers, stake holders, and program managers to identify and eliminate non-technical barriers to liquid biofuels deployment and ensure effective interaction with related groups.

The methods used in searching for organisations, companies, governmental bodies and individuals related to Biodiesel production followed a standard pattern of Internet browsing. A range of search engines and directories (including Google, Yahoo, OpenDirectory) were utilised, and links that appeared to lead to organisations that matched the study criteria were investigated. Various search terms were employed (such as "Biodiesel", "(liquid) biofuels", "renewable energy"). A large proportion of the organisations included were not found directly through search engines, but through links in other pages or specialized directories (governmental directories world-wide, environmental business directories). In other words, a form of snowball sampling was used.

Several informal e-mail interviews were also conducted with the same purpose as the e-mail questionnaire, but focussing on specific topics that had not been tackled before. These varied considerably in length and in format. Some consisted of interviews in which e-mail responses would be followed up by further questions involving up to four e-mails with questions sent by the researcher. Others simply involved one or two questions emailed to an individual or organisation.

3.11 Questionnaire design

The survey contained 8 questions grouped according to their focus on general, juridical and business matters. The questions were directly entered in the body of the e-mail after the explanatory introduction. A copy of the e-mail is included in Appendix II.

3.12 Administration

In response, the participant would then answer the e-mail-question form and send it to world.report@biodiesel.at. An e-mail reminder was sent out to participants approximately 3 weeks after they were sent the e-mail questionnaire.

3.13 Survey analysis

The survey was set up in various loops according to the size and quality of the feedback. In a few countries (mainly those with an established Biodiesel industry and centralised Biodiesel producer-interest associations like France and the United States) the first contacts were so effective that further contacts were not needed and only one more loop tackling remaining questions had to be established. On the other hand, loop 1 had to be repeated up to five times (always addressing new potential information sources and reminding the most promising ones from the anterior loop) before getting a response.
Experience showed that approaching governmental bodies was more promising than contacting NGOs. This was due to the obligation of many public bodies to keep records of e-mail correspondence.
From the quality of the feedback it can be asserted that the answers became more

precise and valuable the more the person contacted was effectively involved in this sector.
Response data were then manually imported into a corresponding country data folder and structured according to the main chapters (i.e. introduction/history, legal framework, production/quality/marketing and summary/forecast).

3.14 Survey response rate

About 1.400 survey requests were emailed to individuals or organisations. 420 of these were returned with invalid email addresses, leaving 1.180 survey requests that were likely to have got through to the intended recipient.[86]
A total of approximately 280 survey responses were received, meaning that the overall response rate for this survey was 23,7%. This response rate is slightly below the standard response rate in comparison with mail-out surveys with one follow up.[87]

3.15 Target group

As a preliminary information source, 68 national offices of the Austrian Federal Chamber of Commerce were contacted. Although this type of information is offered to members of the organisation only, 32 offices provided the author with the basic information of whether there are Biodiesel activities in the country concerned or not.

Generally the following sectors in each country were contacted:

- Government bodies: Ministries of energy, transport, environment, agriculture, science & technology...
- Agencies, semi-governmental bodies: Agency for energy efficiency, renewable energy, national energy agencies, rural development agencies
- National NGOs dealing with renewable energy, biomass and sustainable development matters in the respective country
- R&D institutions: Universities, research institutes
- Interest groups: Biodiesel producers´ associations, farmers´ interest groups, oil-processor- and oil-producer-interest associations

Stakeholders and potential multipliers were contacted in the following countries:

[86] These figures are estimations, the „snowball-sampling"- method as well as technological limitations were responsible for a fragmentary chronicle of all e-mails sent and received.
[87] DE VAUS, D.: Surveys In Social Research; Sydney 1999, chapter 7

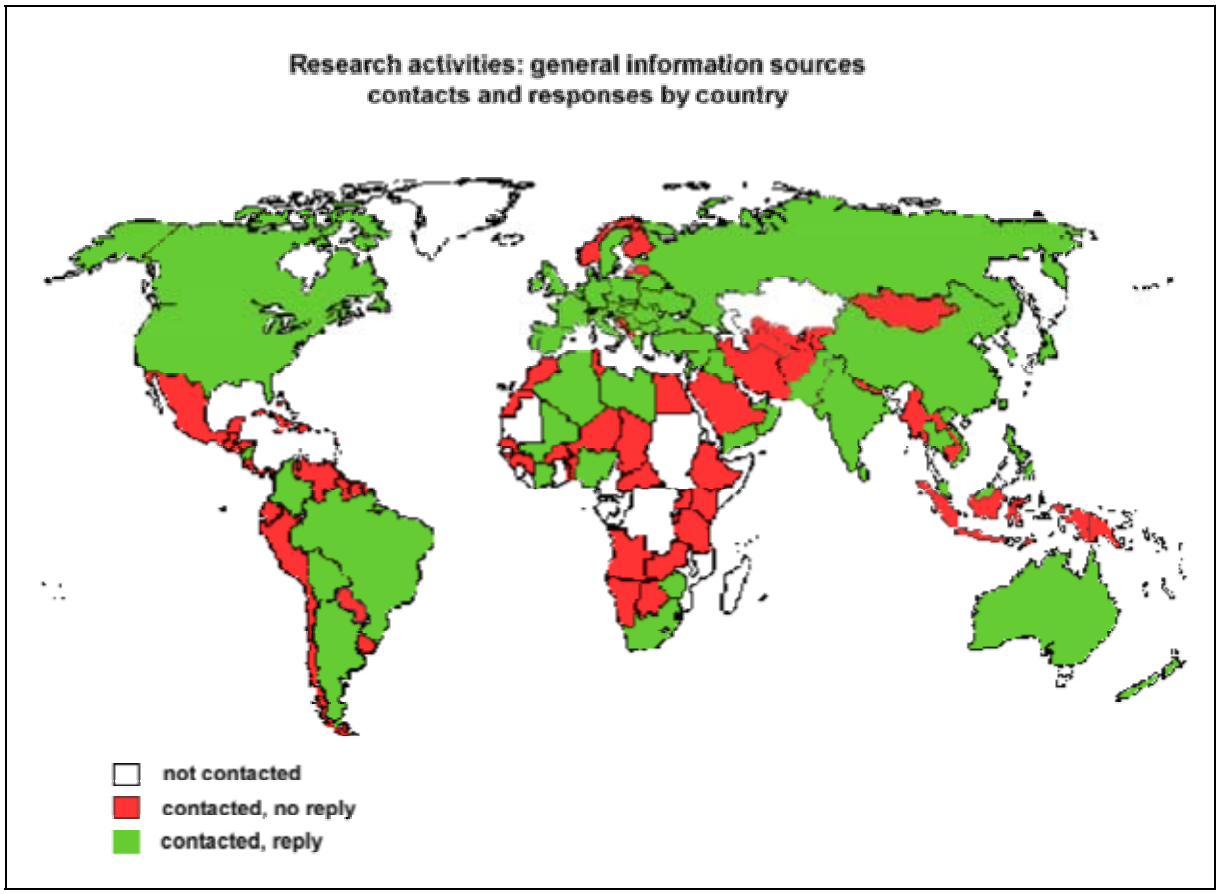

Fig. 16: World-wide request for information and response, by country

Source: Quantitative analysis of incoming e-mails, by the author, Vienna 2003

3.2 Online database

- Purpose: gaining insight into the technological, legal and business surroundings of Biodiesel producers.
- Target population: Biodiesel producers
- Survey period: 15/9/02 through 15/01/03
- Survey methods: online questionnaire linked to database
- Sample size: 43 valid responses from 130 recipients
- Languages: English, Spanish

3.21 Questionnaire design

The creation of the questionnaire by the author took place between July 15th , 2002 and September 15th 2002. A final test run was made to check the comprehension, the structure and the operability of the questionnaire.

The questionnaire was eight pages long, contained 38 question topics (one topic sometimes included various questions), and was available in English and in Spanish. Most responses were entered in check boxes. Several questions allowed "other" with text data as an option. All responses were optional except for identification (name of the company, address, name of individual, professional position). The main page stated the regulations of data privacy[88], further information about the report as well as a link to the pdf-version of the questionnaire.
The questionnaire was kept short so as to ensure minimum inconvenience for participants. It took about 15-25 minutes to complete. The word version of the questionnaire was designed first, then converted to a pdf-file; the Internet (www) version was adapted from this.
The www version permitted a greater number of selections for closed-answer questions than would be possible in a paper questionnaire, as some selections were made from drop-boxes which hid unselected options. For example, 80 options were given for the country the organisation was based in, but the question took up very little space on the questionnaire.
A copy of the word version is included in Appendix I.

3.22 Administration

The questionnaire was administered entirely in electronic format. Participants could choose whether to respond online by using the www form or offline by filling out the pdf.-version of the questionnaire. Requests to take part were e-mailed to participants. This request included brief instructions on the research topic, focus and aim of the survey as well as the URL for the project website. Again the option to receive valuable research publications related to Biodiesel production was included as a gesture of our appreciation for their participation.
To respond to the survey using the www form, participants used the URL supplied in the request e-mail (http://www.biodiesel.at/research for the English version and http://www.biodiesel.at/research_es for the Spanish version) to direct their browsers to the questionnaire webpage. They then filled out the survey and pressed the "submit" button at the bottom of each page. This instantly saved the results to the connected database thus eliminating the need for data entry.
Administration of the questionnaire online offered several advantages over a paper-and-pencil administration. First, responses automatically went into a database that was available for analysis at all times. This allowed for monitoring of survey progress and eliminated the time and cost associated with data entry.
All producers that had not yet filled out the questionnaire were reminded after one month and then again after 5 weeks. The second reminder contained the word-version (.doc) of the questionnaire as a possible alternative in case of uncertainty regarding the user handling of the Internet form.

[88] Wording: “In order to protect you from data misuse, we are neither publishing nor passing on any contact information (address, e-mail, telephone, fax), unless explicitly desired otherwise by you and confirmed in writing to us. By filling out this questionnaire, you accept that the information provided by you is used for the report "Review on Commercial Production of Biodiesel World-wide" only.”

3.23 Survey analysis

Survey data were imported (in the case of WWW responses) and entered (in the case of e-mail responses) into a computer database for analysis. The survey was analysed using qualitative methods. These qualitative results were used to provide examples and give explanations for trends apparent in the quantitative data; They also drew attention to important aspects of this topic, aspects which may not have been considered otherwise.
Concerning the statistical analysis of the quantitative results, the number of responses was not high enough to create meaningful cross-tabulations or to utilise other more advanced analysis approaches.

3.24 Survey response rate

In total, 150 potential companies were addressed. 130 of these were later clearly identified as Biodiesel producers. Response was provided from 43 of them (39 online database, 1 faxed questionnaire, 3 questionnaires as word-versions), which amounts to a 33 % reply-quota.

This quota means that there are limits to the generalisation of the results. Other factors, such as the possibility that groups with certain characteristics may have been more likely to respond than others, also affect the generalisation.

3.25 Target group

Biodiesel producers in the following countries were contacted:

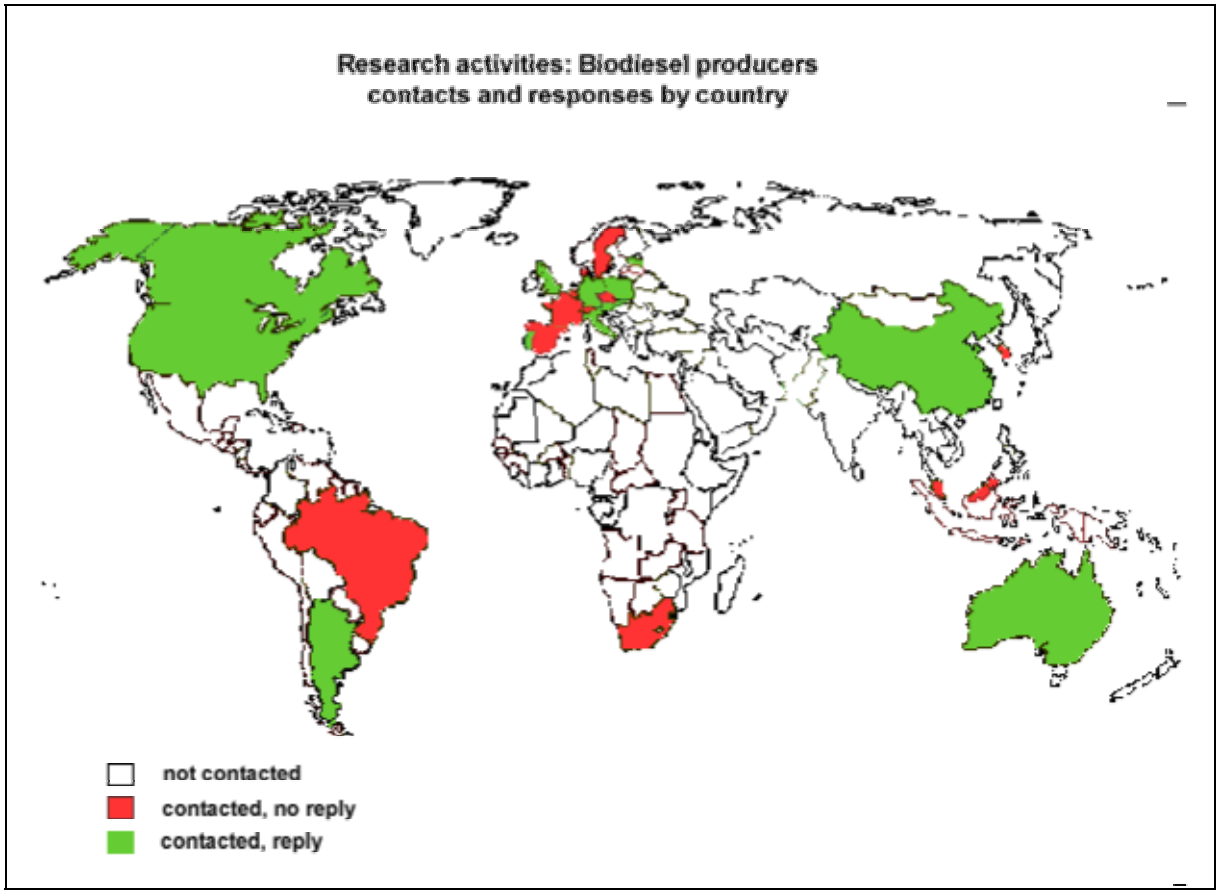

Fig. 17: World-wide requests for information and response, by country

Source: Derived from internal database, by the author, Vienna 2003

3.3 Webdirectory

- Purpose: faster information access, network of global stakeholders
- Target population: All persons/bodies contacted
- Survey period: 1/7/02 through 22/2/03
- Survey methods: Internet research, compilation of all producers and stakeholders contacted
- Sample size: 1.147

All persons and institutions contacted that had a website were included in a webdirectory that was built simultaneously to the data gathering process. The webaddresses were then sorted by country and divided into 3 groups: governmental bodies, producers and others. This gave us access to enhanced literature and allowed faster information research.
The final „webdirectory of Biodiesel stakeholders world-wide“ consists of 1.147 webaddresses.

4. COUNTRY REPORTS

4.1 Asia & Australasia

4.11 Australia

4.111 Introduction / history

Today Biodiesel production is still in its infancy, but the production of liquid biofuels is receiving increased attention.[89]
Two main facts can be held responsible for this trend:

- Petroleum imports account for more than half of the total usage and make up the single largest component of the trade deficit.[90]
- Motorised transport turned out to be the most significant contributor to urban ambient air pollution in Australia; therefore, the reduction of emissions from road transport is a key element of air quality management strategies established by commonwealth, state and territory governments.[91]

The federal government has recently commissioned a "barriers to entry study" for Biodiesel and ethanol. The interim results were due to be released at the end of November 2002; the study and its recommendations are expected to be released by the end of 2003.[92]

4.112 Framework / legislation

4.1121 Supportive taxation measures

At the moment, Biodiesel enjoys an excise exempt status as it is not listed in the fuel excise laws. There are several approaches that are being reviewed for Biodiesel. These include tradeable certificates and the promised production grant.[93]

[89] Internet: http://www.energycentral.com.au/Energy/default.asp?MenuID=100&RefMenuID=94&Category=Liquid+Fuels [10.9.2002]
[90] Internet: http://www.biodiesel.org.au/ [11.9.2002]
[91] MACKIE, K.: Improving Air Quality, National Fuel Quality Standards for Australia, presented during the Energy Federation Conference: "'The New Zealand Road to Cleaner Air" Internet: http://www.worldenergy.org/wec-geis/publications/default/other_papers/NZConf/2_09.asp [10.10.2002]
[92] SCHUCK, S., (Bioenergy Australia): In response to the e-mail questionnaire sent by the author, Australia, Killara NSW 2002
[93] SCHUCK, S., (Bioenergy Australia): In response to the e-mail questionnaire sent by the author, Australia, Killara NSW 2002

4.1122 Regulations for market penetration

Federal Environment Minister David Kemp and Agriculture Minister Warren Truss announced a $5 million, two-year study to address market barriers to the increased use of biofuels (mainly ethanol and Biodiesel) in transport. The study will develop a broad strategy to increase biofuels production to 350 million litres per annum by 2010. The study will examine options for addressing market access difficulties including an assessment of the respective merits of nationally mandated minimum biofuel standards for transport fuels, and voluntary arrangements. Existing biofuel manufacturers report that, even with an excise exemption, they are having difficulty accessing markets.[94]

4.1123 Other motives and regulation measures

Recently there have been regulatory disputes: Trade Measurement Regulation bodies at the state and federal level have been refusing to approve the use of "diesel" dispenser pumps (bowsers) for Biodiesel.[95]

[94] BIOENERGY AUSTRALIA: Bioenergy newsletter September 2002, Internet: http://www.users.bigpond.net.au/bioenergyaustralia/ [2.10.2002]

[95] SAFF (South Australian Farmers Fuels): In response to the e-mail questionnaire sent by the author, Australia, Pooraka 2002

4.1124 Stakeholders

Name	Web-address	Logo	Description
Bioenergy Australia	http://www.users.bigpond.net.au/bioenergyaustralia/		Alliance of some 49 organisations fostering biomass for energy and products , established in 1997
Australian Biofuels Association	http://www.australianbiofuelsassociation.org.au/		Promoting mainly ethanol
EA-Environment Australia	http://www.ea.gov.au/		Plans to develop standards for Biodiesel under the Fuel Quality Standards Act 2000
Australian Renewable Fuels PTY LTD	http://www.ausrf.com.au		Biodiesel producer
Australian Biodiesel Consultancy	http://www.biodiesel.net.au/		Producer
Biodiesel Association	http://www.biodiesel.org.au/		
SAFF	http://www.farmersfuel.com.au		First retailer offering Biodiesel at its headquarter

Tab. 12: Biodiesel industry stakeholders in Australia

Source: SCHUCK, S., (Bioenergy Australia): In response to the e-mail questionnaire sent by the author, Australia, Killara NSW 2002, p. 1;
Bioenergy Australia: Bioenergy newsletter September 2002,
Internet: http://www.users.bigpond.net.au/bioenergyaustralia/ [2.10.2002];
Websites as denominated in the table

4.113 Production / quality / marketing

4.1131 Plants

Actually there are three production plants nation-wide with two of them being commercial ones. Total capacity amounts to 48.000 t/a. Six major potential producers have been identified. They plan a production capacity of greater than 40.000 t/a with another 10 potential smaller/niche market producers.[96] These include:

- Clearwater Industrial Services /Western Sydney: Conversion of liquid waste (oils, fats, tallows) to produce Biodiesel fuel; applying for SEDA (Sustainable Energy Development Authority) grant of 650.000 AUD (= 361.000 €).[97]
- Australian Biodiesel Consultancy/ Berkeley Vale: Project to more than double production of Biodiesel from recycled vegetable oils and tallow; applying for SEDA (Sustainable Energy Development Authority) grant of 205.000 AUD (=114.000 €).[98]
- Australian Renewable Fuels / Western Australia: planning to produce Biodiesel from tallow or animal fats using Austrian technology. It will initially produce 40 million litres of Biodiesel a year processing animal fats and recycled cooking fats.[99]

4.1132 Feedstock

Current production originates from recycled cooking oil (that may otherwise be exported to Asia for soap production or be reused in stockfeed), tallow and animal fats.[100]
Soybeans are grown predominantly in the wheat belts of Queensland NSW, to a lesser extent in Victoria and could –depending on soy prices- represent some additional feedstock.[101]

4.1133 Quality standards / quality management

Currently there is no Biodiesel standard in Australia. Actual modus operandi: Each new batch is tested at the production plant against variables and monitored for storage stability (as part of a state government-funded and operated Biodiesel Verification Trial).[102]

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96 SCHUCK, S., (Bioenergy Australia): In response to the e-mail questionnaire sent by the author, Australia, Killara NSW 2002

97 BIOENERGY AUSTRALIA: Bioenergy newsletter September 2002, Internet: http://www.users.bigpond.net.au/bioenergyaustralia/ [2.10.2002]

98 BIOENERGY AUSTRALIA: Bioenergy newsletter September 2002, Internet: http://www.users.bigpond.net.au/bioenergyaustralia/ [2.10.2002]

99 Internet: http://www.energycentral.com.au/Energy/default.asp?MenuID=100&RefMenuID=94&Category=Liquid+Fuels [3.10.2002]

100 Internet: http://www.greenhouse.gov.au/transport/comparison/pubs/1ch4.pdf p.1 [1.2.2003]

101 Internet: http://www.greenhouse.gov.au/transport/comparison/pubs/1ch4.pdf p.1 [1.2.2003]

102 SAFF (South Australian Farmers Fuels): In response to the e-mail questionnaire sent by the author, Australia, Pooraka 2002

The future agenda includes consideration of standards for Biodiesel, Diesohol and Compressed Natural Gas (CNG). The Australian Greenhouse Office has commissioned a study of the life-cycle emissions and environmental benefits of these fuels in order to obtain information to assess their eligibility under the Diesel and Alternative Fuels Grants Scheme. This work will provide a starting point for development of quality standards for these fuels.[103]

4.1134 Marketing strategy / distribution system

Biodiesel is not yet available for general supply through out Australia. Very limited trials are being carried out. There are three service stations that have been selling Biodiesel.[104]
Currently Biodiesel has a pump price that isapproximately the same as fossil diesel AUD 0,90/litre (=0,5 €).[105]
SAFF (South Australian Farmers Fuels) is retailing Biodiesel B100 at its head office site in Pooraka, South Australia, and will retail B20 blend after the necessary excise lift has been implemented.[106]

4.114 Summary / forecast

Estimations for this year´s Biodiesel production capacity are at about 40.000 t/a, but further development of Australia's Biodiesel industry is highly dependent on the outcome of the federal "barriers to entry" study.[107]
The federal government has a target of 350 million litres of bio fuels (ethanol and Biodiesel) by 2012; if the current 6 major potential producers implement their plans, the total production will reach 350 million litres by 2006.[108]
Also, the development of an Australian Biodiesel fuel standard has just begun. Engine manufacturers have provided statements of support and are starting to look at involvement in trials. Until a standard has been implemented, all Biodiesel should at least meet specifications outlined in the DIN 51606 and/or ASTM D6751 to guarantee trouble-free use.[109]

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[103] MACKIE, K.: Improving Air Quality, National Fuel Quality Standards for Australia, presented during the Energy Federation Conference: "'The New Zealand Road to Cleaner Air" Internet: http://www.worldenergy.org/wec-geis/publications/default/other_papers/NZConf/2_09.asp [10.10.2002]
[104] SCHUCK, S., (Bioenergy Australia): In response to the e-mail questionnaire sent by the author, Australia, Killara NSW 2002
[105] FORSTER, T., The Australian Institute of Energy: In response to the e-mail questionnaire sent by the author, Australia, Toukley 2002, p. 1
[106] SAFF (South Australian Farmers Fuels): In response to the e-mail questionnaire sent by the author, Australia, Pooraka 2002, p. 1
[107] SCHUCK, S., (Bioenergy Australia): In response to the e-mail questionnaire sent by the author, Australia, Killara NSW 2002
[108] SCHUCK, S., (Bioenergy Australia): In response to the e-mail questionnaire sent by the author, Australia, Killara NSW 2002
[109] SAFF (South Australian Farmers Fuels): In response to the e-mail questionnaire sent by the author, Australia, Pooraka 2002, p. 1

4.12 People's Republic of China (including Hong Kong)

4.121 Introduction / history

The transportation sector was left out of China's economic plans for many years, and the resulting lack of infrastructure is a major bottleneck for the country's energy sector and overall economy.[110] Nevertheless, China is one of the biggest diesel oil consumers world-wide. About 60-70 million tons of diesel oil are used every year, with approximately one third of it being imported to balance the market.[111]

China´s government emphasized its support of biofuels sometime ago, but it seems that ethanol development is much faster than Biodiesel.[112]

4.122 Framework / legislation

4.1221 Supportive taxation measures

There are no special regulations or tax exemptions for Biodiesel, neither in mainland China nor in Hong Kong, but they may be implemented if usage increases.[113]

[110] ENERGY INFORMATION ADMINISTRATION: International Energy Outlook 2002, Washington 2002; Internet: http://www.eia.doe.gov/oiaf/ieo/ [4.10.2002], p. 152; Internet: http://www.eia.doe.gov/oiaf/ieo/ [4.10.2002]

[111] Internet: http://www.gsfoc.com/cooperation [15.1.2003]

[112] LEUNG, D. (Dept. of Mechanical Engineering, University of Hong Kong): In response to the e-mail questionnaire sent by the author, Hong Kong 2002, p. 1

[113] LEUNG, D. (Dept. of Mechanical Engineering, University of Hong Kong): In response to the e-mail questionnaire sent by the author, Hong Kong 2002, p. 1

4.1222 Stakeholders

Name	Web-address	Logo	Description
Gushan Vegetable Fat Chemistry Co. LTD	http://www.gsfoc.com	古杉油脂化学有限公司	First commercial Biodiesel producer; 10.000 t/a since 6/2001, plans to extend capacity to 100.00t/a by then end of 2003
Dunwellgroup	http://www.dunwellgroup.com/		Since 8/2001, 3.700 t/a capacity
CNPC ZHZH Petroleum Co., Ltd.			10/2002 with the process technology of Gushan, plans to extend capacity to 50.000 t/a by the end of 2004
State development planning commission	http://www.sdpc.gov.cn/		
The University of Hong Kong	http://hkumea.hku.hk/		Main research, feasibility study concerning the introduction of Biodiesel in Hong Kong

Tab. 13: Biodiesel industry stakeholders in China

Source: LEUNG, D. (Dept. of Mechanical Engineering, University of Hong Kong): In response to the e-mail questionnaire sent by the author, Hong Kong 2002

4.123 Production / quality / marketing

4.1231 Plants

At least four companies are already producing Biodiesel in China, including a pharmaceutical company, a vegetable fat chemistry company and a lubricating oil company, with the biggest production unit accounting for 10.000 t/a.[114]

Projected:
One company plans to expand its production capacity to 100.000 t/a as mentioned in its brochure.[115]

4.1232 Feedstock

Currently, rapeseed oil, cottonseed oil and recycled frying oils are used for Biodiesel production.[116]

[114] LEUNG, D. (Dept. of Mechanical Engineering, University of Hong Kong): In response to the e-mail questionnaire sent by the author, Hong Kong 2002, p. 2

[115] LEUNG, D. (Dept. of Mechanical Engineering, University of Hong Kong): In response to the e-mail questionnaire sent by the author, Hong Kong 2002, p. 3

[116] Gushan Co. LTD, Dunwellgroup, CNPC ZHZH Petroleum Co., Ltd. : Producers technical, legal and business frame conditions, via database entry to the author, Vienna 2002

4.1233 Quality standards / quality management

All existing producers have their product checked according to the German DIN 51606 FAME[117] standard.[118]

4.1234 Marketing strategy / distribution system

China's vehicle stock is dominated by heavy commercial vehicles, but in forecasts passenger cars are expected to be the fastest growing component.[119]
Currently, Biodiesel is predominantly exported to Hong Kong; the users are fleet operators and a limited amount of private light vehicles.[120]

4.124 Summary / forecast

The Hong Kong government has commissioned the University of Hong Kong to conduct a feasibility study of Biodiesel being used as automotive fuel in Hong Kong. The report has recently been submitted to the government for consideration. It is expected that price competitiveness will be the most decisive factor concerning the decision for promoting/abandoning this fuel in Hong Kong and China.[121]

The potential markets are expected to grow rapidly. Vehicle ownership rate in China is at about 8,5 vehicles per 1.000 persons, the level the U.S was at in 1912,[122] and the number of vehicles per thousand people in China is projected to have grown sixfold by 2020 (52 vehicles per 1.000 persons).[123]

Corresponding to these figures, transportation energy demand in China is projected to grow by 6,4 percent per year from 1999 to 2020, increasing its share of world energy use for transportation from 4,1 percent in 1999 to 9,1 percent in 2020.

This implies that China is expected to pass Japan by 2005 and become the world's second largest consumer of transportation fuels.[124]

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117 DIN E 51606 : Fat and oil derivatives, standard for fatty-acid-mehtyl-ester (FAME), edited by the German Institute for Standardization, Berlin 1997

118 Gushan Co. LTD, Dunwellgroup, CNPC ZHZH Petroleum Co., Ltd. : Producers technical, legal and business frame conditions, via database entry to the author, Vienna 2002

119 ENERGY INFORMATION ADMINISTRATION: International Energy Outlook 2002, Washington 2002, p. 152; Internet: http://www.eia.doe.gov/oiaf/ieo/ [4.10.2002]

120 LEUNG, D. (Dept. of Mechanical Engineering, University of Hong Kong): In response to the e-mail questionnaire sent by the author, Hong Kong 2002, p. 2

121 LEUNG, D. (Dept. of Mechanical Engineering, University of Hong Kong): In response to the e-mail questionnaire sent by the author, Hong Kong 2002, p. 2

122 BIRKY, A., GREENE, D., GROSS, T.: Future U.S Highway Energy Use: A Fifty Year Perspective, Office of Transportation Technologies, U.S. Department of Energy, Washington 2001, p. 37

123 ENERGY INFORMATION ADMINISTRATION: International Energy Outlook 2002, Washington 2002, p. 153; Internet: http://www.eia.doe.gov/oiaf/ieo/ [4.10.2002]

124 ENERGY INFORMATION ADMINISTRATION: International Energy Outlook 2002, Washington 2002, p. 153; Internet: http://www.eia.doe.gov/oiaf/ieo/ [4.10.2002]

4.2 Europe

4.21 The European Union

4.211 Introduction / history

In Europe, consumer interest in passenger cars with diesel engines strongly increased after the oil shortages of 1973 and 1979. The industry in Germany, France and Italy developed energy-saving, highly efficient engines.[125] The first research activities regarding the development of alternative and renewable fuels were started.[126]

Commercially motivated Biodiesel-initiatives in Europe could be observed as early as 1988 predominantly in Austria and also in France, where the first industrial scale Biodiesel production plants went into operation in 1990/1991.[127]

In 1992, reform of the Common Agricultural Policy addressed European agricultural surpluses by idling some land used for food production through a set-aside policy. This policy stimulated the use of set-aside land for non-food purposes.[128]

Low oil prices in the second half of the 90s have resulted in reduced interest of industry and politics in liquid biofuels. In 1998, the very disappointing contribution of 452.000 t coming from biofuels reflects the situation that specific policies had been adopted in four member states only: France contributed 58%, Germany 21%, Italy 18% and Austria 3%.[129]
In June of the same year, as a consequence of the 1997 Kyoto Conference on Climate Change, the EU-member states decided on a reduction of 8,1 % on the basis of 1990 emissions for 2012, a goal which can only be realised with an important share of by using a considerable amount of renewable energy sources including liquid biofuels.[130]

This urgent need for practical action to address increasing CO_2 emissions from the transport sector resulted in a proposal for an EC Directive promoting the use of alternative transport fuels derived from biomass and reducing rates of excise duty on such fuels.[131]

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[125] WÖRGETTER, M., RATHBAUER, J. LASSELSBERGER, L., DISSEMOND, H., KOPETZ, H., PLANK, J., RAKOS, C.: Bioenergy in Austria: Potential, Strategies, Success Stories, Proceedings of the 10th Biennial Bioenergy Conference "Bioenergy 2002", Boise Idaho 2002, Internet: http://www.blt.bmlf.gv.at/vero/artikel/artik009/austria.pdf

[126] Internet: http://www.eva.wsr.ac.at/projekte/ren-in-a08.htm [10.9.2002]

[127] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 4

[128] Internet: http://www.greenfuels.org/bioworld.html [11.10.2002]

[129] EVA (Austrian Energy Agency): Exploitation of Biomass, papers from the contractors meeting to enhance the exchange of information and experience, Vienna 2000, Internet: http://www.eva.wsr.ac.at/publ/pdf/alt99.pdf [23.9.2002]

[130] SCHARMER, K., GET- Gesellschaft für Entwicklungstechnologie: Alternative Fuels from Renewable Resources, Jülich 1999, p. 5, Internet: http://www.biodiesel.org/resources/reportsdatabase/reports/gen/19990101_gen-189.pdf [14.9.2002]

[131] EUROPEAN COMMISSION: Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions on Alternative Fuels for Road Transport and on a Set of Measures to Promote the Use of Biofuels, COM (2001) 547, Brussels 2001

In recent years, the production of Biodiesel has made a substantial leap in the European Union. From 1996 to 2002, the Biodiesel production capacity grew fourfold to a total of 2 million tons.[132]

4.212 Framework / legislation

At the moment there is no community legislation for energy products except for mineral oils and for taxes other than excise duty and VAT.[133]

4.2121 Supportive taxation measures

There are plenty of different regulations regarding tax relief and other financial incentives in favour of liquid biofuels in Europe:

Country	Regulation
Austria	In July 1999 an amendment of the Austrian tax law was published. Beginning with January 1, 2000 the utilisation of fuels from renewable raw materials is free of mineral oil taxes: - the Austrian Law on Tax Reform 2000 exempts the use of pure Biodiesel and the blending of it, if it is used as sole (bio-)fuel - if up to 2% biofuel is blended with diesel fuel (Biodiesel) Blends > 5% (in gasoline) or >2% (in diesel fuel) are taxed in the full amount
Belgium	Tax relief (100%) adopted for experimental projects using plants with a capacity under 5.000 t/a, from 1994 to 1996
Finland	Tax incentive for reformulated diesel fuel (0,025 €/l) and for reformulated gasoline (0,008 €/l)
France	Tax incentive adopted for VOME mixed with diesel (0,35 €/l) and for bioethanol (0,50 €/l) or ETBE mixed with gasoline (0,23 €/l) within alloted quota, 320.000 t/a for Biodiesel
Germany	No excise tax for Biodiesel substituting standard fuels, either unblended or blended with fossil diesel in the vehicle tank
Greece	No tax relief and no financial incentives
Ireland	No tax relief and no financial incentives
Italy	Biodiesel was sold in an exemption regime within an annual contingent of 125.000 t until 2001. The financial Law 2001 (L.388/2000) concerning a three-year programme raised this annual contingent to 300.000 t to promote the Biodiesel technical development
Portugal	Tax relief (100%) adopted for biofuels in the scope of pilot projects, since February 2001
Spain	Tax relief on methyl ester used in experimental project and no financial incentives
The Netherlands	No financial incentives, but tax relief on bioethanol is requested

Tab. 14: Tax regulations and financial incentive programs in European Countries

Source: Internet: http://www.ademe.fr/anglais/webaltener/htdocs/financial.htm [15.9.2003]

[132] BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 2

[133] Internet: http://www.ademe.fr/anglais/webaltener/htdocs/financial.htm [15.9.2003]

In 1994, the first attempts to harmonize these regulations on a European basis were undertaken:

Detaxation scheme (1994):
A first draft for a European Directive with the objective to support the development of biofuels (Bioethanol and Biodiesel) in Europe that suggested a unitary detaxation scheme for both biofuels was proposed in 1994. The initiative was accepted by the European Parliament, but it did not obtain the required unanimous agreement in the European Council.[134]

New Directive Proposals for obligatory use and detaxation of liquid biofuels:
In 2001, the „Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions, on Alternative Fuels for Transportation and on a Set of Measures to Promote the Use of Biofuels" - COM (2001) 547 - was published.
This assessment of the transport sector analyzed the sector´s impact on issues such as environment and energy supply security. Subsequently DG TREN (General Directorate: Transport and Energy) published two commission proposals for a council directive:

- The first on "the Promotion and the Use of Biofuels" and
- the second on "an Amendment to Directive 92/81/EEC with Regard to the Possibility of Applying a Reduced Rate of Excise Duty on Certain Mineral Oils Containing Biofuels and on Biofuels."[135]

On May 17th 2003, the "European Directive for the Promotion of the Use of Biofuels" was published, which is setting goals for reaching market shares of biofuels sold in each member state and is asking for 2 % market share by 2005 and 5,75 % by 2010.
The initial plan to introduce a mandatory blend was dropped. Every country would be free to choose its way to comply with the market shares stated. An additional chapter was added dealing with countries having considerable problems achieving these goals. Upon request, the fulfilment of the shares quoted may be postponed by 2 years.[136]

The second is amending an existing Directive, which permits detaxation measures, but limited for biofuels produced in pilot plants only. As many member countries have already established commercial sized production plants, the status of pilot plant production has become outdated. The directive proposal permits detaxation of up to 50 % which, in the case of Germany and Austria, is not acceptable, as both countries are marketing with great success 100 % pure Biodiesel with 100 % detaxation.[137]

[134] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 38
[135] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 39
[136] UFOP (Union for the Promotion of Oilseed- and Protein plants): Statement regarding the proposed of the Commission regarding the New Directive Proposal for obligatory use and detaxation of liquid biofuels, via e-mail to the author, 2003
[137] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 38

4.2122 Other motives and regulation measures

- Kyoto-Protocol

There is a growing interest in Biodiesel on the part of the European Commission when it comes to meeting the commitments made in the Kyoto-Protocol in reducing greenhouse gas emissions. This was stated by the Commissioner for the Environment *Mrs. Margot Wallström*: "The EU Ministers have emphasised that they are committed to the Kyoto-Protocol and that they are ready to ratify it."[138] This statement was made on 12 June 2001 as an answer to the hesitations concerning the Kyoto-protocol as expressed by Mr. George W. Bush, President of the USA.

- White Paper on Renewable Energy (1998)

In 1998, the DG XVII (General Directorate for Energy) developed and published "Energy for the Future: Renewable Energy - White Paper for a Common Strategy and an Action Plan."[139]
The White Paper asks for increasing the share of renewable energy from 5,3 % in 1995 up to 12 % market share by the year 2010. The following results are expected: reduction of greenhouse gases by 400 mill t, slower exploitation of fossil resources, creation of additional 500.000 jobs, development of new technologies and related export market opportunities.
The target for biofuels is defined with 5 mill ton (crude oil equivalent) by the year 2003 and 18 mill ton by the year 2010.[140]

- Green Paper on Energy Supply Security (2000)

In November 2000, the DG TREN (General Directorate for Transport & Energy) published the Green Paper "Towards a European Strategy for the Security of Energy Supply" dealing with a key issue, namely to reinforce sustainable security of supply.[141]

- Blair House Agreement

This agreement (of GATT participants) fixes the limit of 1 million t of soymeal equivalents and a constant set aside rate for production of rape seed at set-aside areas for non-food purposes.
Through equal subsidies for oil seeds and grains starting with the year 2002, some

[138] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 39
[139] Communication from the Commission: Energy for the future, renewable sources of energy, White Paper for a Community Strategy and Action Plan COM(97)599 final (26/11/97), Brussels 1997, Internet: http://www.environment.fgov.be/Root/tasks/atmosphere/klim/pub/eu/com/97-599_en.htm [28.9.2003]
[140] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 38
[141] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 39

European farmer associations (e.g. Germany) hoped that the restrictions of the Blair House Agreement would be suspended for oil seeds, which was not the case until now.[142]

4.2123 Stakeholders

Name	Web-address	Logo	Description
EBB	http://www.ebb-eu.org/	EBB	Association of European BD producers, representation and promotion of R&D, studies, info dissemination
AEBIOM	http://www.ecop.ucl.ac.be/aebiom/	AEBIOM	European Biomass Association- group of national biomass associations with membership open to representatives of the European Union, Central and Eastern Europe
FEDIOL	http://www.fediol.be/	FEDIOL	Seed crushers´ and oil processors´ federation
DG-TREN	http://europa.eu.int/comm/dgs/energy_transport		The Directorate-General for Energy and Transport
DG-ENV	http://europa.eu.int/comm/dgs/environment/index_en.htm		The Directorate-General for Environment
ENR-network	http://www.enr-network.org		Association of European organisations having a responsibility for the planning, management or review of national research, development, demonstration or dissemination programmes in the fields of energy efficiency and renewable energy.
BioMatNet	http://www.nf-2000.org	BioMat	Results of RTD projects supported by the European Commission in the area of Biological Materials for Non-Food Products (Renewable Bioproducts)
EEA	http://www.eea.eu.int/		European Environment Agency
AGORES	http://www.agores.org/		The official EU website for renewable energy
EUBIONET	http://eubionet.vtt.fi/	Altener	European Bioenergy Networks, established 1995 by the European Commission

Tab. 15: Biodiesel industry stakeholders in the European Union

Source: KÖRBITZ, W., Austrian Biofuels Institute, 18.7.2003;
Websites as denominated in the table

[142] EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 29, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

4.213 Production / quality / marketing

4.2131 Plants

Since 1992 rape seed and sunflower Biodiesel production has highly increased. The estimations for the total European production in 2001 are about 780.000 t, representing 14 times the production levels of 1992. FAME was mainly produced in Germany, France, Italy and Austria. In 2001, they produced respectively 46 %, 40 %, 10 % and 4 %.[143]

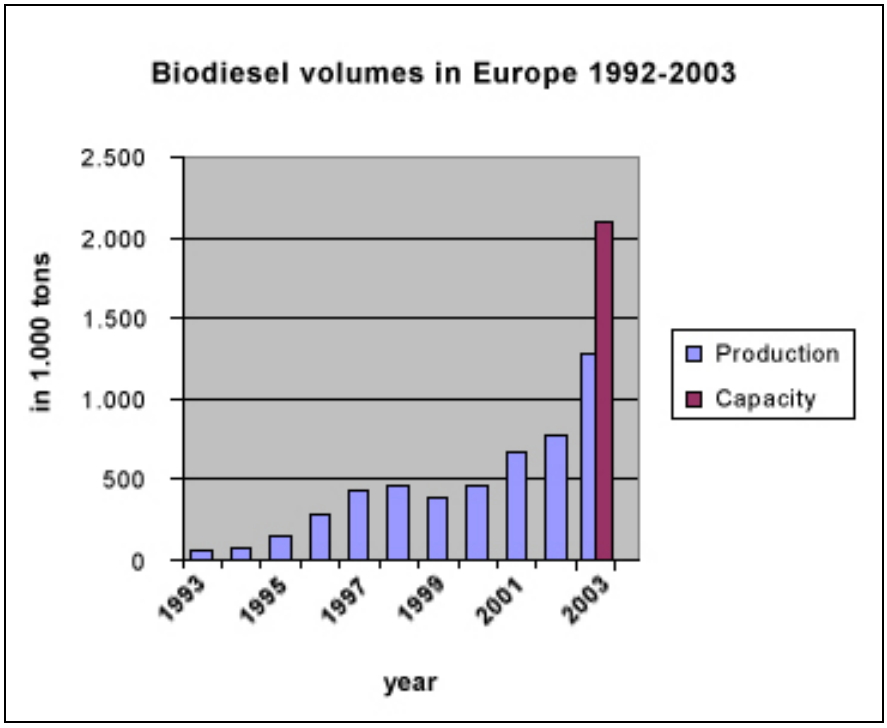

Fig. 18: Capacity and production in Europe 1992-2003

Source: ABI (Austrian Biofuels Institute): In response to the e-mail questionnaire sent by the author, Austria, Vienna 2002, Figures taken from the respective country reports

[143] Internet: http://www.ademe.fr/anglais/webaltener/htdocs/biofuels.htm [15.10.2002]

More detailed figures for 2002 highlight this tremendous increase:

Country	Capacity 2002	Estimated production 2002
Germany	936	685
France	360	320
Italy	600	220
Czech Republic	70	70
Austria	73	33
Spain	18	8
Denmark	10	5
U.K.	25	5
Sweden	5	3
Switzerland	2	1
Slovakia	127	1
Total	**2.226**	**1.351**

Tab. 16: European capacity and estimated production of Biodiesel 2002 (in 1.000 t)

Source: ABI (Austrian Biofuels Institute): In response to the e-mail questionnaire sent by the author, Austria, Vienna 2002; Country capacity estimates from the sources stated in the respective country reports

4.2132 Feedstock

At present, most Biodiesel in the EU is processed from rapeseed and sunflower oil with a growing percentage of recycled frying oil.[144]

The industry relied to a significant extent on obtaining the right quantity of feedstock at a competitive price by virtue of the non-food set-aside scheme, which resulted from the MacSharry Common Agricultural Policy (CAP) Reforms introduced in 1992. Although the CAP Reforms -agreed upon within the framework of Agenda 2000 at the Berlin Summit of March 1999- provided for a reference rate for obligatory set-aside of 10% for the period 2000/2006, the variable nature of set-aside rates actually applied from year to year did not always offer a sustainable base for Biodiesel production.[145]

It seems that the main possibilities for the production of conventional feedstock for liquid biofuels production under the studied conditions will be in northern and central EU countries, and will be reduced in Mediterranean countries because the yields are rather low in these areas.[146]

144 EVA (Austrian Energy Agency): Exploitation of Biomass, papers from the contractors meeting to enhance the exchange of information and experience, Vienna 2000, p. 6, Internet: http://www.eva.wsr.ac.at/publ/pdf/alt99.pdf [23.9.2002]

145 WILLIAMS, B.: Biodiesel in the EU – how to maximize the potential, presentation at the 1st world biofuels conference Paris, April 3 2001, Internet: http://www.biodiesel.org/resources/reportsdatabase/reports/gen/gen-313.pdf [15.12.2002]

146 Internet: http://www.ademe.fr/anglais/webaltener/htdocs/externalities.htm [9.9.2002]

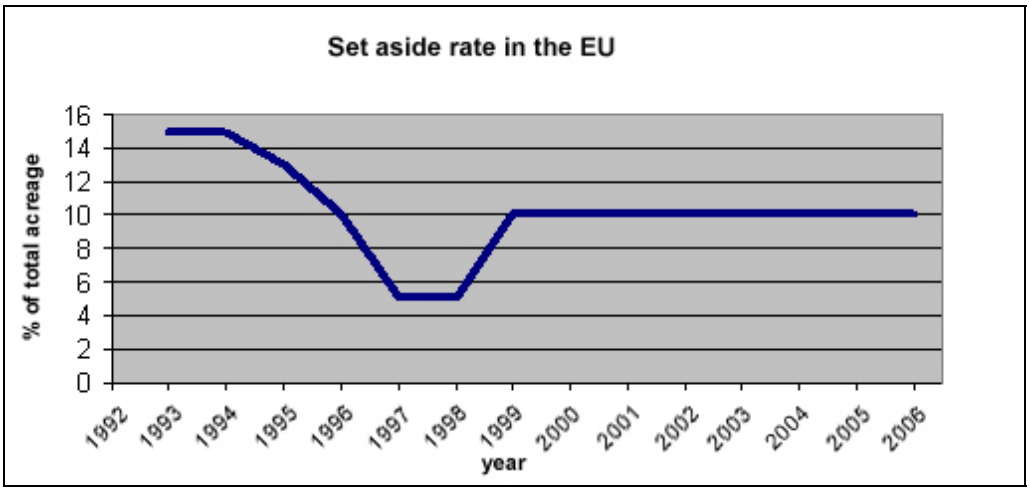

Fig. 19: Set aside rate in the European Union (in % of total acreage)

Source: EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 31, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

Recycled vegetable oils and fats offer some possibilities as alternative low-cost Biodiesel feedstock whose availability is not affected by EU land use policies.
Based on the estimate from eight countries, a total of about 0,4 million t were collected in the EU in 1999, mainly from the catering industry. The amount that could be collected is estimated as being considerably higher, possibly from 0,7 to 1 million t. Its price is variable, but in general about half of that of virgin oil. The countries with most practical experience on this subject are Austria and Germany (with two new Biodiesel plants of 100.000 t/a capacity using recycling oil as the sole feedstock).[147] Even with this alternative, the supply of feedstock will be the limiting factor for further development of the Biodiesel economy. Given the existing production facilities, it cannot be anticipated that over 10 % of diesel fuel consumption can be replaced by Biodiesel.[148]

4.2133 Quality standards / quality management

In 1996, on the initiative of DG XI (General Directorate for Environment) and as a result of the European Auto-Oil programme, a directive (Directive for the Quality of Petrol and Diesel Fuels) for the quality of fuels was developed. Its main objective is to reduce exhaust emissions (nitrogen oxides, unburnt hydrocarbons and particulate matter, etc.). Biodiesel meets the strict directive's requirements already now.[149]

In 1997, the European Commission gave a mandate to CEN (Comité Européen de Normalisation) to develop standards concerning minimum requirements and test

[147] Internet: http://www.ademe.fr/anglais/webaltener/htdocs/waste.htm [15.12.2002]
[148] BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 2
[149] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna, 2001, p. 38

methods for Biodiesel. During the drafting it was decided to use the same requirements for both applications: FAME as sole diesel fuel and FAME as blending component to EN590 diesel fuel. In 2001, the following two drafts were presented and were subject to the 6-month inquiry process:

- prEN 14214 - FAME as automotive fuel for diesel engines
- prEN 14213 - FAME as heating fuel

National comments were included and the final standards were passed on for the formal vote. During 2003, the standards will be available defining the world-wide highest requirements for Biodiesel. [150]

4.2134 Marketing strategy / distribution system

At the moment, 35-40% of Europeans drive diesel cars[151] and it is expected that even more persons may shift to smaller, more efficient cars as well as to diesel fuel. As a result, diesel fuel consumption is estimated to rise by 0,7 million barrels per day from 1999 to 2020.[152]

With regard to marketing, differences exist between the member states which market Biodiesel as an additive to fossil diesel fuel and the member states (Germany and Austria) which market pure Biodiesel.[153]

Country	Strategy
Austria	Pure rape methyl ester (RME) in diesel, pure recycled frying oil ME
Finland	Unmarked use of reformulated gasoline and diesel
France	Rape and sunflower ME used in diesel (Captive fleets and unmarked), sunflower ME used as a domestic fuel blender
Germany	Pure Rape ME used in all kind of vehicles
Greece	Sunflower, maize , olive ME and recycled frying oils ME on pilot tests
Ireland	Pilot tests using Rape ME, Research and Development on used frying oils engines
Italy	Sunflower ME mainly employed (90 %) as pure fuel or a blend with 20 % fossil diesel fuel, in thermal uses for public and private heating
Portugal	Sunflower ME used on captive fleets, blended in mixtures of 30 % and 5 % with diesel
Spain	Sunflower ME
Sweden	RME on captive fleets

Tab. 17: Marketing strategies of EU member states

Source: Internet: http://www.ademe.fr/anglais/webaltener/htdocs/biofuels.htm [15.10.2002]

[150] Internet: http://www.ademe.fr/anglais/webaltener/htdocs/biodiesel.htm [15.12.2002]

[151] Biofuels-biz digest: newsletter nr. 304, via e-mail to the author, 2002

[152] Petroleum Economics, Ltd: World Long-Term Oil & Energy Outlook 2000-2015, London, June 2001

[153] BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 2

Since the VW approval of Biodiesel in 1996, more than 400.000 cars use pure Biodiesel (B100) in Germany, Austria and Sweden today, whereas 10-15 million cars use Biodiesel as an additive (B2) to fossil diesel in France. A possible happy medium is the strategy adopted by Czechia and Slovakia, which offer fossil diesel blended with 30-40% Biodiesel.[154]

4.214 Summary / forecast

The European Commission has acknowledged the importance of Biodiesel by including it in its "Campaign for Take-Off" and has defined it as a "Key Sector Action". The trend set by future projects makes it possible to situate European production in 2003 for all types of biofuels (relatively in phase with European Union objectives) at about 4,8 million tons. A simple projection of the present rate shows that the goal of reaching a 7% share of consumption represented by renewable origin fuel by 2010 will not be met (11,7 million tons vs. 17 million tons) without additional efforts.[155]

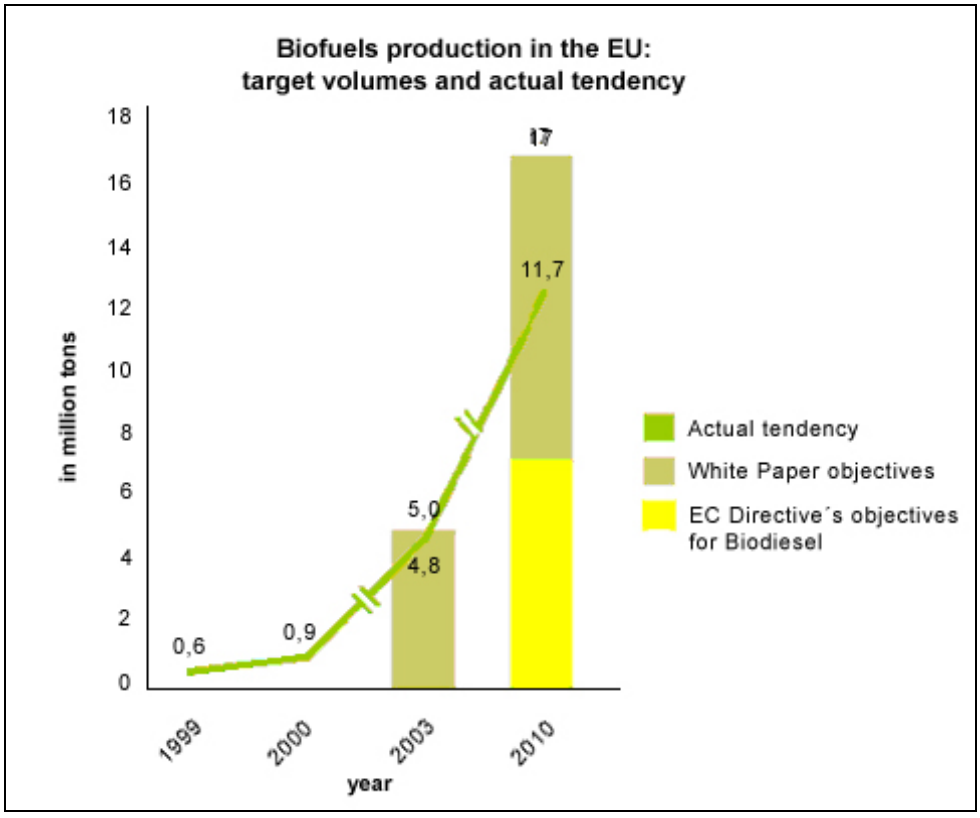

Fig. 20: Comparison of current trend with White Paper objectives (in million tons)

Source: EurObserv´ER: European Barometer 2001,The 2001 Overview of Renewable Energies, April 2002, p.10 ,via e-mail to the author;
Biodiesel figures taken from Tab. 19

[154] ADM (Archer Daniels Midland): Blending Agriculture into Energy-Economic Opportunity, presented at Saskatoon Inn, Saskatoon Canada January 2002, p. 33

[155] EurObserv´ER: The 2001 Biofuel Barometer, press release, Brussels 2002, p. 2, via e-mail to the author

With regard to Biodiesel a further extension of the production capacity must be anticipated due to these initiatives of the EU commission and the associated national amendments to the mineral oil tax laws. The prospective candidates to EU membership are also requested to implement the corresponding EU rulings in their national legislation. A call for action is evident when comparing the minimum target quantities of the fossil diesel fuel consumption.

Country	**Diesel consumption** (in 1.000 t/a)
Austria	3.224
Belgium	4.852
Denmark	1.711
Finland	1.776
France	26.603
Germany	24.834
Greece	2.245
Ireland	1.429
Italy	16.138
Luxembourg	685
The Netherlands	5.607
Portugal	2.863
Spain	16.215
Sweden	2.374
Great Britain	16.597
Total	**126.613**

Tab. 18: Diesel consumption in the European Union 1998 (in 1.000 t)

Source: BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 4

Based on the total diesel fuel consumption in Europe (see Tab. 18) the quantities for biological fuel production from 2005 to 2010 are estimated as follows:

Year/ minimum contingent (based on 1998)	**Biodiesel**
2005 / 2,00 %	2.532
2006 / 2,75 %	3.482
2007 / 3,50 %	4.431
2008 / 4,25 %	5.381
2009 / 5,00 %	6.331
2010 / 5,75 %	7.280

Tab. 19: Minimum target quantities of biological diesel fuel production in the European Union 2005-2010 (in 1.000 t)

Source: BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 5, according to information from the EU Commission (KOM (2001) 547 final

To achieve these target quantities there is a need for improved framework conditions in fiscal matters. CO_2 taxes on fossil fuels for the internalisation of external environmental costs in all European countries may be another supportive measure[156]- and in the agricultural sector: to exploit this potential, an innovative and dynamic marketing campaign[157] as well as good and efficient co-ordination across the agriculture, energy, environment, transport, taxation and R & D sectors will be necessary.[158]

4.22 Austria

4.221 Introduction / history

First R&D work concerning Biodiesel was already effectuated as early as 1973.[159]

The shortage of mineral oil supply in the early 70s led to two major biofuel projects after 1979. The construction of an 80.000 t/year bioethanol plant (not realized) and the development of the Biodiesel technology were planned.[160]

In 1982, the first production of rapeseed oil methyl esters (RME) by transesterification of rapeseed oil and engine tests in diesel engines were carried out in Austria.[161] One year later first trials with recycled frying oil were conducted.[162]

In 1985, the first pilot plant world-wide for the production of Biodiesel for use in agriculture was installed in Silberberg, Styria.[163]

In 1990, the construction of the first industrial scale Biodiesel-plant was started in Aschach.[164]
In 1992, simultaneous to the first specifications for RME in Austria (standard ONC 1190), the first first modern farmers' cooperative production plant for Biodiesel was put into operation in Mureck. A short time later, a second commercial and so far the biggest plant was opened in Bruck.[165]

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156 EIBENSTEINER, F., DANNER, H.: Biodiesel in Europe, System Analysis, Non-Technical-Barriers, Wels 2000, p. 4, Internet: http://www.liquid-biofuels.com/FinalReport1.html [10.10.2002]

157 EVA (Austrian Energy Agency): Exploitation of Biomass, papers from the contractors meeting to enhance the exchange of information and experience, Vienna 2000, p. 4, Internet: http://www.eva.wsr.ac.at/publ/pdf/alt99.pdf [23.9.2002]

158 FEDIOL (Seed crushers´ and oil processors´ federation): Manifesto on non-food oilseeds, Brussels May 2000, p. 8, Internet: http://www.fnr.de/de/li/manifesto1.pdf [19.9.2002]

159 Internet: http://www.eva.wsr.ac.at/projekte/ren-in-a08.htm [10.9.2002]

160 WÖRGETTER, M., PRANKL, H., RATHBAUER, J.: Biodiesel in Austria - an Overview, 3rd Biomass Conference of the Americas, Conference Proceedings , Montreal August 24-28 1997, p. 1043

161 Internet: http://www.biodiesel.org/resources/reportsdatabase/reports/gen/gen-135.pdf [10.9.2002]

162 Internet: http://www.cpc.at/itc/biodiesel/home.htm [10.9.2002]

163 Internet: http://www.biodiesel.org/resources/reportsdatabase/reports/gen/gen-135.pdf [10.9.2002]

164 AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 4

165 Internet: http://www.cpc.at/itc/biodiesel/home.htm [10.9.2002]

The year 1995 saw the first international conference on standardisation and assessment of Biodiesel in Vienna. In the same year 10 buses from the public fleet of Graz switched to 100% Biodiesel produced from recycled frying oil.[166]

In June 1999, the drafts of two regulations were signed by the Austrian Minister of the Environment. These regulated the quality of transportation fuels (maximum of 5% Biodiesel in fossil diesel fuel) and including a regulation for a mandatory adding of 2% Biodiesel in fossil diesel fuel. Consent could not be found on the latter point, so the mandatory adding was rejected. The blending level was limited to 3%. [167]

An amendment of the fuel regulation was published in December 1999 creating the possibility of using Biodiesel as a sole diesel fuel and as a blending component to fossil diesel fuel.[168]

4.222 Framework / legislation

4.2221 Supportive taxation measures

Beginning with January 1st 2000, the utilisation of fuels from renewable raw materials is tax exempt if

- it is used as sole (bio-)fuel
- if up to 2% biofuel is blended with fossil diesel fuel (Biodiesel)[169]

Since January 1st 2000, it has also been possible to blend up to 3% of Biodiesel with fossil diesel fuel.[170]

4.2222 Other motives and regulation measures

On a voluntary and/or incentive basis: public traffic in cities (e.g. Graz, Feldkirch), recycling oil collection systems (Tyrol, Graz, Upper and Lower Austria, Vienna).[171]

166 Internet: http://www.cpc.at/itc/biodiesel/home.htm [10.9.2002]
167 WÖRGETTER, M., PRANKL, H.: The Introduction of Biodiesel as a Blending Component to Diesel Fuel in Austria, Final Report of NTB-net Phase IV, Wieselburg 2000, p. 8
168 WÖRGETTER, M., PRANKL, H.: The Introduction of Biodiesel as a Blending Component to Diesel Fuel in Austria, Final Report of NTB-net Phase IV, Wieselburg, 2000, p. 9
169 Steuerreformgesetz 2000 (Law for taxreform), Artikel XII: Änderung des Mineralölsteuergesetzes 1995, BGBl. 106/1999, Edited in Austria 1999
170 WÖRGETTER, M., PRANKL, H.: The Introduction of Biodiesel as a Blending Component to Diesel Fuel in Austria, Final Report of NTB-net Phase IV, Wieselburg 2000, p. 10
171 ABI (Austrian Biofuels Institute): In response to the e-mail questionnaire sent by the author, Austria, Vienna 2002, p. 1

4.2223 Stakeholders

Name	Web-address	Logo	Description
Ölmühle Bruck			Biggest producer, branch of a large industrial oil mill, recently acquired by BUNGE; Since 10/1992
BAG-	http://www.bag-guessing.at		Farmers' co-operative, producer
SEEG	http://www.seeg.at/		Producer, Farmers' co-operative with 6.000 t/a capacity Biodiesel from Rapeseed-oil- and recycling oil
Energea	http://www.energea.at		Producer, developing a new and continuous process technology
RME Treib-stoff, Starrein	http://e-taten.municipia.at/alle/o_Name/f000086.html		Farmer´s co-operative
Biodiesel Kärnten	http://www.biodiesel-kaernten.com/		In construction, start-up date March 2003, initial capacity 25.000 t/a, to be increased to 50.000 t/a
BIOENERGY	http://www.bioenergy.co.at/		In construction
ABI- Austrian Biofuels Institute	http://www.biodiesel.at		International centre of competence for liquid biofuels- R&D, demonstration, dissemination, lobbying, worldwide studies
BLT	http://www.blt.bmlf.gv.at		Federal Institute of Agricultural Engineering, R&D in the field of agricultural engineering, testing
University of Graz	http://www.kfunigraz.ac.at http://www-och.uni-graz.at/		The renewable resources group from the Institute of Bioorganic Chemistry have more than 20 years of extensive experience in R&D
AWI, Lagerhaus, AVIA	http://members.eunet.at/awi-diskont/ http://www.lagerhaus.at http://www.avia.at/		Main Biodiesel distributors

Tab. 20: Biodiesel industry stakeholders in Austria

Source: KÖRBITZ, W., Austrian Biofuels Institute, 18.7.2003; Websites as denominated in the table

4.223 Production / quality / marketing

4.2231 Plants

Actually there are 6 commercial production plants:

Producer	Location	Production capacity t/a
Biodiesel Raffinerie Donauwind	Zistersdorf	40.000
Ölmühle Bruck	Bruck/Leitha	25.000
Biodiesel Kärnten (start 3.2003)	Arnoldstein	25.000
SEEG	Mureck	6.000
RME Treib- & Heizstoffe	Starrein	1.500
BAG	Güssing/Jennersdorf	1.000

Tab. 21: Biodiesel producers 2003

Source: ABI (Austrian Biofuels Institute): In response to the e-mail questionnaire sent by the author, Austria, Vienna 2002

One further processing plant will appear shortly:

Producer	Location	Production capacity (t/a)
Biodiesel-Erzeugungs GesmbH	Wöllersdorf / NÖ	20.000

Tab. 22: Planned production plants

Source: ABI (Austrian Biofuels Institute): In response to the e-mail questionnaire sent by the author, Austria, Vienna 2002

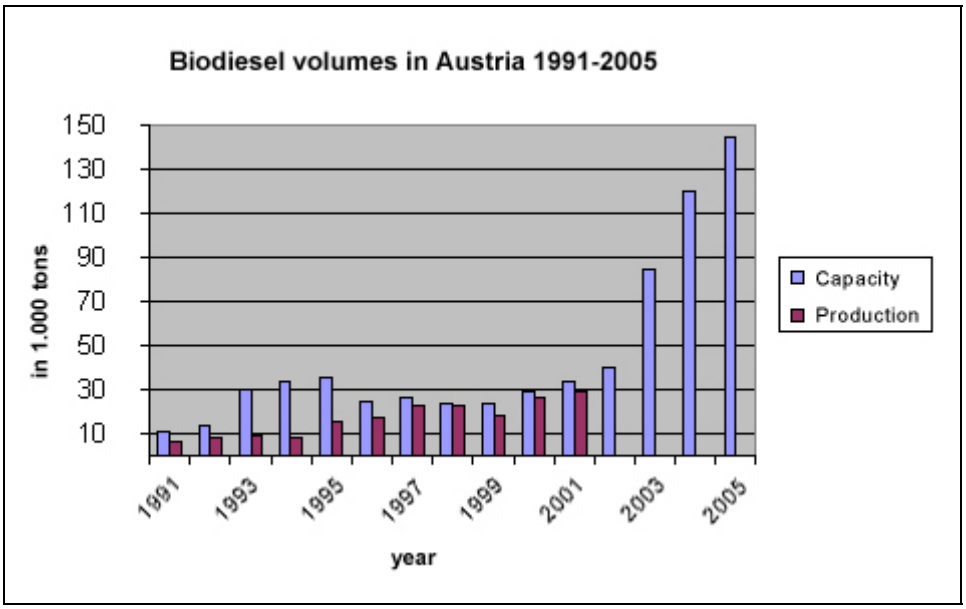

Fig. 21: Capacity and production 1991-2005

Source: ABI (Austrian Biofuels Institute): In response to the e-mail questionnaire sent by the author, Austria, Vienna 2002

4.2232 Feedstock

Initially rapeseed and sunflower oil were tested as feedstock, but later on low-cost recycled frying oil was also used successfully.[172]Currently, McDonald´s (135 restaurants in Austria) collects approx. 1.100 tons of recycled frying oil, which then is transesterified into Fatty-acid-methyl-ester (FAME) of standardised quality.[173]

Feedstock	1994	1995	1996	1997	1998	1999	2000	2001
Rape seed oil	7.700	14.700	17.000	22.000	20.500	15.600	23.100	24.200
Recycled frying oil					2.300	2.500	3.400	4.500
Sunflower oil		500	400	400				
Total	**7.700**	**15.200**	**17.400**	**22.400**	**22.800**	**18.100**	**26.500**	**28.700**

Tab. 23: Feedstock- usage and application 1994-2001

Source: WÖRGETTER, M., RATHBAUER, J. LASSELSBERGER, L., DISSEMOND, H., KOPETZ, H., PLANK, J., RAKOS, C.: Bioenergy in Austria: Potential, Strategies, Success Stories, Proceedings of the 10th Biennial Bioenergy Conference "Bioenergy 2002", Boise Idaho 2002, Internet: http://www.blt.bmlf.gv.at/vero/artikel/artik009/austria.pdf [10.10.2002], p. 5

172 WÖRGETTER, M., RATHBAUER, J. LASSELSBERGER, L., DISSEMOND, H., KOPETZ, H., PLANK, J., RAKOS, C.: Bioenergy in Austria: Potential, Strategies, Success Stories, Proceedings of the 10th Biennial Bioenergy Conference "Bioenergy 2002", Boise Idaho 2002, Internet: http://www.blt.bmlf.gv.at/vero/artikel/artik009/austria.pdf [10.10.2002], p. 6

173 KÖRBITZ, W.: New Trends in Developing Biodiesel, presentation at Asia Bio-Fuels, Singapore 2002, p. 4, via e-mail to the author

4.2233 Quality standards / quality management

Research institutes, the Biodiesel and the mineral oil industry together with the motor industry developed and completed the world's first Biodiesel standard ON C 1190 for Rapeseed-oil-Methyl-Ester (RME) in 1991. This standard was the basis for further work in the Czech Republic, Italy, Sweden, Germany and the USA.[174]

The world's first Biodiesel standard ON C 1191 for Fatty-acid-methyl-ester (FAME) followed in July 1997, thus allowing a broad scope for any suitable feedstock. This standard set the foundation for the German DIN 51.606 (FAME) and the soon to be implemented CEN-standard EN 14214, which is scheduled to be adopted by CEN in 2003.[175]

4.2234 Marketing strategy / distribution system

In the last 30 years, the share of diesel fuel increased, with a strong growth in overall demand, from 42% to 68%. Biodiesel contributes 0,7% to the supply of diesel.
After the regulation for a mandatory blending of 2% had been dropped, similar to Germany, the marketing of Biodiesel as a 100% pure product was adopted. This opened a series of positive arguments to improve the acceptance of this fuel on the part of the consumer but also the politicians. These arguments include: biodegradability, reduction of exhaust emission, not a hazardous substance, etc.[176]

AWI, a fuel discounter, is the main distributor in volume with over 23 fuel pumps all over Austria, followed by AVIA with 13. In addition to AWI, the farmers' cooperative fuel pumps offer Biodiesel on 25 retail sales points. In total, 88 pump stations are known to sell Biodiesel throughout Austria.[177]

Concerning the market segment "public transport", the first field tests were started 1994 in Graz with two public buses (type STEYR SS 11 HUA 210 and MAN NL 202) running on Fatty-acid-methyl-ester (FAME), which was produced from recycled frying oil.
After the successful pilot test with two buses, eight additional buses were converted to Biodiesel in a common project of the Grazer Verkehrsbetriebe (public transport company of Graz) and the Department of Environmental Protection of the City of Graz, and a company filling station was built. Due to this positive experience, the use

[174] WÖRGETTER, M., RATHBAUER, J. LASSELSBERGER, L., DISSEMOND, H., KOPETZ, H., PLANK, J., RAKOS, C.: Bioenergy in Austria: Potential, Strategies, Success Stories, Proceedings of the 10th Biennial Bioenergy Conference "Bioenergy 2002", Boise Idaho 2002, Internet: http://www.blt.bmlf.gv.at/vero/artikel/artik009/austria.pdf [10.10.2002], p. 8

[175] WÖRGETTER, M., RATHBAUER, J. LASSELSBERGER, L., DISSEMOND, H., KOPETZ, H., PLANK, J., RAKOS, C.: Bioenergy in Austria: Potential, Strategies, Success Stories, Proceedings of the 10th Biennial Bioenergy Conference "Bioenergy 2002", Boise Idaho 2002, Internet: http://www.blt.bmlf.gv.at/vero/artikel/artik009/austria.pdf [10.10.2002], p. 8

[176] BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 5

[177] Internet: http://www.diesel-bi.at [14.1.2003], http://www.biodiesel.at [14.1.2003], http://www.agqm-biodiesel.de [14.1.2003]

of Biodiesel by the company was extended year by year.[178]
For 25 busses with an annual consumption of approx. 600.000 litres, the emission savings are as shown in Tab. 24.

CO	CO_2	NOx	HC	Soot	SO_2
1.460 kg	1,250.000 kg	+/- 0	1.500 kg	510 kg	1.380 kg

Tab. 24: Annual reduction in emissions when 25 busses are filled up with Biodiesel

Source: PRUTSCH, W., PROSSNIG, B.: Eco-drive with Biodiesel: Buses in Graz cause lower emissions and are less of a burden to the climate, position paper, copy to the author, Graz 2002

In 2000 40 buses were running on Biodiesel made from recycled frying oils (originating from Mc Donald´s) and from that time on, the GVB accepts in their procurement policy, only those buses which are approved by the manufacturer for the use of Biodiesel (FAME).[179]
The collecting systems for recycled frying oils have been constantly improved; a very efficient originated from Tyrol[180] and was licensed out to waste management logistic systems in Lower Austria, Upper Austria and Vienna.[181]

The price development for pure Biodiesel is similar to the one in Germany, constantly undercutting the price for fossil diesel.[182]

4.224 Summary / forecast

Actual capacity analysis predicts that the mandatory 2 % market share for biofuels to be reached by 2005 (as defined in the new European Union Directive Proposals for Promotion and Detaxation of Liquid Biofuels) will be reached without any major difficulties.
Future total potential for rapeseed cultivation is at approx. 70.000 ha. If the climatic conditions and the traditional farming structure are taken into consideration, this may result in a maximum potential of 154.000 t/a of Biodiesel from rapeseed.
Additional feedstock supply may be secured by the extension of recycling oil collection and from external sources (i.e. the import of Slovakia's excess capacity) due to cost-efficient transportation possibilities along the Rhine-Main-Danube waterway.[183]

[178] PRUTSCH, W., PROSSNIG, B.: Eco-drive with Biodiesel: Buses in Graz cause lower emissions and are less of a burden to the climate, position paper, position paper, copy to the author, Graz 2002
[179] PROSSNIG, B.: Experiences with Biodiesel in the Bus fleet of the Public Transportation System of the City of Graz (GVB); Lecture at the seminar: "From the Frying Pan into the Tank - Recycled Frying Oil Collection and its Use as Biodiesel in Styria", Graz 2000, via e-mail to the author
[180] FORUM-FOrtschritt im Regionalen UMweltschutz, Hall i. T., November 2002, Internet: http://www.atu.onle.at/projekte/oeli.php [15.8.2003]
[181] ABI (Austrian Biofuels Institute): In response to the e-mail questionnaire sent by the author, Austria, Vienna 2002, p. 1
[182] ABI (Austrian Biofuels Institute): In response to the e-mail questionnaire sent by the author, Austria, Vienna 2002, p. 1
[183] ABI (Austrian Biofuels Institute): In response to the e-mail questionnaire sent by the author, Austria, Vienna 2002, p. 1

4.23 Belgium

4.231 Introduction / history

Interest in liquid biofuels started at the beginning of the 90s with the set-aside regulation allowing non-food crops.[184]
Since 1991, several trials on commercial buses have been made to promote the Biodiesel utilization. A transesterification pilot plant was installed in 1994.[185]

In 1994, 9.500 ha of oilseed rape were grown on set-aside land and Biodiesel was used in several trials (busses in Mons (15 busses running with 20% Biodiesel, 740.000 km, technical survey, favourable results), municipal vehicles in Charleroi and Philippeville, vehicles of AVEVE and cars in Mol (5 cars, 100% Biodiesel, 300.000 km, technical survey, no major technical problems).[186]

In 1998 almost 5% of the Biodiesel in Europe was produced in Belgium by Pantochim (19.000 out of 390.000 t produced).[187]
Belgium had taken Biodiesel to the research, development and demonstration stage, but there was no considerable progress to the deployment stage because of the reservations on the overall economic and environmental performance of the fuel.[188]

After these projects, the use of Biodiesel stopped and actually there is no usage of Biodiesel as a transport fuel in Belgium.[189]

4.232 Framework / legislation

4.2321 Supportive taxation measures

At the moment there are no tax exemptions for Biodiesel in Belgium.[190]
Because of the European drive for lower greenhouse gas emissions and the increased focus on biofuels (5,75% by 2010), a tax reduction for Biodiesel is being considered in Belgium. However, the specific political situation in Belgium (overlap between federal and regional authorities) does not favour quick changes.[191]

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184 VALBIOM (Valorisation de la Biomasse asbl) : In response to the e-mail questionnaire sent by the author, Belgium, Gembloux 2002, p. 1
185 Internet: http://btgs1.ct.utwente.nl/eeci/countries/BE.html [20.9.2002]
186 VALBIOM (Valorisation de la Biomasse asbl) : In response to the e-mail questionnaire sent by the author, Belgium, Gembloux 2002, p. 1
187 Le baromètre des biocarburants, in : OBSERV'ER, n°134, Paris 1999, Internet: http://www.observ-er.org [10.11.2002], p.6
188 Internet: http://europa.eu.int/comm/energy_transport/atlas/htmlu/lbrtdc.html [20.9.2002]
189 VITO (Flemish Institute for Technological Research): In response to the e-mail questionnaire sent by the author, Belgium, Mol 2002, p. 1
190 VITO (Flemish Institute for Technological Research): In response to the e-mail questionnaire sent by the author, Belgium, Mol 2002, p. 1
191 VITO (Flemish Institute for Technological Research): In response to the e-mail questionnaire sent by the author, Belgium, Mol 2002, p. 2

4.2322 Stakeholders

Name	Web-address	Logo	Description
VITO	http://www.vito.be/		The Flemish institute for technological research
Oleon	http://www.oleon.com/		Biodiesel producer (non-dedicated plant)
BASF	http://www.basf.be/		Biodiesel producer (non-dedicated plant)
A.P.P.O. asbl -Association pour la Promotion des Protéagineux et des Oléagineux			Representative of farmers, technical assistance for rape production

Tab. 25: Biodiesel industry stakeholders in Belgium

Source: VALBIOM (Valorisation de la Biomasse asbl) : In response to the e-mail questionnaire sent by the author, Belgium, Gembloux 2002, p. 1;
VITO (Flemish Institute for Technological Research): In response to the e-mail questionnaire sent by the author, Belgium, Mol 2002, p. 2;
Websites as denominated in the table

4.233 Production / quality / marketing

4.2331 Plants

OLEON produces oleochemicals based on vegetable and animal oils and fats. They have 2 production units, one in Ertvelde and one in Oelegem. They have a total oleochemical production of 285.000 t/a, of which 50.000 t/a are fatty esters**.**
These are not used for Biodiesel (only on request), but a production of up to a few ten thousand tons per year could be undertaken without new investment.[192]. This production unit belonged to PetroFina until 2000.[193]
The capacity in Oelegem is likely to be increased to 100.000 t/a in the next 2 – 3 years. PetroFina also had a Biodiesel production facility in Feluy. This production plant was acquired by the Italian company SISAS.[194] In 2000, BASF took over the production that has a Biodiesel production capacity of 30.000 to 60.000 t/a. After BASF had tried to sell Biodiesel without success they decided to give up the Biodiesel production.[195]
Currently there are no production facilities planned.[196]

[192] VALBIOM (Valorisation de la Biomasse asbl) : In response to the e-mail questionnaire sent by the author, Belgium, Gembloux 2002, p. 3
[193] VITO (Flemish Institute for Technological Research): In response to the e-mail questionnaire sent by the author, Belgium, Mol 2002, p. 1
[194] VITO (Flemish Institute for Technological Research): In response to the e-mail questionnaire sent by the author, Belgium, Mol 2002, p. 1
[195] VALBIOM (Valorisation de la Biomasse asbl) : In response to the e-mail questionnaire sent by the author, Belgium, Gembloux 2002, p. 1
[196] VITO (Flemish Institute for Technological Research): In response to the e-mail questionnaire sent by the author, Belgium, Mol 2002, p. 4

4.2332 Feedstock

In Belgium, oilseed rape is the only non-food crop grown at a significant scale on set-aside land. Linseed was also grown in the past (742 ha in 1994) but decreased to a very few hectares. Now oilseed rape is grown on 3 – 4.000 ha and the production is sold abroad.[197]
The potential of recycling oil, provided an efficiently organised recycling oil collection is established, can amount up to 3% of the total diesel consumption in Belgium.[198]

4.2333 Marketing strategy / distribution system

Biodiesel is not for sale in public pump stations but can be bought as an oleochemical (in bulk) only.[199]
For the time being, the only commercial user of Biodiesel is the company Xylowatt SA, working in the field of renewables.[200]
From the market side, there are more and more requests concerning the use of vegetable and recycled frying oils for vehicles or for (green) energy production. Especially the used recycled oil market is quite substantial and has been asking for solutions since the ban on their use in animal feed.[201]

4.234 Summary / forecast

Liquid biofuels are again subject to polemics in Belgium as a position towards the new directive proposals (COM(2001)547) has to be stated.[202]
It is clear that fuel consumption is large, however, and agriculture alone cannot meet such demand. To substitute 5,75% of fossil diesel with Biodiesel, 351 Ml of Biodiesel have to be produced with rape grown on 270.000 ha (average production of 1.300 l/ha); the total agricultural surface in Belgium is 1,4 million ha, of which 58,4% are for meadows).[203]
Currently, rape is grown on less than 10.000 ha and set-aside land represents about 20.000 ha.[204] As a consequence, it makes sense to speak about small scale production in Belgium; a special emphasis to be put into captive fleets might be considered in the years to come.

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197 VALBIOM (Valorisation de la Biomasse asbl) : In response to the e-mail questionnaire sent by the author, Belgium, Gembloux 2002, p. 4
198 PELKMANS, L.: Biodiesel as an alternative motor fuel, in : CADDET Energy Efficiency, newsletter 3, 1997, Harwell/Didcot/Oxon England, Internet: http://www.caddet-ee.org//nl_pdf/973_02.pdf [5.9.2003], p. 8
199 VITO (Flemish Institute for Technological Research): In response to the e-mail questionnaire sent by the author, Belgium, Mol 2002, p. 1
200 VALBIOM (Valorisation de la Biomasse asbl) : In response to the e-mail questionnaire sent by the author, Belgium, Gembloux 2002, p. 4
201 VITO (Flemish Institute for Technological Research): In response to the e-mail questionnaire sent by the author, Belgium, Mol 2002, p. 1
202 VALBIOM (Valorisation de la Biomasse asbl) : In response to the e-mail questionnaire sent by the author, Belgium, Gembloux 2002, p. 1
203 VALBIOM (Valorisation de la Biomasse asbl) : In response to the e-mail questionnaire sent by the author, Belgium, Gembloux 2002, p. 5
204 VALBIOM (Valorisation de la Biomasse asbl) : In response to the e-mail questionnaire sent by the author, Belgium, Gembloux 2002, p. 5

4.24 Czechia

4.241 Introduction / history

In 1992, the "Oleoprogram" was created in order to provide subsidies for the utilisation of rape for Biodiesel production. In the initial years of this program, returnable loans were granted by the Ministry of Agriculture of the Czech Republic (MZe CR) for the creation of technical background for rape oil methylesters (RME, national abbreviation: FARME). In this framework, 16 of initial 18 production facilities were supported and realised. Due to the subsidy of rape non-food utilisation from the MZe CR budget, in 2000, 67.200 t of FARME were produced, of which 93 % were with the state subsidy. After the expiration of this program on 30.9.2001, a new grant system was introduced. The modification of the grant scheme led to a massive drop in Biodiesel consumption (total consumption in CR: -26,7 %). In order to enable delivery to public fuelling stations, large-scale users were gradually put off.[205]

4.242 Framework / legislation

4.2421 Supportive taxation measures

Since July 2001, Biodiesel has been subject to a reduced excise tax, whereas methylester has been completely exempt from the tax.[206]
The tax load for the common blend of 31% Biodiesel is Kč 5.624,-/1.000 l (177,5 €) compared to Kč 8.150,- (257,3 €) for fossil diesel.[207]
The VAT for Biodiesel was reduced to 2% (instead of 22%), but there is also the possibility for total excise tax exemption for farmers.[208]

4.2422 Regulations for market penetration

In January 2001, a new decree was approved installing the SZIF (State Agricultural and Intervention Fund) that purchases rapeseed for non-food utilisation from contracted producers as well as on the free market at a determined minimum price.[209]
The rape is then sold to 12 contracted oilseed processors at approx. 2/3s of the official market price.[210] The price is calculated on the presumption that the final price of the

[205] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 2
[206] AWO- Aussenwirtschaft Österreich (National Office of the Austrian Federal Economic Chamber, Czech Republic): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 1
[207] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 3
[208] AWO- Aussenwirtschaft Österreich (National Office of the Austrian Federal Economic Chamber, Czech Republic): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 1
[209] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 3
[210] AWO- Aussenwirtschaft Österreich (National Office of the Austrian Federal Economic Chamber, Czech Republic): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 1

blended fuel will be 95 % of the fossil diesel fuel.[211]
Total volume of rapeseed traded by SZIF amounts to 230.000 t/a (170.000 t/a from contracted suppliers). [212]

4.2423 Stakeholders

Name	Web-address	Logo	Description
SETUZA	http://www.setuza.cz	SETUZA	The biggest oil seed processing company and the dominant producer of edible plant oils and fats on the Czech market
VUZT	http://www.vuzt.cz	vúzt	Research Institute of Agricultural Engineering
SDRUŽENÍ PRO VÝROBU BIONAFTY			Association for Biodiesel Production
SZIF	http://www.szif.cz/	SZIF	State Agricultural Intervention Fund

Tab. 26: Biodiesel industry stakeholders in Czechia

Source: CEU (Czech Environmental Institute): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 1;
Websites as denominated in the table

4.243 Production / quality / marketing

4.2431 Plants

Actually there are 14 plants with a total capacity of about 70.000 t/a of rape-oil methylester. The largest producer in the country is Setuza which processes about 150.000 t/a of rape into 50.000 t/a of RME. One further plant is planned.[213]

[211] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 3
[212] AWO- Aussenwirtschaft Österreich (National Office of the Austrian Federal Economic Chamber, Czech Republic): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 2
[213] CEU (Czech Environmental Institute): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002

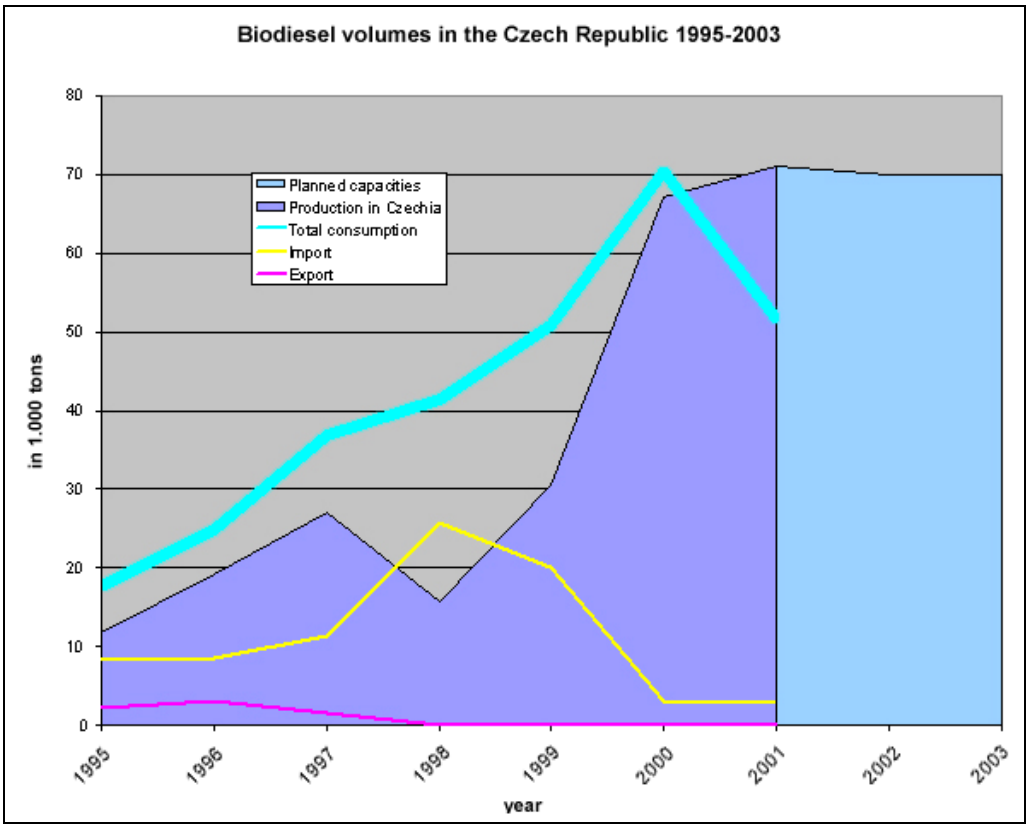

Fig. 22: Biodiesel production, export, import and consumption in the Czech Republic 1995-2001

Source: VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 3

4.2432 Feedstock

Main feedstock is rapeseed with small amounts of sunflower and soybean.[214]

Indicator	Unit	1994/ 1995	1995/ 1996	1996/ 1997	1997/ 1998	1998/ 1999	1999/ 2000	2000/ 2001	2001/ 2002
Harvested area	ha	189.913	252.675	226.533	227.310	264.300	348.949	323.842	343.004
Rape production	t	451.628	662.176	520.572	560.509	680.216	931.053	844.428	974.131

Tab. 27: Rapeseed oil production in the Czech Republic 1994-2001

Source: Ministry of Agriculture of the Czech Republich (MZe CR): Situation and prospectives-report oil crops; commodity council negotiations, Prague 2001

[214] AUSTRIAN BIOFUELS INSTITUTE (ABI): Review on Commercial Biodiesel Production World-wide, Wieselburg 1997, p. 16

4.2433 Quality standards / quality management

Biodiesel is offered according to the Czech standard ČSN 65 6508 Motor fuel - "Fuel for Diesel engines with rapeoil methylesters content above 30 % - technical requirements and testing methods", edited in August 1998.[215]
With respect to Regulation No. 227/2001 of the Ministry of Industry and Trade of June, 2001, determining requirements for road vehicles transport and method of monitoring of their activity, the Czech Trade Inspection removes and evaluates twice a year (summer/winter) a minimum of 100 samples of the blended fuel and FARME for quality control.[216]
With the acceptance of the European standard EN 14214, it will become the adopted standard for FARME. The FARME quality will be determined according to the CSN EN 14214. The blended fuel quality with 31% vol. share of FARME with respect to the CSN 65 6508 revision will be determined by the CSN 65 6508/Z1.[217]

4.2434 Marketing strategy / distribution system

Biodiesel is offered as a 31 % (min.) - 36 % (max.) blend with fossil diesel; other blends are available too.[218]
Major sales are being effectuated at public filling stations; currently there are more than 200 Biodiesel stations nationwide.[219]

In 2000 total sales of Biodiesel with 31 % of FARME were 227.100 t representing 9,7 % of the total diesel fuel consumption in the Czech Republic.[220]

4.244 Summary / forecast

The political will to support this environmental-friendly technology led from initial farmers´ co-operative small scale plants to a well established industrial sector. The growing demand for the blended fuel and transformed economic conditions have become an impulse to the extension of existing capacity and to construction of new facilities.[221]
Admittedly, the maximum of feedstock supply (in consideration of crop rotation) has

[215] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 2
[216] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 5
[217] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 6
[218] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 2
[219] AWO- Aussenwirtschaft Österreich (National Office of the Austrian Federal Economic Chamber, Czech Republic): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 1
[220] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 2
[221] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 3

almost been reached (1,000.000 t/a of rapeseed).[222]
The experiences of the last decade have shown that special emphasis has to be put on quality management by taking into consideration the whole supply chain: producers, trade organisations and enterprises, transport and storage, final sale at the filling stations.[223]
There are also negotiations for an additional blend to be introduced to the market (a mixture of fossil diesel fuel with 5% of rape-oil methyl ester as a lubricant).[224]

The RME and blended fuel export have gradually increased.[225] In order to reflate the national market, the State Agricultural Intervention Fund (SZIF) decided in Dec 2002, that biofuel should be up to 10% cheaper than fossil diesel. Currently it is 5% cheaper.[226]

4.25 France

4.251 Introduction / history

It was in the mid-80s that France's oilproducing and –processing industry was looking for new markets in order to promote oil of colza that was heavily underrepresented in the food-market at the European level.[227]

From 1991 to 1995, a test program with the participation of all stakeholders involved (vehicle industry - Renault, Peugeot; oil-processing industry, petrol-industry - Elf, Total; Ministries of Agriculture and Industry; energy agencies and public transport companies) tried to figure out the most favourable way to produce, distribute and use Biodiesel. The result was to incorporate a 5% blend with fossil diesel and commercial production started.[228]

From the first unit pilot in the Compiegne area to the opening of the Rouen/Dico unit with 150.000 t/a of RME, the specificity of the French Biodiesel activity has been to move toward big transesterification units.[229]

- 1993 : demonstration plant initiation in Compiègne
- 1994 : Novaol adapting two sites for Biodiesel production

[222] CEU (Czech Environmental Institute): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002
[223] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 3
[224] Internet:http://www.soyatech.com/bluebook/news/viewarticle.ldml?a=20021220-8 [30.12.2002]
[225] VUZT (Research Institute of Agricultural Engineering): In response to the e-mail questionnaire sent by the author, Czechia, Prague 2002, p. 3
[226] Internet:http://www.soyatech.com/bluebook/news/viewarticle.ldml?a=20021220-8 [30.12.2002]
[227] VERMEERSCH, G.: Lipids, fats and oils- Opportunities and Responsibilities in the New Century; Congress DGF/AFECG - Würzburg, October 8-10 2000, p. 1
[228] VERMEERSCH, G.: Lipids, fats and oils- Opportunities and Responsibilities in the New Century; Congress DGF/AFECG - Würzburg, October 8-10 2000, p. 3
[229] Internet: http://www.villesdiester.asso.fr/5.Abstracts/Habstract.html [10.9.2002]

- 1995 : start-up of the Grand Couronne- site
- 1997 : 250.000 t/a production
- 1998 : downturn of Biodiesel consumption due to the reduction of mandatory set- aside land
- 2000: 317.500 t/a authorized state quota[230]

Today, Biodiesel is known under the trademark and common name “Diester”, the contraction of Diesel and Ester.

4.252 Framework / legislation

4.2521 Supportive taxation measures

Full tax exemption is granted for an established state quota.

4.2522 Regulations for market penetration

In order to benefit from tax incentives, Biodiesel has to be produced in one of the certified production units denominated through public invitation to tender at European level:

Plant location	**Quota** in t/a
Compiegne (F)	60.500
Boussens (F)	33.000
Grand-Couronne (F)	180.500
Verdun (F)	33.500
Leer (D)	10.000
Total	**317.500**

Tab. 28: Authorized production quota (tax exempt)

Source: VERMEERSCH, G.: Lipids, fats and oils- Opportunities and Responsibilities in the New Century; Congress DGF/AFECG - Würzburg, October 8-10 2000, p. 6

[230] VERMEERSCH, G.: Lipids, fats and oils- Opportunities and Responsibilities in the New Century; Congress DGF/AFECG - Würzburg, October 8-10 2000, p. 7

4.2523 Stakeholders

Name	Web-address	Logo	Description
Diester Industries			Biggest producer, connected to Prolea
Bunge	http://www.bunge.com		Bunge took over Cereol and its Biodiesel production sites in November 2002
ADECA			(Association pour le développement des carburants agricoles) Associaton for the development of agricultural fuels
PROLEA	http://www.prolea.com		The major professional agriculture association, gathers all professionals of a structured oil yielding activity
FOP	http://www.prolea.com/fop		Represents all producers of Oilseed and High-Protein Crops
CETIOM	http://www.cetiom.fr		Interprofessional Technical Centre of Oil &Technical centre for agricultural production
ONIDOL	http://www.prolea.com/onidol		Interprofessional oil Association; Biodiesel tests in captive fleets, different studies
SOFIPROTEOL	http://www.prolea.com/sofi		Prolea´s financial branch, owner of the Diester trademark.
Institut Français du Pétrole (IFP)	http://www.ifp.fr		French Petrol Institute, developed the first transesterification process of vegetable oils as transport fuel : the ESTERFIP-process
ADEME	http://www.ademe.fr		French Agency for Environment and Energy Management
Partenaires Diester- former Club des Villes Diester	http://www.villesdiester.asso.fr		Community of public and commercial fleets using Biodiesel
French car manufacturing industry			

Petrol companies	http://www.total.com	TOTAL	France´s biggest mineral oil company; changed its name from “TotalFinaElf” to “Total France”

Tab. 29: Biodiesel industry stakeholders in France

Source: ADEME (Agency for Environment and Energy Management): In response to the e-mail questionnaire sent by the author, France, Paris 2002, p. 1;
Websites as denominated in the table

4.253 Production / quality / marketing

4.2531 Plants

Four plants are actually responsible for more than 360.000 t/a of Biodiesel capacity:

- Compiègne (60.500 t/a): The first smallscale pilot plant built with the technology developed by the Institut Francais Du Petrole (IFP) began commercial production of 20.000 t/a in 1993. Currently, a project to further expand production is on its way.
- Grand-Couronne (180.500 t/a): The biggest dedicated Biodiesel production plant in the world. In 1995, Grand Couronne started its production with impressive 120.000 t/a, expanding to currently 180.500 t/a. With the actual process of enlargement being concluded, total capacity will amount to 250.000 t/a.
- Verdun (33.500 t/a): an adapted chemical plant that started production in 1995.
- Boussens (33.000 t/a): First Biodiesel batches were produced in this methylester plant that is still producing.[231]

Total authorized production capacity for French producers amounts to 307.500 t/a, but effective production tends to be superior thus allowing potential exports.[232]

[231] ADEME (Agency for Environment and Energy Management): In response to the e-mail questionnaire sent by the author, France, Paris 2002, p. 1

[232] ADEME (Agency for Environment and Energy Management): In response to the e-mail questionnaire sent by the author, France, Paris 2002, p. 1

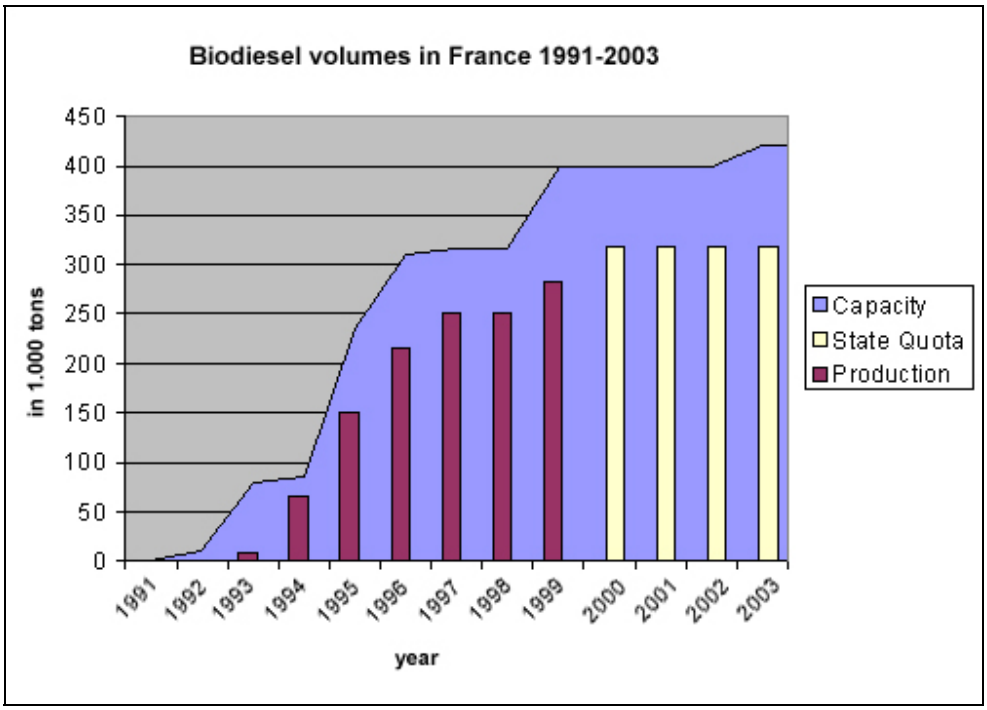

Fig. 23: Biodiesel capacity, production and tax exempt quota 1991-2003

Source: ADEME (Agency for Environment and Energy Management): In response to the e-mail questionnaire sent by the author, France, Paris 2002, p. 1;
own research: database entries of French Biodiesel producers, Vienna 2002

4.2532 Feedstock

Today, the surface for the cultivation of colza for Biodiesel production averages approximately 300.000 ha; an enormous development as the surface grew eightfold in less than 10 years.[233]

[233] VERMEERSCH, G.: Lipids, fats and oils- Opportunities and Responsibilities in the New Century; Congress DGF/AFECG - Würzburg, October 8-10 2000, p. 5

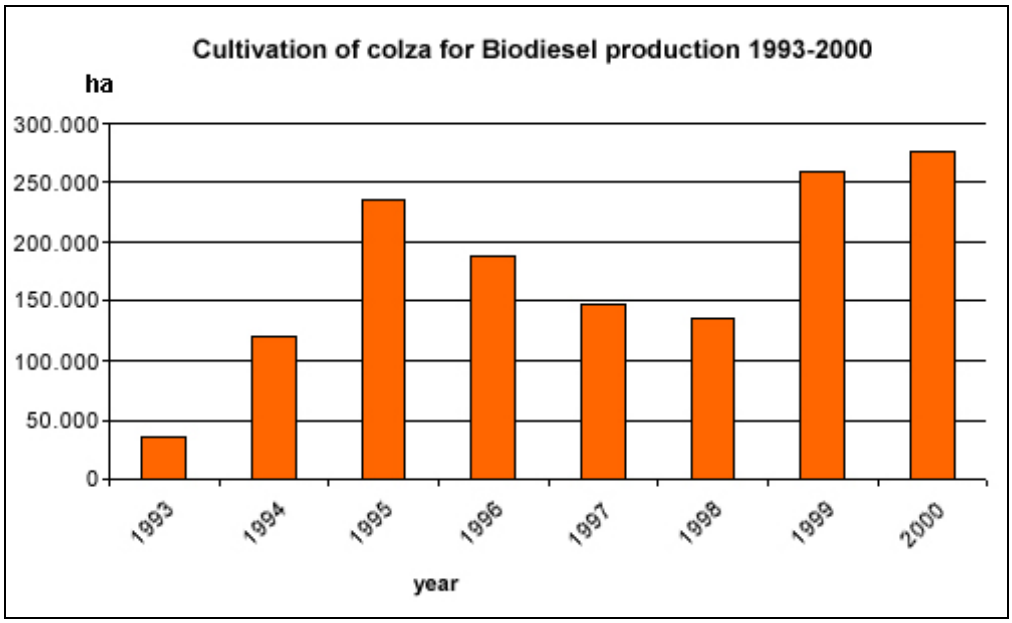

Fig. 24: Harvest fluctuation of rapeseed (colza) for Biodiesel production in France, 1993-2000

Source: VERMEERSCH, G.: Lipids, fats and oils- Opportunities and Responsibilities in the New Century; Congress DGF/AFECG - Würzburg, October 8-10 2000, p. 5

As we can see above, there has been a considerable reduction in land cultivation for Biodiesel purposes from 1996 to 1998. This was caused by a reduction of the percentage of obligatory non-food set-aside-land in those years. With renewed increase of the minimum rate, production took off again.[234]

Year	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
set-aside land (%)	15	15	12	10	5	5	10	10	10	10

Tab. 30: Obligatory set-aside land, % of total acreage

Source: VERMEERSCH, G.: Lipids, fats and oils- Opportunities and Responsibilities in the New Century; Congress DGF/AFECG - Würzburg, October 8-10 2000, p. 5

4.2533 Marketing strategy / distribution system

There are seven refineries blending RME into diesel fuel. This unmarked Diester, officially adopted by French authorities, is distributed via the oil companies and offered in two forms:

- The vast majority in form of 5% blend (Shell: 2%) with fossil diesel to enhance lubricity.

[234] VERMEERSCH, G.: Lipids, fats and oils- Opportunities and Responsibilities in the New Century; Congress DGF/AFECG - Würzburg, October 8-10 2000, p. 5

- The second form is a 30 % blend used by public transport fleets in more than 30 towns united in the "Club des Villes Diester" (Club of Biodiesel Towns), with the main target to exploit the environmental benefits of Biodiesel.[235]

Name	Start	Type, number of vehicles	RME-blend
AGEN	1991	22 buses	30%
ALENCON	1995	10 PL, 10 VL and 18 buses	20%
AMIENS	1992	47 (VL, VU, PL)	30%
ANGOULEME	1993	12 buses	30%
BORDEAUX	1992	10 buses	100%, then 30%
CAEN	1993	180 buses	30%
CAHORS	1993	36 (PL, VL, VU)	5%, then 30%
Chalon-Sur-Saone	1993	36 buses	5%
CHELLES	1994	35 (buses and VU)	5%
CRETEIL	1994	78 (all types)	30%
DUNKERQUE	1992	95 buses	5%
EPERNAY	1994	50 buses and VL	30%
EVREUX	1994	40 buses	30%
GRENOBLE	1992	60 buses	30%
LA ROCHELLE	1993,1997	87 buses	5%, then 30%
LE HAVRE	1996	441 (all types)	10%
LAON	1992	19 buses	30%
MONTAUBAN	1992	3 buses	30%
MULHOUSE	1992	8	5%
NANCY	1993	20, then 180 buses	30%, then 20%
PALAISEAU	1996	50 (PL, VL, VU, cars)	5%
PARIS	1992	120 PL and 1 600 VL	30%
PAU	1992	87 TCP and 8 VU	30%
ROANNE	1993	45 buses and 2 VU	5%, then 20%
ROUEN	1992	200 buses and 20 VL	30%
SALON DE PROVENCE	1994	89	5%
SARREGUEMINES	1994	30	5%
SOISSONS	1996	16 buses	5%
STRASBOURG	1992	390 PL, 106 VU, 338 engines	30%
VALENCE	1993	75 buses	5%

VL= light vehicle **VU=** staff car **PL=** heavy goods vehicle **TCP**= Passenger transport vehicle with more than 9 seats

Tab. 31: Urban fleets using Biodiesel

Source: Internet: http://www.villesdiester.asso.fr/1.association/Hassos.html [10.9.2002]

[235] Internet: http://www.villesdiester.asso.fr/5.Abstracts/Habstract.html [10.9.2002]

In order to widen the scope of membership, the „Club des Villes“ was re-organized and re-named to „Partenaires Diester“ in March 2003, which allows large commercial fleets to take advantage of all the supportive measures of the French Biodiesel industry.[236]

4.254 Summary / forecast

For more than ten years, France has been working in this field area. Its unique industry structure (a couple of big producers) and a joint marketing strategy combined with tamper-proof legal framework promoting Biodiesel marked the impressive development of this industry. Today, biofuel production is the major agricultural alternative on non-food set-aside land, representing some 70 % of the 410.000 ha of crops on set-aside land.[237]
Future development will depend on the establishment of alternative non-fuel products (lubricants, solvants…). Further production plants may only arise after the new European directive has become effective.[238]

4.26 Germany

4.261 Introduction / history

In 1982, early trial work on tractor diesel engines was completed at the Institute for Agricultural Engineering) in Braunschweig.[239]

The year 1990 saw the foundation of UFOP (Union for the Promotion of Oilseed and Protein plants) as an alliance between farmers and oilseed breeders.[240]
Initial supplies of RME for Biodiesel trials were produced by HENKEL in a non-dedicated plant;[241] Finally in 1991, the first small-scale dedicated Biodiesel pilot plant started at Oelmühle Leer Connemann.[242]

The agrarian reform of 1992 (reform of the EU´s Common Agricultural Policy CAP in 1992) represented the fundament of new markets for vegetable raw materials as it encouraged the production of renewable raw materials for non food uses (bio-fuels, starch….), in particular on set aside land.[243]

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[236] Internet: http://www.prolea.com [10.7.2003]
[237] Internet: http://europa.eu.int/comm/energy_transport/atlas/html/biodmarfutc.html [04.09.2002]
[238] ADEME (Agency for Environment and Energy Management): In response to the e-mail questionnaire sent by the author, France, Paris 2002, p. 1
[239] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna, June 2001, p. 4
[240] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna, June 2001, p. 4
[241] AUSTRIAN BIOFUELS INSTITUTE (ABI): Review on Commercial Biodiesel Production World-wide, Wieselburg 1997, p. 19
[242] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna, June 2001, p. 4
[243] Internet: http://europa.eu.int/comm/agriculture/envir/report/en/ens_en/report_en.htm [20.10.2002]

In 1995 Oelmühle Leer Connemann started its commercial scale Biodiesel production with a total capacity of 80.000 t/a based on its own process technology.[244]
Later on that same year the CEO of VOLKSWAGEN AG, Dr. Ferdinand Piëch, declared the full support of Biodiesel by assuring the provisions of warranties for nearly all diesel models of the group including the brands AUDI, SEAT, SKODA and VOLKSWAGEN.[245]

One year later, the marketing of "leaded petrol" was prohibited by law. More than a thousand tanks in public fuel pump stations were open for replacement and Biodiesel was adopted as an attractive option by more than 600 independent public fuel pump stations within a few months.[246]

In September 1997 the DIN fuel standard DIN E 51.606 FAME was released.[247]

The year 1998 brought a record low of crude oil prices combined with high prices for vegetable oils and a set-aside percentage of only 5%; this was a massive peril for the Biodiesel industry that resulted in poor economic performance that year.[248]

In 1999 rising crude oil prices as well as the government's decision to introduce a new ecologically justified tax (with Biodiesel being exempt) attracted new producers and importers. Biodiesel of substandard quality arose thereby creating continuous mobility problems for customers. In order to re-establish the quality image of Biodiesel the AGQM (Association for Biodiesel Quality Management) was founded.[249]

However, high crude fossil oil prices in 1999 and 2000 turned out to be the fundament for a highly attractive Biodiesel market, but the resulting increase of production plants could not keep up with exponentially growing demand.
The boom years 1997 to 2002 resulted in a tenfold increase of Biodiesel production capacity.[250]

[244] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 5
[245] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 34
[246] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 5
[247] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 5
[248] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 5
[249] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 5
[250] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 5

4.262 Framework / legislation

4.2621 Supportive taxation measures

- Mineral-oil tax
  German law defines that mineral-oil taxation applies only to mineral-oil based fuels; consequently, Biodiesel enjoyed full detaxation since the very beginning.[251]
- On June 7th 2002, the German Bundestag had its final reading of the new law for the tax relief for biofuels. It was endorsed by the Bundesrat on June 21st and will extend the tax exemption until December 31st 2008. [252]
- Ecological tax (Eco-tax)
  From April 1999 onwards, the additional tax will be added to the mineral-oil tax. Biodiesel is exempted from this environmentally oriented taxation.[253]

4.2622 Regulations for market penetration

In contrast to tax legislation in France and Italy, there is no quantitative contingent and hence no artificial upper limit for the production of biological fuels.[254]

4.2623 Other motives and regulation measures

In its up-to-date study "Total Economic Assessment of Rapeseed Oil Cultivation for Biodiesel Production", the ifo-Institute for Economic Research in Munich came to the conclusion that the Biodiesel production branch secures and creates some 19.000 jobs in agriculture, the processing of raw materials and the marketing of Biodiesel.[255]

[251] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 37
[252] Internet: http://www.ufop.de/2543.htm [2.1.2003]
[253] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 37
[254] BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 2
[255] Internet: http://www.ufop.de/hilfe.html [2.1.2003]

4.2624 Stakeholders

Name	Web-address	Logo	Description
Oelmuehle Leer Connemann & Co. GmbH	http://www.biodiesel.de		BD producer
Öhlmühle Hamburg	http://www.oelag.de		Currently the biggest BD producer with 120.000 t/a
MUW-Mitteldeutsche Umesterungs Werke	http://www.muw-biodiesel.de/		BD producer
NEW	http://www.c-thywissen.de/new/marl.htm		BD producer
SARIA Bio Industries	http://www.saria.de		First producer of Biodiesel (12.000 t/a) from recycling oil
VDB	http://www.biodieselverband.de/		Association of German Biodiesel producers, founded end 2002
UFOP	http://www.ufop.de/		Union for the Promotion of Oilseed- and Protein plants
AGQM	http://www.agqm-biodiesel.de/		Association Quality Management Biodiesel reg. Ass. Main objective is the quality control for Biodiesel
FAL	http://www.tb.fal.de/		Institute of Technology and biosystems Engineering conducting emission tests, host of the annual int. Biodiesel conference
IFEU	http://www.ifeu.de		Biodiesel ecology; LCA, GHG balances
FNR-Fachagentur Nachwachsende Rohstoffe	http://www.fnr.de		Agency of Renewable Resources, founded in 1993 by the Federal Ministry of Nourishment, Agriculture and Forestry

Tab. 32: Biodiesel industry stakeholders in Germany

Source: Websites as denominated in the table; own research

4.263 Production / quality / marketing

4.2631 Plants

Currently there are 19 Biodiesel plants in Germany with a total capacity of 936.000 t/a.

Producer	**Production capacity** t/a	**Start**
Ölmühle Hamburg AG	120.000	09/2001
Ölmühle Leer Connemann GmbH & Co KG	100.000	09/1996
Mitteldeutsche Umesterungswerke Bitterfeld	100.000	09/2001
Natur Energie West	100.000	04/2002
NEVEST AG	100.000	10/2002
Rheinische Bioester GmbH	100.000	12/2002
Campa Biodiesel GmbH	75.000	01/2000
Biodiesel Wittenberge GmbH	60.000	08/1999
Bio-Ölwerke Magdeburg	50.000	03/2003
Thüringer_mehtylesterwerke GmbH& Co. KG	45.000	01/2002
Petrotec GmbH	35.000	05/2002
SARIA Bio-Industries GmbH & Co. Verw. KG	12.000	10/2001
Biodiesel Bokel GmbH	10.000	09/2002
Hallertauer HopfenVerwertungsgesellschaft	8.000	04/1995
Landwirtschaftliche Produktverarbeitungs GmbH	5.000	04/1998
PPM Umwelttechnik GmbH & Co.KG	5.000	11/2001
BioWerk Solhland GmbH	5.000	07/2002
BKK Biodiesel GmbH	4.000	12/2001
Verwertungsgenossenschaft Biokraftstoffe	2.000	04/1996
Sum	**936.000**	

Tab. 33: Biodiesel plants in operation 2003

Source: Internet: http://www.ufop.de/Biointernational.pdf [2.1.2003]

Additionally, there are five more plants under construction with an additional capacity of 173.000 t/a.

Producer	**Production capacity** t/a
Marina Biodiesel GmbH & Co.KG	100.000
EOP Elbe Oel AG	30.000
Biodiesel Kyritz GmbH	28.000
Kartoffelverwertungsgesellschaft Cordes & Stoltenburg GmbH & Co.	10.000
BioWerk Kleisthöhe GmbH	5.000
Sum	**173.000**

Tab. 34: Biodiesel plants in construction 2003

Source: Internet: http://www.ufop.de/Biointernational.pdf [2.1.2003]

This means that with an anticipated Biodiesel production capacity of around 1,1 million tons, the total capacity will have increased more than tenfold since 1998:

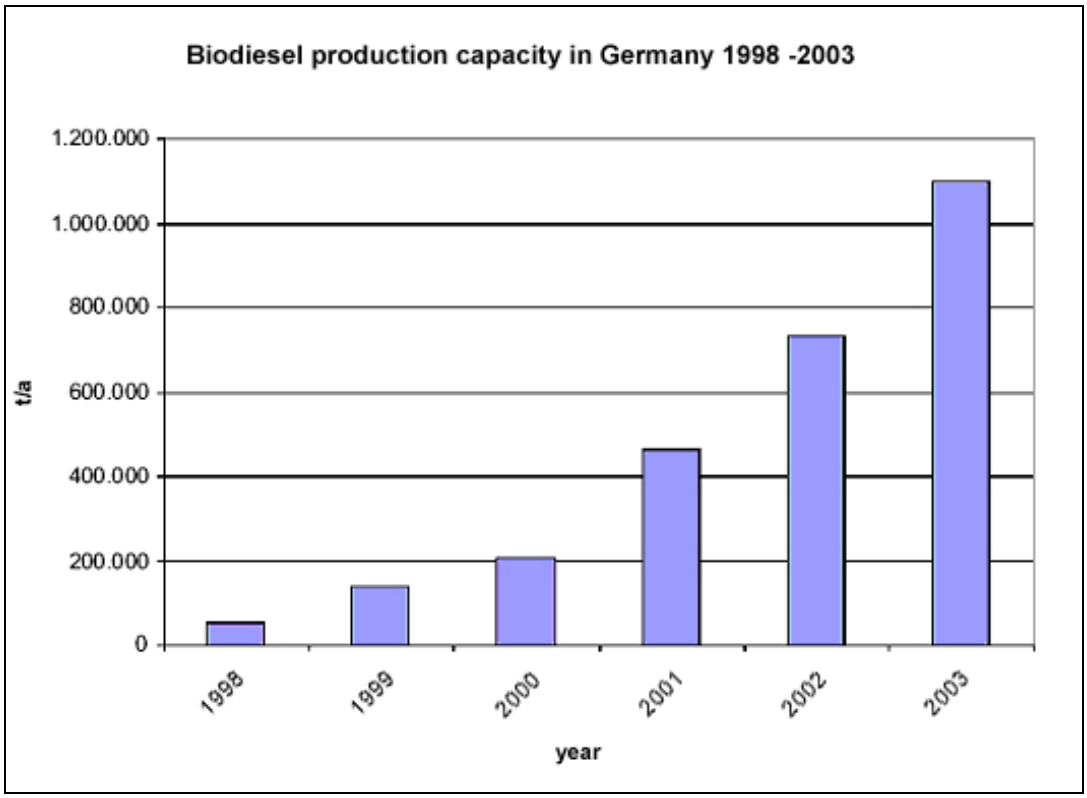

Fig. 25: Biodiesel production capacity 1998-2003

Source: Internet: http://www.ufop.de/Biointernational.pdf [2.1.2003]

4.2632 Feedstock

Biodiesel production is based on nearly 100% rapeseed.[256]
The Agenda for 2000 established an obligation to set-aside land accounting for 10 % of the arable land meaning that over 1 million ha have been put to fallow in Germany.[257]

In future, reasonably priced rapeseed oil may be supported by further progress in breeding for higher oil contents and by higher yields achieved by new breeds and precision farming.[258]

There is accrued interest regarding recycling oil as feedstock basis. Currently there is one plant producing Biodiesel from recycling oils.[259]

4.2633 Quality standards / quality management

With the Austrian standard ON C 1190 from 1991 as a model, DIN V 51.606 for PME (plantoil methyl esters) was published in June 1994.[260]
In 1997, the German standardisation group developed the DIN E 51606 for Fatty-acid-methyl-ester (FAME), one of the most elaborate Biodiesel standards at that time and still valid today.[261]
The actual quality requirements for Biodiesel are stipulated by the fuel standard E DIN 51606 and in future, the European DIN EN 14214 must be fulfilled.[262]

With the objective of establishing a strict quality control system, the AGQM was formed in December 1999.[263]
Main Activities consist in taking samples at public pumps and having them analyzed by independent laboratories. If the sample meets the DIN-standard a quality seal is awarded. This seal can be promoted and used visually as a sign of top quality for the end-user. If the standard is not met, the operator of the selling pump is informed; he or she may be listed as an insecure supplier and the quality seal withdrawn.[264]

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256 ADEME (French Agency for Environment and Energy Management)- Non Technical Barriers to the Development of Biofuels Phase IV, Final Report, Brussels 2000, p. 12
257 Internet: http://www.ufop.de/Biointernational.pdf [2.1.2003]
258 AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 20
259 AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 26
260 AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 28
261 AUSTRIAN BIOFUELS INSTITUTE (ABI): Review on Commercial Biodiesel Production World-wide, Wieselburg 1997, p. 19
262 Internet: http://www.ufop.de/Biointernational.pdf [2.1.2003]
263 AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 30
264 AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 32

4.2634 Marketing strategy / distribution system

The main characteristic of Germany is to market 100% pure Biodiesel which is sold in Germany at over 1.500 public filling stations. For the so-called "free stations", Biodiesel has become an important supplementary product for survival in the ruinous competition between filling stations; therefore, the marketing of Biodiesel through the public filling station network will certainly be extended in the future.

One main drive for initial demand was certainly the cost savings realised when switching from fossil diesel to Biodiesel. Since then, the price gap has even increased.

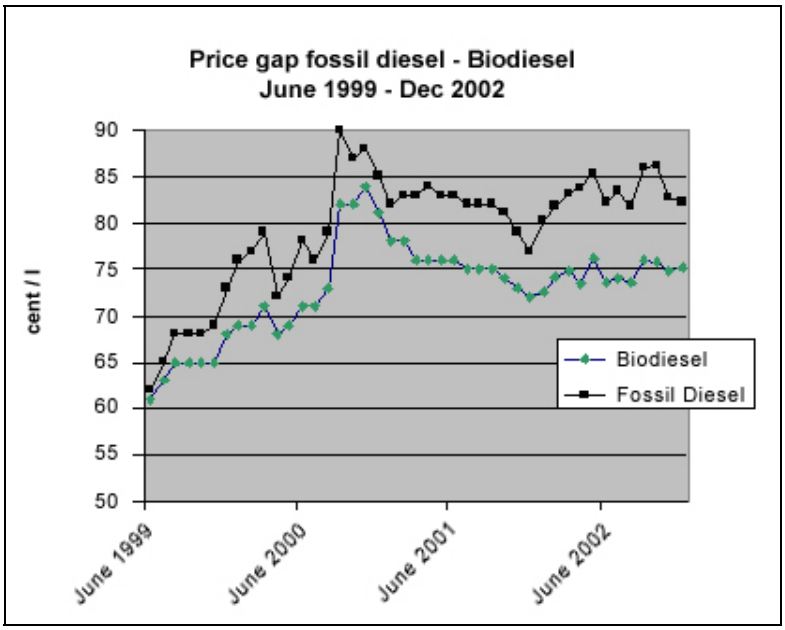

Fig. 26: Price gap fossil diesel – Biodiesel 1999-2002

Source: Internet: http://www.iwr.de

In 2003, over 1.700 filling stations and thereby every 10th public filling station in Germany will supply Biodiesel.[265]

[265] BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 5

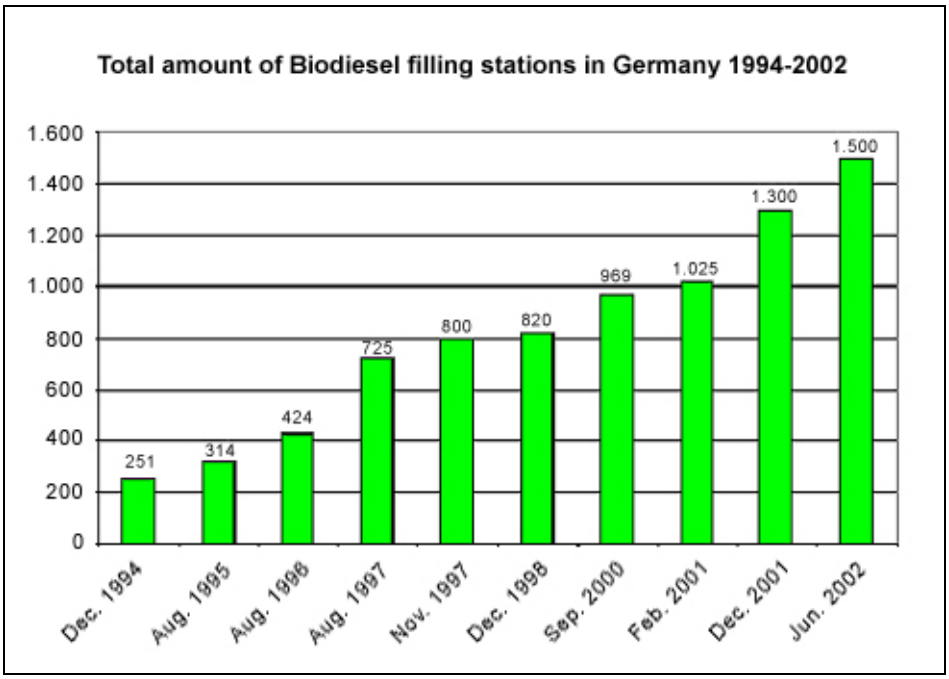

Fig. 27: Development of the Biodiesel filling station network in Germany, 1994-2002

Source: Internet: http://www.ufop.de/Biointernational.pdf [2.1.2003]

Around 30 % of the Biodiesel is distributed through the public filling station network and 70 % through major customers or the operators of public transport fleets, taxi companies etc.[266]

This leads to an average distance between two Biodiesel selling petrol stations of about 23 km.[267]

Realistically estimated there is potential for a further 1.000 petrol stations.[268]

[266] BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 6

[267] Internet: http://www.ufop.de [15.1.2003]

[268] BOCKEY, D.: Biodiesel production and marketing in Germany The situation and perspective, edited by UFOP, Berlin 2002, p. 8

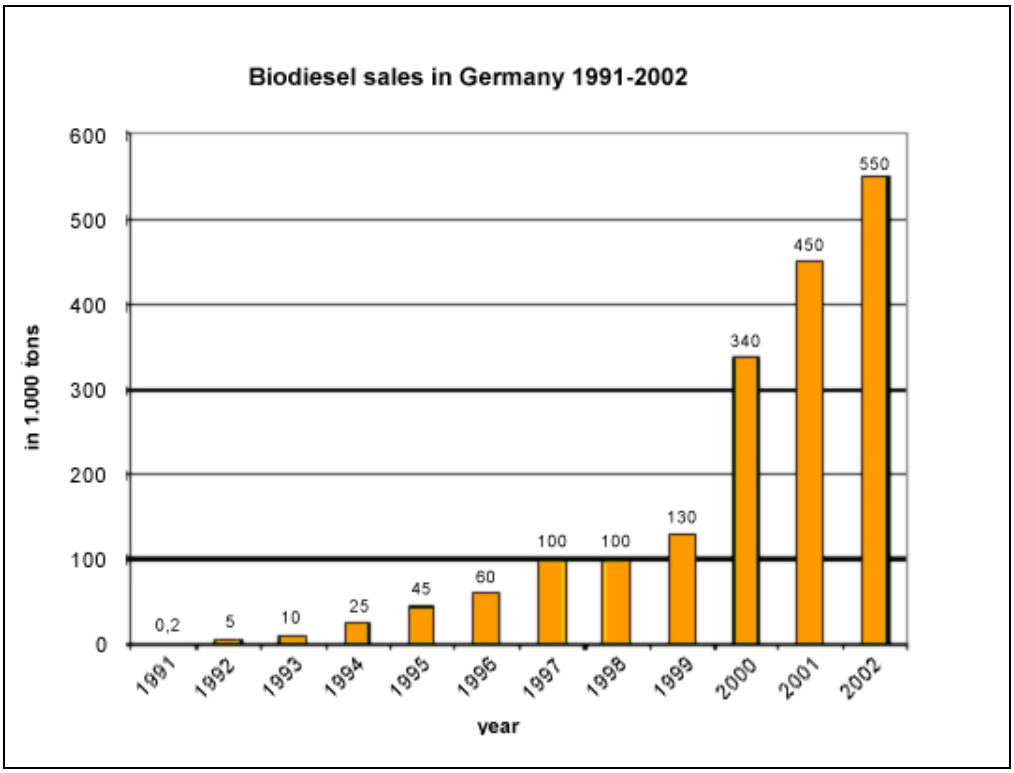

Fig. 28: Biodiesel sales 1991-2002

Source: Internet: http://www.ufop.de/Biointernational.pdf [2.1.2003]

4.264 Summary / forecast

Nationally, enough production capacity has been set up to satisfy customer needs for the years to come. However, as the sales development is not keeping step with the growth of capacity, surplus demand will lead to fierce competition amongst producers. This may result in a price advantage for vehicle keepers in comparison with fossil diesel fuel.[269]

On an international level, the production capacity of more than 1 mil t/a of biofuel leads to an excellent supply position in the European Union; the target quantities stipulated in the action plan can be fulfilled without difficulty.[270]
However with the existing national contingent rulings in many potential target countries and increased production activities in neighbouring countries (i.e. Poland) in mind, it seems difficult that German Biodiesel manufacturers and wholesalers will be able to take advantage of their supply position and consolidate their role as Biodiesel exporters.[271]

[269] BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 6
[270] BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 7
[271] Internet: http://www.ufop.de/Biointernational.pdf [2.1.2003]

Therefore, the future of the German Biodiesel industry will mainly depend on the stable development of national demand. With the aim to support this, UFOP and AGQM lobbied for a separate Biodiesel producers´ association that was finally founded in November 2002.[272]

4.27 Italy

4.271 Introduction / history

Biodiesel production in Italy started in 1992 after a joint venture project co-financed by the European Commission.[273]
In 1995, the Italian government provided the detaxation of 125.000t in order to make the selling cost of Biodiesel comparable to that of fossil diesel.[274]
Nevertheless, production in 1998 was still less than 90.000 t/a.
However, an increasing trend has been recorded in the last four years.[275]

4.2711 Supportive taxation measures

The last finance act of 2001 extended the tax exemption to 300.000 t/a of Biodiesel thereby allowing the same price for Biodiesel and fossil diesel. This regulation will expire in 2004 but the Ministry of Finance still has not approved the regulations establishing in which way the programme will be carried out.[276]
Additional production exceeding this quota is fully taxed and not competitive with fossil diesel.[277]

4.2712 Other motives and regulation measures

According to the current regulations, fossil diesel can only be blended with 5% heating oil and with 25% of Biodiesel.[278]

[272] AUSTRIAN BIOFUELS INSTITUTE (ABI): Biodiesel- a success story, The development of Biodiesel in Germany, Vienna 2001, p. 31
[273] AUSTRIAN BIOFUELS INSTITUTE (ABI): Review on Commercial Biodiesel Production World-wide, Wieselburg 1997, p. 21
[274] ENEA (Italian National Agency for New Technologies, Energy and the Environment): In response to the e-mail questionnaire sent by the author, Italy, Rome 2002, p. 1
[275] ENEA (Italian National Agency for New Technologies, Energy and the Environment): In response to the e-mail questionnaire sent by the author, Italy, Rome 2002, p. 1
[276] ENEA (Italian National Agency for New Technologies, Energy and the Environment): In response to the e-mail questionnaire sent by the author, Italy, Rome 2002, p. 1
[277] CTI (Italian Thermotechnical Committee Energy and Environment): In response to the e-mail questionnaire sent by the author, Italia, Milano 2002, p. 1
[278] AWO- Aussenwirtschaft Österreich (Italian Office of the Austrian Federal Economic Chamber; Italy): In response to the e-mail questionnaire sent by the author, Italy, Rome 2002, p. 1

4.2713 Stakeholders

Name	Web-address	Logo	Description
Cti	http://www.cti2000.it/		Italian Thermotechnical Committee Energy and Environment
Assobiodiesel	http://www.assobiodiesel.it		Producers association
ITABIA	http://www.itabia.it		Italian Biomass Association with a working Group on Biodiesel
Novaol	http://www.novaol.it		The biggest Biodiesel producer Brand: Diesel-Bi® Acquired in December 2002 by Bunge

Tab. 35: Biodiesel industry stakeholders in Italy

Source: Websites as denominated in the table; own research

4.272 Production / quality / marketing

4.2721 Plants

Italy has seven Biodiesel production plants:
Novaol, Fox petroli, Bakelite, Italbioil, Comlube, De.fi.lu, Estereco.[279]

[279] ENEA (Italian National Agency for New Technologies, Energy and the Environment): In response to the e-mail questionnaire sent by the author, Italy, Rome 2002, p. 1

The estimated shares in national production:

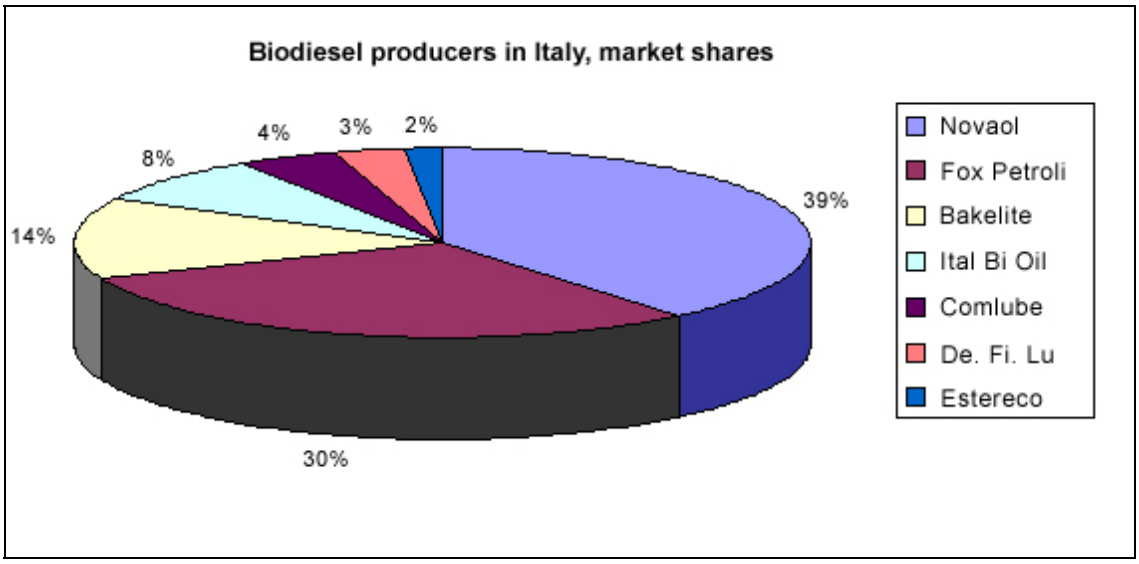

Fig. 29: Producer´s contributions to national Biodiesel production in Italy

Source: ENEA (Italian National Agency for New Technologies, Energy and the Environment): In response to the e-mail questionnaire sent by the author, Italy, Rome 2002, p. 1

In 2002, effective production amounted to 220.000 t[280] with an overall production capacity of 600.000t/a.[281] Due to governmental quota limitations, the market situation does not allow additional plants in the near future.[282]

[280] CTI (Italian Thermotechnical Committee Energy and Environment): In response to the e-mail questionnaire sent by the author, Italia, Milano 2002, p. 1

[281] ENEA (Italian National Agency for New Technologies, Energy and the Environment): In response to the e-mail questionnaire sent by the author, Italy, Rome 2002, p. 1

[282] CTI (Italian Thermotechnical Committee Energy and Environment): In response to the e-mail questionnaire sent by the author, Italia, Milano 2002, p. 2

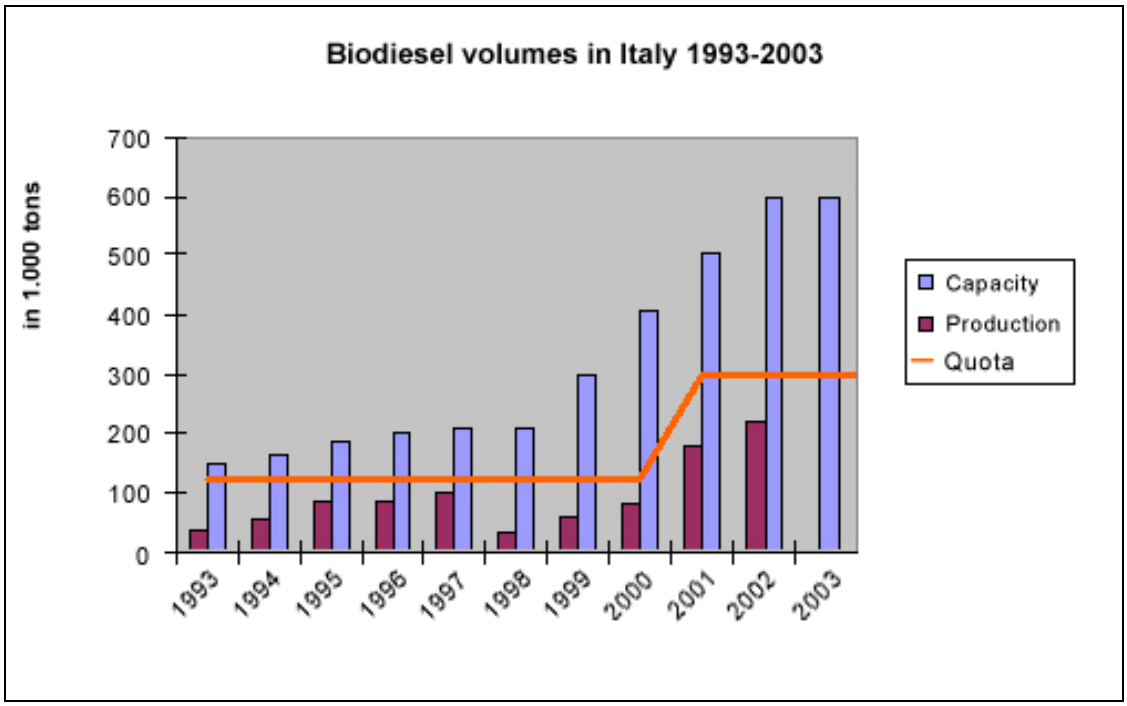

Fig. 30: Biodiesel volumes in Italy 1993-2003

Source: ENEA (Italian National Agency for New ENEA (Italian National Agency for New Technologies, Energy and the Environment): In response to the e-mail questionnaire sent by the author, Italy, Rome 2002, p. 1; own research

4.2722 Feedstock

The production cost of Biodiesel is almost 49 Euro cents. More than 80% of this cost is due to the raw material (rape and sunflower) which is mostly imported from France and Germany.[283]
An interesting perspective would be the recovery and reuse of the exhausted oils to produce Biodiesel. The national production of vegetal oils in Italy is around 2 mld t/a. Only half of it is currently recovered through a deacidification and dehumidification process.[284]

4.2723 Quality standards / quality management

Based on the CUNA standard NC 635-01 developed in 1993 the UNI standard was published, which is going to be replaced by the new CEN-standard EN14214. [285]

[283] ENEA (Italian National Agency for New Technologies, Energy and the Environment): In response to the e-mail questionnaire sent by the author, Italy, Rome 2002, p. 12
[284] ENEA (Italian National Agency for New Technologies, Energy and the Environment): In response to the e-mail questionnaire sent by the author, Italy, Rome 2002, p. 2
[285] KÖRBITZ, W., Austrian Biofuels Institute, 18.7.2003

4.2724 Marketing strategy / distribution system

Fatty-acid-methyl-ester has found its main market segment in the heating oil market with lower distribution cost and lower quality requirements than in the diesel fuel market.[286]
Recently several producers have enlarged their marketing activities to position Biodiesel in the transport sector as well, where a blend of 5% Biodiesel with fossil diesel is used in large fleets. Novaol has furthermore launched a project called "one hundred cities on sunflower" with the aim to promote a 30% blend Biodiesel in public transport, as already used successfully in France.[287]

4.273 Summary / forecast

Overall activities in Italy have been limited so far to utilise Biodiesel mainly in the heating oil segment and not in transportation as exercised in all other European countries. With the new Directives of the European Commission in place the well established and experienced Italian Biodiesel producers will have to reconsider their marketing philosophy in order to fully exploit the new market opportunities in the transport sector.[288]

4.28 Slovakia

4.281 Introduction / history

In 1991, under the former federal system of the ČSFR government, an oleo-programme was launched, supported by initiatives for process development and quality control at the University of Bratislava.[289]
The first small-scale plant went into operation in 1992 followed by additional facilities for the rapeseed oil methyl ester (ROME) production developed by small and medium entrepreneurs.[290]
In 2001, total production capacity amounted to more than 120.000 t RME.[291]
Changes in subsidy legislation paralyzed Biodiesel production at the end of 2001.[292]

[286] CTI (Italian Thermotechnical Committee Energy and Environment): In response to the e-mail questionnaire sent by the author, Italia, Milano 2002, p. 1
[287] KÖRBITZ, W., Austrian Biofuels Institute, 18.7.2003
[288] KÖRBITZ, W., Austrian Biofuels Institute, 18.7.2003
[289] MINISTRY OF ECONOMY, In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 1
[290] AUSTRIAN BIOFUELS INSTITUTE (ABI): Review on Commercial Biodiesel Production World-wide, Wieselburg 1997, p. 16
[291] MINISTRY OF ECONOMY, In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 1
[292] Energy Centre Bratislava: In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 1

4.282 Framework / legislation

4.2821 Supportive taxation measures

Until December 31 2001, the Law Act No. 316/1993 was in force. According to this act, the excise duty for fossil diesel fuel was 14.600,- SKK/t (349,80 €), whereas for biogenic diesel fuel (31% RME + 69% gas oil the excise duty made only 3.000 SKK/t (71,90 €), providing a detaxation bonus not only for the Biodiesel share, but also for the fossil diesel share in the blended fuel, which became very attractive in the market place. This triggered a very fast expansion of the Slovakian Biodiesel capacity.
Since January 2002 however a new law (Act No. 239/2001) ceased this preferential treatment of the Biodiesel blend by increasing the excise duty for fossil diesel share significantly while maintaining full tax exemption for the Biodiesel share.
As a result Biodiesel production was no longer profitable and production declined quickly.[293]
The Ministry of Agriculture (MoA) prepared a program for MERO and bio ethanol production and their use in motor fuels. The program tied together information from the Ministry of Economy submitted to be considered by the government. It suggestsed legislative instruments that secured sale of fuels from renewable energy sources in a way to make their market share 5% in 2005. The Ministry of Finance disapproved.[294]

4.2822 Other motives and regulation measures

As part of the integration process of the Slovak Republic into the EU internal market, ensuring sufficient production volume of motor biofuel will be among the tasks listed in the section dealing with energy.
A speedy preparation of a motor biofuel development policy, in a joint effort by the state authorities involved and entrepreneurs operating in this field, will be high on the agenda.[295]

[293] VURUP (Research Institute of Petroleum and Hydrocarbon Gases): In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 1
[294] Energy Centre Bratislava: In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 2
[295] MINISTRY OF ECONOMY, In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 1

4.2823 Stakeholders

Name	Web-address	Logo	Description
EKOIL	http://www.ekoil.sk		Biggest producer with a capacity of more than 50.000 t/a of RME
Slovnaft VURUP	http://www.vurup.sk		Research Institute of Petroleum and Hydrocarbon Gases - applied research for the requirements of refineries.
SK-Biom	http://www.skbiom.sk/		Slovak Biomass Association with a subsection for RME-producers
Faculty of chemical and food production	http://www.chtf.stuba.sk		Research institute of the Slovak Technical University focusing on Biodiesel research

Tab. 36: Biodiesel industry stakeholders in Slovakia

Source: Websites as denominated in the table; own research

4.283 Production / quality / marketing

4.2831 Plants

Two FAME production concepts are currently available in Slovakia. In a network of low-capacity units with a production of 500 – 5.000 t/a or in a few large-capacity production plants with a production volume of 10.000 – 50.000 t/a, mostly joined to existing capacities of press plants and refineries:[296]

[296] CVENGROS, M.: Review on Development and Legislation of Biodiesel production and utilization in Slovakia, article presented at Techagro Fair, Brno 2002, p. 2

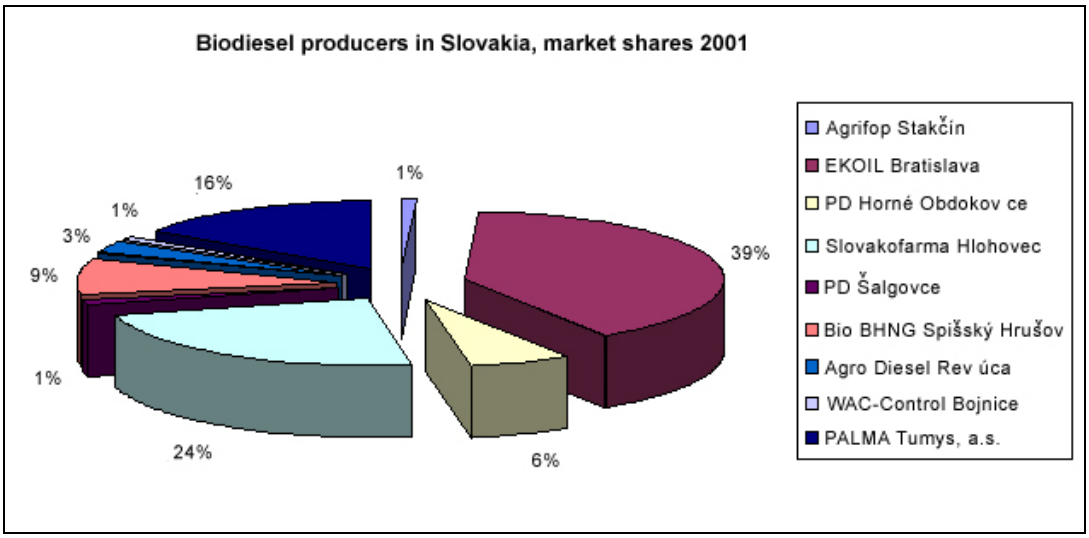

Fig. 31: Biodiesel production in Slovakia, market shares 2001

Source: VURUP (Research Institute of Petroleum and Hydrocarbon Gases): In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 1

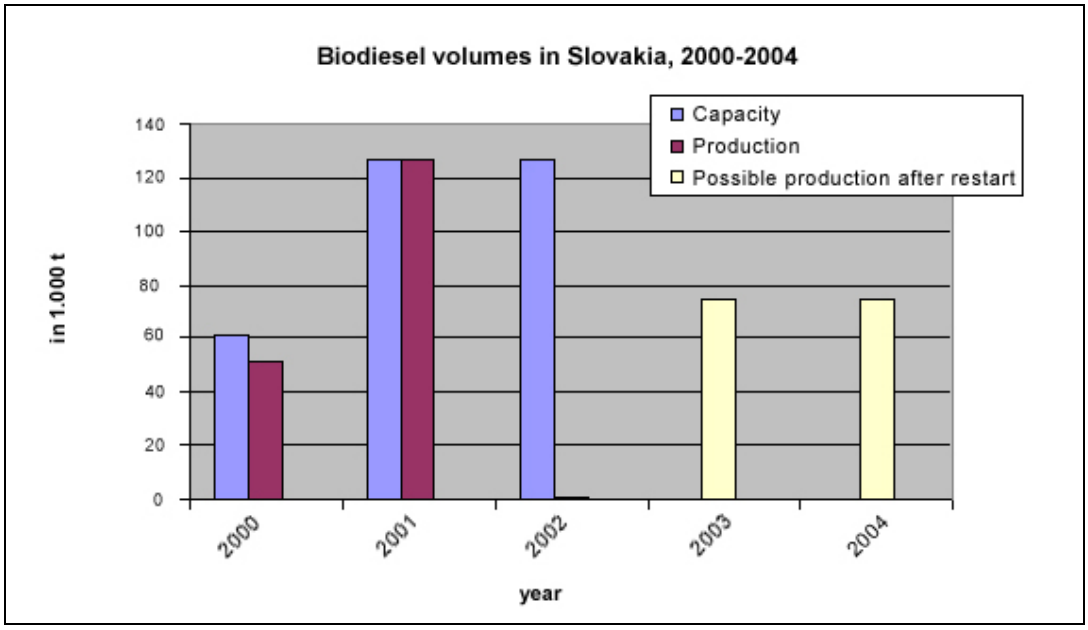

Fig. 32: Biodiesel volumes in Slovakia 2000-2004

Source: VURUP (Research Institute of Petroleum and Hydrocarbon Gases): In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 1
2002 figures: EC Bratislava (Energy Centre Bratislava): In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 1

In 2000, the total RME production in Slovakia amounted to 52.000 t (with total capacity of 61.200 t). The production capacity in 2001 represented 127.000 t.[297]

[297] VURUP (Research Institute of Petroleum and Hydrocarbon Gases): In response to the e-mail questionnaire sent by the

For the time being there are no new production plants planned or in construction.[298]

4.2832 Feedstock

Most of the plants process rapeseed with a minor share of sunflower and soybean as well.[299]

4.2833 Process technology

The vast majority of Biodiesel producers use the technology developed by the company VVÚ ZTS Martin, a former producer of heavy weapons and tanks that later became MDT Ltd.[300]

4.2834 Marketing strategy / distribution system

Biodiesel is primarily sold as a 30% (RME)/ 70% (diesel) blend with the main market being the agriculture and forestry industry, as tax relief has been made only for these two sectors; a small part is sold as pure RME.[301]

4.284 Summary / forecast

Due to the fact that production price of RME is approx. 29 SKK/litre (0,69 €) higher than the price of fossil diesel fuel at filling stations) there has been no biogenic diesel fuel on the motor fuel market in Slovakia since January 2002.[302]
It is a fact that the legislative development will be determined by the approximation of Slovak law system with EU legislation.[303] In order to have full support for biofuels, the following legislative modifications are under discussion:

- an amendment to a new act on taxes for mineral oil, containing tax release for fuels that contain bio-ingredients
- in case of disapproval, to secure a percentage share of bio-ingredients of fuel to be exempt of the tax and returned to the branch, which will use it to support rape planting.[304]

The capacity of RME after the possible re-launch of its production (in the case of law regulation modifications) is estimated to be at the level of approximately 75.000 t/a.[305]

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author, Slovakia, Bratislava 2002, p. 1

298 VURUP (Research Institute of Petroleum and Hydrocarbon Gases): In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 2

299 AUSTRIAN BIOFUELS INSTITUTE (ABI): Review on Commercial Biodiesel Production World-wide, Wieselburg 1997, p. 24

300 AUSTRIAN BIOFUELS INSTITUTE (ABI): Review on Commercial Biodiesel Production World-wide, Wieselburg 1997, p. 24

301 MINISTRY OF ECONOMY, In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 2

302 VURUP (Research Institute of Petroleum and Hydrocarbon Gases): In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 3

303 VURUP (Research Institute of Petroleum and Hydrocarbon Gases): In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 3

304 Energy Centre Bratislava: In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 3

305 VURUP (Research Institute of Petroleum and Hydrocarbon Gases): In response to the e-mail questionnaire sent by the author, Slovakia, Bratislava 2002, p. 3

4.29 Switzerland

4.291 Introduction / history

After initial research activities in the early 90s by various Swiss institutes (FAT, EMPA), a small but steady production was realised[306].

4.292 Framework / legislation

4.2921 Supportive taxation measures

Fuels produced in pilot and demonstration plants from renewable raw materials are exempt from mineral oil tax. Tax exemption is granted by the Finance Department upon application.[307]
In order to promote the use of renewable raw materials, there is a price subsidy for oilseeds (rapeseed, colza, sunflower) being processed in pilot and demonstration plants.[308]

306 AUSTRIAN BIOFUELS INSTITUTE (ABI): Review on Commercial Biodiesel Production World-wide, Wieselburg 1997, p. 25
307 BLW - Bundesamt für Landwirtschaft (Swiss Federal Office for Agriculture): In response to the e-mail questionnaire sent by the author, Switzerland, Bern 2002, p. 1
308 BLW - Bundesamt für Landwirtschaft (Swiss Federal Office for Agriculture): In response to the e-mail questionnaire sent by the author, Switzerland, Bern 2002, p. 1

4.2922 Stakeholders

Name	Web-address	Logo	Description
Eco Energie Etoy	http://www.ecoenergie.ch/		Biodiesel producer since 1996
Flamol	http://www.flamol.ch/raps/		Mineral oil company offering Biodiesel
FAT Tänikon	http://www.sar.admin.ch/fat/		Federal Research Station for Agricultural Economics and Engineering- responsible for quality control.

Tab. 37: Biodiesel industry stakeholders in Switzerland

Source: Websites as denominated in the table; own research

4.293 Production / quality / marketing

4.2931 Plants

Currently there is one production plant with a capacity of 2.000 t/a.[309]
There are no new Biodiesel plants planned.[310]

4.2932 Feedstock

Mainly rapeseed oil is used with small amounts of sunflower.
From the 300.000 ha arable farmland, 20% could be cropped with rapeseed, which represents a fossil diesel substitution rate of 4%. Medium-term substitution potential is 36.000 t/a.[311]

4.2933 Quality standards / quality management

German DIN V 51606 is used as the standard.[312]

[309] AUSTRIAN BIOFUELS INSTITUTE (ABI): Review on Commercial Biodiesel Production World-wide, Wieselburg 1997, p. 26
[310] FLAMOL Mineralöl AG: In response to the e-mail questionnaire sent by the author, Switzerland, Bern 2002, p. 1
[311] Internet: http://www.raps-diesel.ch/raps/index.htm [10.12.2002]
[312] FLAMOL Mineralöl AG: In response to the e-mail questionnaire sent by the author, Switzerland, Bern 2002, p. 1

4.2934 Marketing strategy / distribution system

Biodiesel is sold in two ways:

- directly to agricultural cooperatives[313]
- to one Swiss petrol distributor that sells Biodiesel at five public filling stations (all in the Bern district) where it is offered 100 % pure.[314]

Some transport companies use it as “Combi-Diesel”, which is a 30% blend with fossil diesel.[315]

The glyerine produced is exported to Germany for further processing and usage in the chemical and pharmaceutical industry.[316]
The Biodiesel price is kept stable and currently it is 10 % lower than fossil diesel. [317]

4.294 Summary / forecast

Total consumption of diesel fuel in Switzerland averages to approximately 1,200.000 t/a, effective substitution amounts to 0,2 % only.[318]
After some years of constant production and turnover, Biodiesel finally could experience a new boost in the medium run. After a successful launch at the public pumps of one company, it is now, as prices for fossil fuels went up again, the transport sector that is showing renewed interest.[319]

4.210 UK

4.2101 Introduction / history

In 1993, BABFO, the British Association for Biofuels and Oils, was founded as a Biodiesel promoting agency.[320]

Up until December 1995, 200 tons of RME were produced by a consortium of UK companies for use in experimental field trials of alternative fuelled vehicles. This ceased following a change in taxation applied to the production.[321]

The Budget Statement of 1997 stated: "The Government places a high priority on the

313 Internet: http://www.ecoenergie.ch/ [10.12.2002]
314 FLAMOL Mineralöl AG: In response to the e-mail questionnaire sent by the author, Switzerland, Bern 2002, p. 1
315 Internet: http://www.ecoenergie.ch/index2.htm [11.12.2002]
316 Internet: http://www.ecoenergie.ch/index2.htm [11.12.2002]
317 FLAMOL Mineralöl AG: In response to the e-mail questionnaire sent by the author, Switzerland, Bern 2002, p. 1
318 Internet: http://www.raps-diesel.ch/raps/index.htm [11.12.2002]
319 BLW - Bundesamt für Landwirtschaft (Swiss Federal Office for Agriculture): In response to the e-mail questionnaire sent by the author, Switzerland, Bern 2002, p. 1
320 AUSTRIAN BIOFUELS INSTITUTE (ABI): Review on Commercial Biodiesel Production World-wide, Wieselburg 1997, p. 25
321 Internet: http://europa.eu.int/comm/energy_transport/atlas/html/biodmarfutc.html [10.9.2002]

use of the tax system to deliver environmental objectives".[322]

Nevertheless, in 1999, this high priority was far from being implemented as the tax exemption rates at that time show:

Fuel type	**Tax** (pence per l)	**Tax** (€ per l)[323]
Aviation turbine fuel	0	0
Unleaded Petrol	48,82	0,7475
Ultra low sulphur diesel	48,82	O,7475
High Octane unleaded Petrol	50,89	0,7792
DERV (includes Biodiesel)	51,82	0,7934

DERV-diesel engine road vehicle

Tab. 38: Excise duty on transport fuels

Source: Internet: http://www.biodiesel.co.uk/memorandum%20to%20policy%20unit%20no10%20downing%20street.htm [10.9.2002]

Finally, a new duty rate for Biodiesel of 25,82 pence per litre (0,371 €)[324] was introduced in the 2002 Budget. [325]
The move, a grudging recognition by a traditionally anti-diesel government that Biodiesel holds real environmental advantages, will only put UK Biodiesel duty on a par with that levied on fossil diesel elsewhere in Europe, but it is a good start.[326]

4.2102 Framework / legislation

4.21021 Supportive taxation measures

The new duty rate for Biodiesel of 25,82 pence per litre (0,371 €) came into effect on 26th July 2002.[327] This is a cut of 20 pence per litre (0,288 €) -with proportionate rebates for blends- compared to ultra low sulphur diesel.[328]
Requested level of fuel excise duty derogation for Biodiesel as a road transport fuel is 40 pence per litre (0,575 €), which would ensure the adequate promotion of large-scale production of Biodiesel. [329]

[322] Internet: http://www.biodiesel.co.uk/memorandum%20to%20policy%20unit%20no10%20downing%20street.htm [10.9.2002]
[323] Currency conversion rate 1 British Pound = 1,531 Euro (Median price (ask) of Thursday, July 1, 1999)
[324] Currency conversion rate 1 British Pound = 1,438 Euro (Interbank rate of Tuesday, September 30, 2003)
[325] Internet: http://www.defra.gov.uk/farm/acu/energy/energy.htm#biofuels [11.10.2002]
[326] Internet: http://www.4car.co.uk/jsp/main.jsp?lnk=250&pageid=3688 [27.12.2002]
[327] Internet: http://www.defra.gov.uk/farm/acu/energy/energy.htm#biofuels [27.12.2002]
[328] ABI (Allied Biodiesel Industries UK): In response to the e-mail questionnaire sent by the author, U.K. 2002, p. 1
[329] MORTIMER, N.: Evaluation of the comparative energy, environmental and socio-economic costs and benefits of Biodiesel, Draft Report for the Department for Environment, Food and Rural Affairs, London 2002, p. 2

4.21022 Stakeholders

Name	Web-address	Logo	Description
BABFO- British Association for Biofuels and Oils	http://www.biodiesel.co.uk/		Promotion of transport fuels and oils from renewable sources
ABI- Allied Biodiesel Industries	http://www.ukbiodiesel.biz		Association of SME producing Biodiesel
Rix Biodiesel Limited	http://www.rixbiodiesel.co.uk/	RIX BioDiesel Limited	So far the biggest producer with a future production capacity of 30.000 t/a
Biofuels Corporation Ltd.	http://biofuelscorp.com/project.htm	BIOFUELS CORPORATIO LIMITED	Plans to construct a modern Biodiesel production plant with a production capacity of 250.000 t/a in the North-East of England.
Argent Energy (Argent Group Europe)	Not available	ARGENT GROUP EUROPE	Capacity: 50.000 t/a Start: 1/2004 Feedstock: tallow In construction
Greenergy	http://www.greenergy.com/	Greenergy	Brand: GlobalDiesel, a blend of 95% ULSD with 5% FAME
Global Commodities	http://www.globeco.co.uk/	GLOBAL COMMODITIES UK LTD	Small size Biodiesel producer driveECO brand:
Ebony solutions	http://www.ebony-solutions.co.uk/		e-diesel - BD producer

Tab. 39: Biodiesel industry stakeholders in the United Kingdom

Source: Websites as denominated in the table; own research

4.2103 Production / quality / marketing

4.21031 Plants

Estimates for current Biodiesel production are at about 5.000 t/a[330] but this figure is soon to be outdated, as the new tax regulation should increase the number of Biodiesel outlets that sell in bulk to local (estimated at a production enlargement of 30.000 t/a[331]), corporate fleets and availability should increase.[332]
Also the first large-scale production plant is about to be constructed in Scotland by Argentgroup. This plant will be equipped with modern BDI process technology with a capacity of 50.000 t/a. Main feedstock will be tallow, start-up date is January 2004.[333]

4.21032 Feedstock

Due to its low purchase price, recycled cooking oil is currently the main feedstock. Once the limited quantities of used industrial frying oils have been fully given over to Biodiesel production, raw feedstock may come from the cultivation of rapeseed crops.[334]
In 1999, the UK total of crops and temporary grassland was 5,968.000 ha. Of this, oil-seed rape/canola took 417.000 ha and linseed (a crop of uncertain future) 209.000 ha. There was 572.000 ha of "set-aside" land and of this 120.000 ha grew industrial oil seed crops.

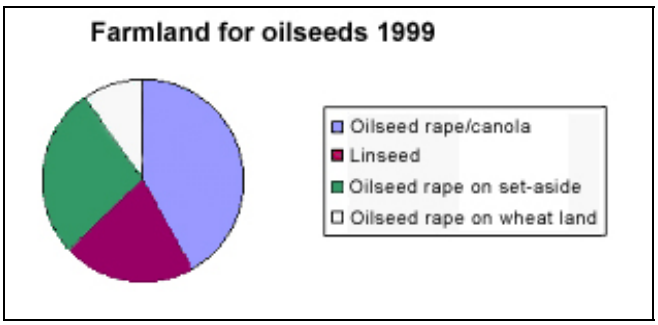

Fig. 33: Farmland for oilseeds 1999

Source: Internet: http://www.biodiesel.co.uk/press_release/submi-ssion_for_biofuels_5.htm#SECTION%20I [20.12.2002]

After deducting the area of oilseeds needed to meet current domestic food and non-food needs (475.000 ha or thereabouts), there may be a further 500.000 ha available in the short to medium term for Biodiesel production (total area 996.000 ha).[335]

330 ABI (Allied Biodiesel Industries UK): In response to the e-mail questionnaire sent by the author, U.K. 2002, p. 1
331 ABI (Allied Biodiesel Industries UK): In response to the e-mail questionnaire sent by the author, U.K. 2002, p. 1
332 Internet: http://www.4car.co.uk/jsp/main.jsp?lnk=250&pageid=3688 [27.12.2002]
333 Internet: http://www.biodiesel-intl.com/referenz_e/referenz.htm [27.12.2002]
334 Internet: http://www.4car.co.uk/jsp/main.jsp?lnk=250&pageid=3688 [27.12.2002]
335 Internet: http://www.biodiesel.co.uk/press_release/submission_for_biofuels_5.htm [28.9.2003]

4.21033 Quality standards / quality management

The EU fuel standard for Biodiesel prEN14214 has not yet been formally ratified, but might become the standard for rebate eligibility in due course.[336]

4.21034 Marketing strategy / distribution system

The main marketing activities are focused on the promotion of a 5% blend of Biodiesel with fossil diesel; part of the Biodiesel sold is imported from France, Germany and Denmark. Largest quantities are sold either directly to large fleets or to more than 70 road-side filling stations. Close to the few small scale methyl-ester production sites fuel is sold in containers of 25 to 1.000 litres.[337]

4.2104 Summary / forecast

The new duty rate for Biodiesel may be the cornerstone for an initial Biodiesel industry. In view of the AA (Automobile Association) predicting UK road traffic doubling by 2025[338] it would make sense to follow the French in supplementing fossil diesel fuel with up to 2 % Biodiesel. Not only would this reduce the dependence on crude oil, but the improved lubrication qualities of Biodiesel would eliminate the need for the exotic additives currently used in diesel engines.[339]
Large-scale production would by all means require an increased tax rebate (40 pence instead of 20 pence, i.e. the parity of duty for Biodiesel with the fossil gas fuels LPG & CNG).[340]
This measure may bring in another 40.000 t/a of recycled oil for Biodiesel production, but currently there is no sign of treasury flexibility in larger tax breaks to enable expanded production (i.e. from rape oil).[341]
There are no technical barriers to growing oilseed crops on (potentially) 500.000 ha for Biodiesel use in the UK.[342]
In the medium term, 2% of diesel use could be Biodiesel, i.e. 340.000 t out of 17,000.000 t/a of diesel used in the UK.[343]
Best-case calculations talk about a maximum fossil diesel substitution rate of 10 %. That would mean a saving of about 1,7 million t/a of fossil diesel.[344]

[336] Internet: http://www.biodiesel.co.uk/newsletter_0802.htm [13.11.2002]
[337] ABI (Allied Biodiesel Industries UK): In response to the e-mail questionnaire sent by the author, U.K. 2002, p. 2
[338] Internet: http://europa.eu.int/comm/energy_transport/atlas/html/biodmarfutc.html [27.12.2002]
[339] Internet: http://www.4car.co.uk/jsp/main.jsp?lnk=250&pageid=3688 [27.12.2002]
[340] Internet: http://www.biodiesel.co.uk/newsletter_0802.htm [11.10.2002]
[341] ABI (Allied Biodiesel Industries UK): In response to the e-mail questionnaire sent by the author, U.K. 2002, p. 2
[342] Internet: http://www.biodiesel.co.uk/biofuels_and_the_future.htm [10.9.2002]
[343] Internet: http://www.biodiesel.co.uk/memorandum%20to%20policy%20unit%20no10%20downing%20street.htm [10.9.2002]
[344] Internet: http://www.4car.co.uk/jsp/main.jsp?lnk=250&pageid=3690 [11.10.2002]

4.3 The Americas

4.31 The USA

4.311 Introduction / history

In the United States interest in Biodiesel was stimulated by the Clean Air Act of 1990 combined with regulations requiring reduced sulphur content in diesel fuel and reduced diesel exhaust emissions.[345]

In 1992, the National SoyDiesel Development Board (NSDB) was formed by soybean farmers, funded through the United Soybean Board with national soybean checkoff funds, as the lead organization in the United States conducting research and market development activities with Biodiesel.[346] At the same time, initial quantities of Biodiesel were produced in non-dedicated plants, e.g. by PROCTER & GAMBLE.[347]
It was also in 1992 that Congress passed The Energy Policy Act of 1992 (EPAct): in order to reduce the nation's dependence on imported petroleum, certain fleets would be required to acquire alternative fuel vehicles (AFVs) which were capable of operating on non-petroleum fuels.[348]

The NSDB changed its name to the National Biodiesel Board (NBB) in September, 1994.[349]

In 1996, there were two companies that were registered Biodiesel suppliers.
Four years later there were more than 14 companies engaged in the development of Biodiesel manufacturing plants and industry development activities with 200.000 t/a (=60 million gallons) of available dedicated capacity.[350]

On June 20th, 2001, the nation's first retail biofueling station started serving the general public in Aiken, South Carolina, offering customers a complete selection of biofuels including E85 (85% ethanol and 15% gasoline), B20 (20% Biodiesel and 80% fossil diesel), and B100.[351]

In April 2002, California became the first US state in which a bill restricting carbon dioxide emissions from automobiles was introduced.[352]

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345 Internet: http://www.greenfuels.org/bioworld.html [3.1.2003]
346 HOWELL, S., WEBER, A.: U.S. Biodiesel Overview, edited by the National Biodiesel Board, Jefferson City 2000, p. 2
347 AUSTRIAN BIOFUELS INSTITUTE (ABI): Review on Commercial Biodiesel Production World-wide, Wieselburg 1997, p. 26
348 Internet: http://www.ott.doe.gov/epact/ [14.1.2003]
349 HOWELL, S., WEBER, A.: U.S. Biodiesel Overview, edited by the National Biodiesel Board, Jefferson City MO USA 2000, p. 2
350 NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 1
351 Internet: http://www.afdc.doe.gov/whatsnew01.shtml [10.10.2002]
352 POLAKOVIC, G.: Davis Signs Bill to Cut Greenhouse Gases, edited in L.A. Times, Los Angeles, July 23, 2002, p. A1

Later on The American Society of Testing and Materials (ASTM) issued Specification D 6751 for all Biodiesel fuel bought and sold in the U.S., a major milestone for the Biodiesel industry.[353]

4.312 Framework / legislation

4.3121 Supportive taxation measures

Biodiesel taxation in the United States has traditionally been at the same rate as fossil diesel fuels.[354] It is taxed at the federal level the same as standard number 2 fossil diesel fuel, 24,4 cents[355] per gallon.[356]

There is pending federal legislation to reduce this by one cent per percentage Biodiesel blended up to B20 (20% Biodiesel/80% fossil diesel).[357]

In addition to federal excise taxes, most states also charge their own taxes on fuel and these taxes are in addition to the federal tax.[358] At the moment state tax incentives for Biodiesel are offered by Idaho, Illinois, Iowa, Hawaii, Massachusetts, Montana, North Dakota (once a plant is built in state) and Texas, and a state mandate has been introduced for Minnesota.[359]

Some states (and even local communities) may also offer incentives for specific blends or for special groups of users.[360]

On April 25th, and by an astounding 88-11 bipartisan vote, the U.S. Senate voted in favour of Bill S-517, the Energy Policy Act of 2002, with multiple provisions to help level the playing field for Biodiesel: excise tax incentive, tax credit, renewable fuels standard, fed fleet use and removal of the 50% Biodiesel limit in EPACT (see in 4.3123).[361]

A second supportive measure is the U.S. Department of Agriculture's (CCC-Commodity Credit Corporation) program that provides a subsidy stimulating industrial consumption of agricultural commodities like soybean oil by promoting their use in

353 Internet: http://www.biodiesel.org/pdf_files/ASTM_Spec_02.pdf [2.1.2003]

354 LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 77

355 Currency conversion rate: 1 USD = 0,85727 € (Interbank rate of Wednesday, October 30, 2003)

356 NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 1

357 NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 1

358 NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 1

359 LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 77

360 TYSON, K.: Biodiesel handling and use guidelines-National Renewable Energy Laboratory- edited by the National Renewable Energy Laboratory, September 2001, p. 20

361 NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 2

bioenergy production.[362] With the subsidies, Biodiesel is currently selling for $1,30 to $1,50 per gallon (1,114 € to 1,286 €)without road taxes. The CCC program is paying producers 40% of the value of soybeans purchased to produce fuel.[363]

4.3122 Regulations for market penetration

Biodiesel has to meet or exceed the specifications of ASTM D6751. In addition to that, the marketer is required to register with the US Environmental Protection Agency pursuant to 40CFR Part 79.[364]

The EPA is the authority to regulate fuels and fuel additives in order to reduce the risk to public health from exposure to their emissions.[365]

In the US Biodiesel is the only fuel/fuel additive to have completed the Tier 1 and 2 testing programs of the EPA. Other alternative fuels such as ethanol on gasoline blends were already being sold in commerce before the regulations were implemented.[366]

4.3123 Other motives and regulation measures

The Energy Policy Act of 1992 (EPACT) required that by the year 2000,
75% of all affected vehicle purchases for state fleets and 90% of all affected vehicle purchases for private alternative fuel provider (mostly utilities) fleets had to be alternative fuelled vehicles. In addition, regulations were finalized that also affect ed federal fleets and the DOE (Department of Energy) had the authority to regulate other fleets in the future in order to meet the established petroleum displacement goals.[367]

362 NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 2

363 Internet: http://www.me.iastate.edu/biodiesel/ [10.1.2003]

364 NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 2

365 LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 79

366 LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 81

367 TYSON, K. S.: Biodiesel Handling and Use Guidelines, in: NREL - National Renewable Energy Laboratory, Report No. TP-580-30004, Golden CO USA September 2001, Internet: http://www.nrel.gov/docs/fy01osti/30004.pdf [5.9.2003], p. 20

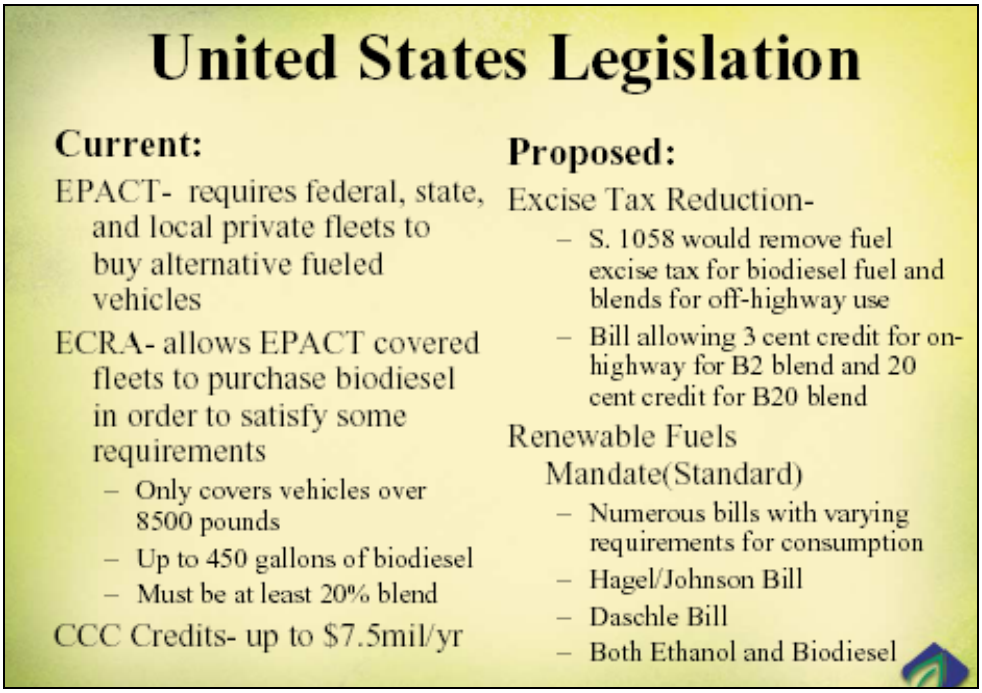

Fig. 34: Current and proposed US legislation

Source: ADM (Archer Daniels Midland): Blending Agriculture into Energy-Economic Opportunity, presented at Saskatoon Inn, Saskatoon, Canada January 2002, p. 28

4.313 Stakeholders

Name	Web-address	Logo	Description
NBB-National Biodiesel Board	http://www.biodiesel.org		National trade association representing the Biodiesel industry as the coordinating body for R&D in the US
West Central Soy	http://www.westcentralsoy.com/		Capacity: 12 million gallons (40.000 t/a) Start: 12/2002; NBB corporate member, brand name: SoyPOWER
Griffin Industries	http://www.griffinind.com/html/biodiesel.html		Biodiesel producer with own brand: BIO 3000
Pacific Biodiesel	http://www.biodiesel.com		Pioneer company in BD production

Imperial Western Products	http://www.imperialwesternproducts.com		NBB corporate member, Biodiesel brand name: BIOTANE FUELS
AG Environmental Products	http://www.soygold.com		Biodiesel marketer with own brand: SOYGOLD
Superior Process Technologies	http://www.superiorprocesstech.com/		Biodiesel process technology provider with a demonstration plant
Biodiesel Industries	http://pipeline.to/biodiesel		NBB corporate member; technology provider for the first large-scale production unit in New South Wales, Australia
ADM- Archer Daniel Midlands	http://www.admworld.com		One of the largest international food providers in the world and largest Bioethanol producer in the US. Engaged with two Biodiesel production plants in Germany; decided recently not to enter the Biodiesel business in Minnesota.
Procter & Gamble	http://www.proctergamble.com		One of the largest producers of methyl esters in the US selling to Biodiesel marketers on contractual basis
Cargill	http://www.cargill.com		International marketer, processor and distributor of agricultural, food, financial and industrial products; engaged in Biodiesel production in Germany.
USB- United Soybean Board	http://www.unitedsoybean.org		Funder of NBB, marketing, research and commercialization programs for soybean products
NREL- National Renewabel Energy Laboratory	http://www.nrel.gov/		The U.S. Department of Energy's premier laboratory for renewable energy research & development
AFDC- Alternative Fuels Data Centre	http://www.afdc.doe.gov/		One-stop shop for all alternative fuel and vehicle information needs
Clean Cities Network	http://www.ccities.doe.gov/		Sponsored by the Department of Energy (DOE), supports public and private partnerships that deploy alternative fuel vehicles (AFVs) and build supporting infrastructure

OTT	http://www.ott.doe.gov/ i.e. on EPACT: http://www.ott.doe.gov/epact/		Office of Transportation Technologies
EREN	http://www.eren.doe.gov		Energy Efficiency and Renewable Energy Network
University of Idaho	http://www.uidaho.edu/		
Iowa State University	http://www.me.iastate.edu/biodiesel/	IOWA STATE UNIVERSITY	R&D, Biodiesel workshop

Tab. 40: Biodiesel industry stakeholders in the United States

Source: Websites as denominated in the table;
NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the, U.S.A., Jefferson City 2002;
own research

4.314 Production / quality / marketing

4.3141 Plants

Currently, the NBB has nine corporate members producing Biodiesel:

Company	Location
Ag Environmental Products	Seargant Bluffs, IA
Biodiesel Industries	Las Vegas, NV
Columbus Foods	Chicago, IL
Griffin Industries	Cold Spring, KY
Stepan Company	Northfield, IL
West Central Soy	Ralston, IA
Ocean Air Environmental	Lakeland, FL
American Biofuels	Bonita, CA
Imperial Western Products	Indio, CA

Tab. 41: NBB (National Biodiesel Board) corporate members producing Biodiesel

Source: NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the, U.S.A., Jefferson City 2002, p. 2

Most of them are dedicated plants; however, Columbus Foods and Stepan Chemical are not dedicated. Current dedicated production capacity is estimated to be between 60-80 million gallons per year. This capacity is mostly modular and could be doubled or tripled in a short time frame. [368]

[368] NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 2

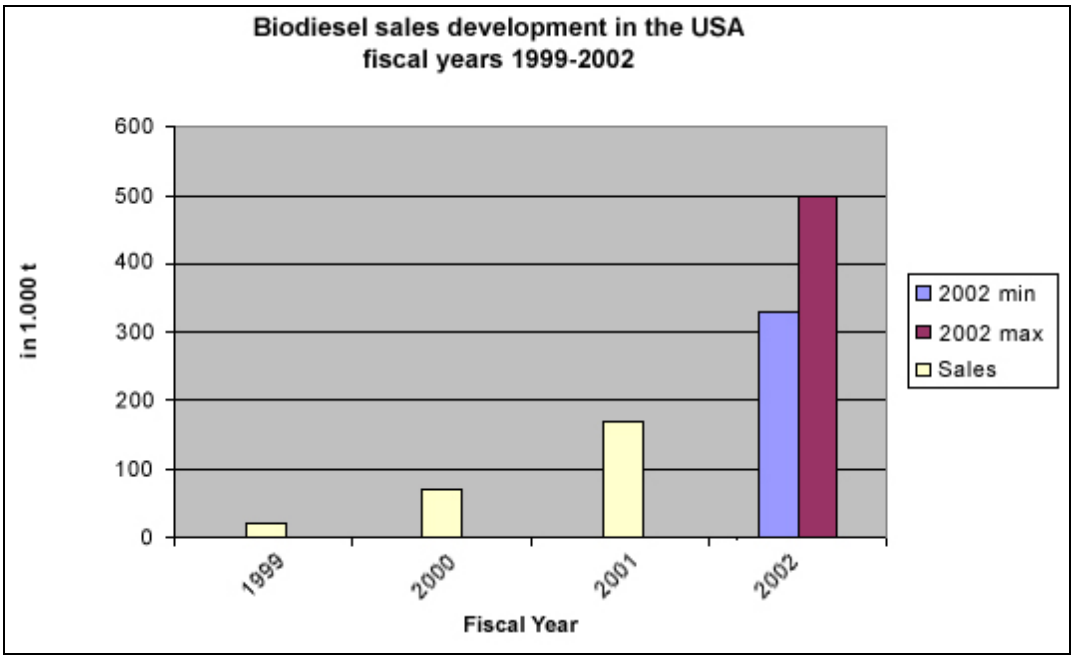

Fig. 35: Biodiesel sales development in the USA, fiscal years 1999-2002

Source: NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 2

In addition to the companies listed, several oleochemical plants with significant volumes of excess methyl ester production make Biodiesel on a contract basis for NBB members. Examples of such companies are PROCTER & GAMBLE, Corsicana Chemical and Soy Solutions. Although few estimates are available to document this surplus capacity within the oleochemical industry, Biodiesel suppliers have reported that up to 660.000 t/a (200 million gallons) of production capacity is available through long-term production agreements with existing Biodiesel marketing firms. More Biodiesel plants are being planned in at least 15 states.[369]

4.3142 Feedstock

More than 90 percent of US-produced Biodiesel is made from soybean oil, with the remainder yellow grease, other oils (canola, cottonseed, etc.) or animal fats.[370]

The soybean equivalent of the oil required (for a 4% share of Biodiesel in 2016) is projected to increase from 51 million bushels (1,389 million tons) in 2002 to 318 million bushels (8,655 million tons) by 2016. [371]

[369] NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 2

[370] NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 2

[371] Bushels Metric equivalent for Wheat and Soybeans: 1 bushel = 0,0272155 metric ton

As shown in Fig. 36, soybeans are expected to remain the predominant feedstock, although an increasing share of Biodiesel production will come from other oils including recycled soybean oil.

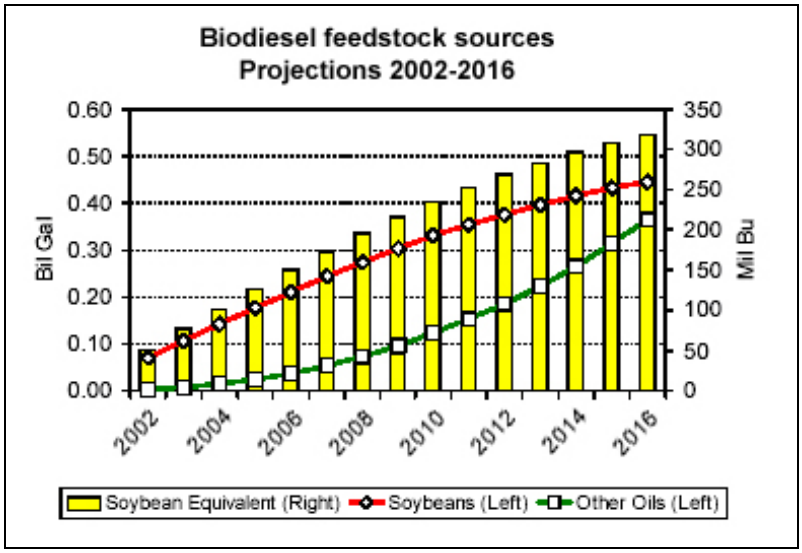

Fig. 36: Feedstock sources 2002-2016

Source: URBANCHUK, J.: An Economic Analysis of Legislation for a Renewable Fuels Requirement for Highway Motor Fuels, edited by AUS Consultants, Moorestown New Jersey 2001, p. 12
Internet: http://www.biodiesel.org/resources/reportsdatabase/reports/gen/gen-315.pdf [6.1.2003]

With the implementation of a mandatory 4% share of Biodiesel, soybean oil prices are projected to increase by an average of 10 percent over baseline levels reflecting a substantial increase in demand for Biodiesel. As a consequence of higher demand for soybean oil to produce Biodiesel, the average price of crude soybean oil between 2002 and 2016 is projected at 25,37 cents per pound (0.0987 €/kg) compared to 23,07 cents per pound[372] (0,0897 €/kg[373]) without a renewable fuel requirement. [374]

4.3143 Quality standards / quality management

The American Society of Testing and Materials (ASTM) issued Specification D 6751 for all Biodiesel fuel bought and sold in the U.S. It was approved by the ASTM Committee D2 in December 2001 after more than 7 years of work by the ASTM Biodiesel Task Force. D 6751 finally replaced the provisional specification issued in 1999. It covers the incorporation of pure Biodiesel (B100) into fossil diesel fuel up to 20 percent by volume (B20) with higher blend levels being acceptable, depending on the experience of the engine company.[375]

[372] Weight conversion: 1 pound = 0.4536 kilogram

[373] Interbank rate of Wednesday, October 30, 2003

[374] URBANCHUK, J.: An Economic Analysis of Legislation for a Renewable Fuels Requirement for Highway Motor Fuels, edited by AUS Consultants, November 2001, p. 13

[375] Internet: http://www.biodiesel.org/pdf_files/ASTM_Spec_02.pdf [10.10.2002]

4.3144 Marketing strategy / distribution system

In recent years, Biodiesel industry efforts were mostly concentrated in four markets where the attributes of Biodiesel appeared to justify the additional cost per gallon in:[376]

- urban transit
- government/regulated fleets
- marine
- underground mining

Biodiesel is used in three primary applications to address three different market segments: B100 (neat Biodiesel); B20 (20% Biodiesel/80% fossil diesel); and B2 (2% Biodiesel). The largest market is probably within EPACT-affected fleets, which requires covered fleets to use alternative fuels. [377]

Total sales for fiscal year 2002 are estimated to range between 33.000 and 50.000 t (10-15 million gallons).

Fiscal Year	Sales: million gallons	t
1999	0,5	2.000
2000	2	7.000
2001	5	17.000
2002	10-15	33.000 – 50.000

Tab. 42: Sales development fiscal years 1999-2002

Source: NBB (National Biodiesel Board) : NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the, U.S.A., Jefferson City 2002, p. 3

More than 200 fleets use Biodiesel commercially. These include federal fleets like the US Department of Agriculture and Yellowstone National Park; state fleets like the Missouri Department of transportation; municipal fleets like Peterson Air Force Base in Colorado Springs; school district fleets such as Medford Schools in New Jersey and St. John's in Michigan; and public utility companies like Florida Power & Light and Alabama Power. As per announcement of June 29th the city of Berkeley, California, switched more than 180 of the City's diesel vehicles to B100, representing 90 percent of its fleet.[378]
There are several ways to purchase the fuel: directly from a Biodiesel supplier, from a petroleum distributor or a public pump. There are hundreds of petroleum distributors carrying Biodiesel and Biodiesel blends nationwide, and over 35 pumps now make Biodiesel or Biodiesel blends available to the public at stations and fuel docks. [379]

[376] HOWELL, S., WEBER, A.: U.S. Biodiesel Overview, edited by the National Biodiesel Board, Jefferson City MO USA 2000, p. 9
[377] NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 2
[378] Internet: http://www.biodiesel.org [18.7.2003]
[379] NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A.,

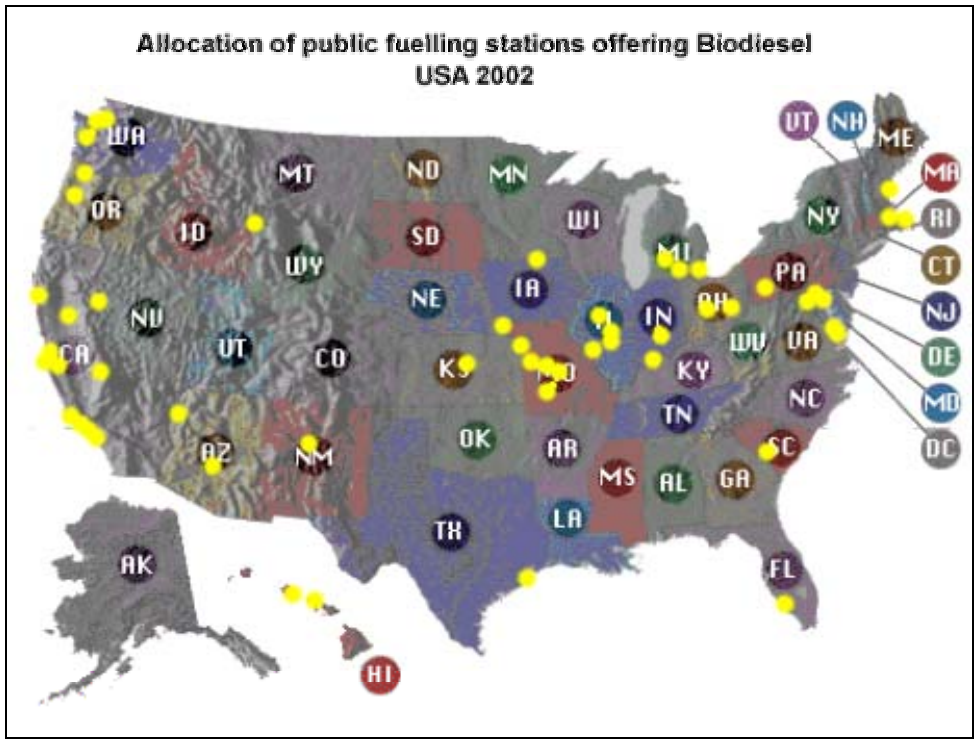

Fig. 37: Allocation of public fuelling stations

Source: Internet: http://www.biodiesel.org/buyingbiodiesel/retailfuelingsites/default.shtm [10.10.2002]

4.315 Summary / forecast

Currently, several significant pieces of legislation have passed or are pending in the US Congress that would dramatically increase the fuel's use in the US market.[380]

A number of other important alt-fuels areas were touched by the new Energy Policy Act. These include a green school bus pilot program, temporary Biodiesel credit expansion…; this will boost the renewable fuels industry's volume to 18 billion litres by 2012 (Biodiesel & Bioethanol).[381]

From the supply side, this tremendous increase won't result in any production shortages, as actual expansion of dedicated Biodiesel production capacity and a vast surplus of capacity resources in the oleochemical industry could be utilized to meet this new market growth for Biodiesel in the years to come.[382]

Jefferson City 2002, p. 2

380 NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 3

381 Internet: http://www.greenfuels.org/newsletters/june2002.pdf [10.10.2003]

382 NBB (National Biodiesel Board) : In response to the e-mail questionnaire sent by the author, U.S.A., Jefferson City 2002, p. 3

There are estimations that if the minimum percentage by volume of renewable fuel content of motor vehicle fuel were increased from 1,2 percent in 2002 to four percent by 2016, this would support the creation of nearly 300.000 new jobs in all sectors of the economy.[383]

[383] URBANCHUK, J.: An Economic Analysis of Legislation for a Renewable Fuels Requirement for Highway Motor Fuels, edited by AUS Consultants 2001, Moorestown New Jersey 2001, p. 2

5. SUMMARY

5.1 Introduction / history

In 1988, Biodiesel fuel was produced commercially for the first time.
Tremendous progress has been made since then by

- broadening the feedstock basis
- improving process technology through high flexibility in processing multi-feed-stocks (MFS) at highest yield levels
- developing sophisticated fuel standards thus assuring highest fuel quality
- establishing Biodiesel production capacities in many countries
- intelligent product positioning in defined fuel market segments
- obtaining numerous diesel engine warranties and
- implementing a number of different supportive legal measures and voluntary regulations.[384]

This allowed most members of the Biodiesel community to survive even difficult periods when non-food oilseeds were only grown on minimal acreages, vegetable oil prices soared to extreme heights and, at the same time, the crude mineral oil price reached a record low level of approx. 9 US$ / barrel (as was the case in 1998/1999).[385]

5.2 Framework / legislation

A broad range of policy options have been identified; they can be grouped in four classes:[386]

- Research, Development and Demonstration
- Information and Education
- Regulation and
- Fiscal measures

Available policies can directly affect the supply of new fuels and efficiency technologies with measures aimed directly at researchers and manufacturers – including tax credits for R&D, government/industry partnerships, regulatory targets, fuel subsidies, and so forth. Complementary measures that increase the demand for new technologies and fuels – including information programs, rebates or tax credits to vehicle purchasers, government fleet vehicle and fuel purchases, and taxes on

[384] ABI (Austrian Biofuels Institute): „World-wide Trends in Production and Marketing of Biodiesel", ALTENER – Seminar "New Markets for Biodiesel in Modern Common Rail Diesel Engines",University for Technology Graz, Graz Austria 22 May 2000

[385] ABI (Austrian Biofuels Institute): „World-wide Trends in Production and Marketing of Biodiesel", ALTENER – Seminar "New Markets for Biodiesel in Modern Common Rail Diesel Engines",University for Technology Graz, Graz Austria 22 May 2000

[386] BIRKY, A., GREENE, D., GROSS, T.: Future U.S Highway Energy Use: A Fifty Year Perspective, Office of Transportation Technologies, U.S. Department of Energy, Washington 2001, p. 30

conventional fuels (or tax breaks on new fuels) – will also stimulate supply as vehicle manufacturers and fuel suppliers respond to market demands.[387]

The motives for these actions taken can be observed as there is:[388]

- increase of energy supply security
- reduction of dependence on fossil energy forms
- reduction of greenhouse gas effect
- reduction of harmful locally acting emissions
- protection of soil by biodegradable products
- reduction of health hazards by using non-toxic products

Some examples for the implementation of regulatory measures to achieve these goals are summarised:

Motives	**Country**	**Measures (legal)**
Security of energy supply	USA EU	Alternative Fuel Vehicles / EPAct Obligatory market share of 2 up to 5 %
Limitation of harmful emissions	USA USA I	Clean Air Act (Amendments) Clean City Programme Clean City Programme
Workers health	USA D A	Underground mining / emission limits Fork lifts in halls / Technical rule 554 Work in tunnels / emission limits
Soil protection	A NL	Chainsaw lubrication regulation Higher depreciation on equipment
Water protection	D,A, CH	International Ship Traffic Commission Lake Constance: limits
Climate protection	D	Ecological-tax system
Motives		**Measures (voluntary)**
Cost reduction of waste disposal and improvement of city image	A	City of Leibnitz: Waste oil collection and utilisation as Biodiesel in the fleet
Regional-Image: „Nature pure“	A	Tourism-region of Lech / Tyrol
Company-Image: „We care“	D	Bus traffic system in Heinsberg
Incentives to switch to public bus	A	Bus traffic system in Feldkirch
Incentives to use clean vehicles	S	Free parking for Bioethanol vehicles

Tab. 43: Regulatory motives and their different implementation measures

Source: AUSTRIAN BIOFUELS INSTITUTE (ABI): World-wide Trends in Production and Marketing of Biodiesel; presented at the ALTENER – Seminar “New Markets for Biodiesel in Modern Common Rail Diesel Engines”, University for Technology Graz, Graz Austria 22 May 2000

[387] BIRKY, A., GREENE, D., GROSS, T.: Future U.S Highway Energy Use: A Fifty Year Perspective, Office of Transportation Technologies, U.S. Department of Energy, Washington 2001, p. 35

[388] KÖRBITZ, W.: New Trends in Developing Biodiesel, presentation at Asia Bio-Fuels, Singapore, April 22-23 2002, p. 7

5.21 Supportive taxation measures

Due to the fact that alternative fuels are more expensive than gasoline and diesel a support to cover the difference in costs is imperative. No implementation has occurred without this support and in cases where it has been removed, the implementation has halted (e.g. Slovakia).[389]
The extent of necessary support cannot be generalised, as production costs for alternative fuels as well as retail prices for fossil diesel oil vary greatly from country to country:

Country	Retail prices		
	US$ (per l)[390]	€ (per l)[391]	Index (US = 100)
Belgium	0,537	0,590	160
Canada	0,408	0,449	122
Denmark	0,648	0,712	193
France	0,575	0,632	172
Germany	0,617	0,678	184
Greece	0,467	0,513	139
Hungary	0,706	0,776	211
India	0,474	0,521	141
Korea	0,479	0,527	143
Poland	0,514	0,565	153
Slovakia	0,497	0,546	148
South Africa	0,537	0,590	160
Switzerland	0,603	0,663	180
United Kingdom	0,932	1,025	278
United States	0,335	0,368	100

Tab. 44: Diesel oil retail prices in selected countries

Source: Key World Energy Statistics, International Energy Agency (IEA), Paris 2002, p. 42
Internet: http://www.iea.org/statist/keyworld2002/keyworld2002.pdf [10.2.2003]

The cost difference between alternative fuels and gasoline/diesel (representing the subsidising requirement) is mainly guided by oil price, feedstock price for alternative fuels and the manufacturing costs. The oil price can not be controlled by politicians. The feedstock price is a delicate question since a lowered price affects one of the main stakeholders (farmers).[392]

[389] Internet: http://www.liquid-biofuels.com/FinalReport1.html appendix 5 [28.10.2002]
[390] Prices of 4th quarter 2001
[391] Currency conversion rate: 1 USD = 1.09938 € (Interbank rate of Monday, October 1, 2001)
[392] ÖSTMAN, A.: Implementation of alternative fuels in certain countries, Consultant Task 2000; IEA Bioenergy, Task 27, Vienna 2000, p. 2, Internet: http://www.liquid-biofuels.com/FinalReport1.html [14.1.2003]

5.22 Stakeholders

Commercial activities of all kinds are largely dependent on their actors. In this specific case (i.e. phase III-commercial production of Biodiesel) lobbying and pressure groups are evidently not enough, but stakeholders that are willing to be involved in the commercial realisation have to be attracted.[393]
The stakeholders' attention to alternative fuels has obviously been caught in different ways. For farmers, the possibility of acquiring a new market is obvious. A factor in common seems to be individual initiatives originating from farmers, farmer's organisations, environmentalists, private companies and governmental organisations. No general scheme for attracting stakeholders seems clear. Rather they are convinced by the continuous work on the part of dedicated individuals and stimulated by reports in news media.[394]

State initiatives or ventures encompassing production and sales of alternative fuels have hardly ever been started; there are some examples where governmental funding has been incorporated in development companies (e.g. former Yugoslavia, South Africa) but its commercial activities never reached a sustainable level. The oil companies were incorporated in all cases of successful implementation of alternative fuels in phase III (distributors, blenders), but not to that extent they were in (other) oil and gasoline additives sectors, in MTBE manufacture or chemical production.[395]

5.3 Production / quality / marketing

5.31 Plants

Recapitulating: commercial production plants have been established in the following countries:

[393] ÖSTMAN, A.: Implementation of alternative fuels in certain countries, Consultant Task 2000; IEA Bioenergy, Task 27, Vienna 2000, p. 12, Internet: http://www.liquid-biofuels.com/FinalReport1.html [14.1.2003]
[394] ÖSTMAN, A.: Implementation of alternative fuels in certain countries, Consultant Task 2000; IEA Bioenergy, Task 27, Vienna 2000, p. 11, Internet: http://www.liquid-biofuels.com/FinalReport1.html [14.1.2003]
[395] ÖSTMAN, A.: Implementation of alternative fuels in certain countries, Consultant Task 2000; IEA Bioenergy, Task 27, Vienna 2000, p. 2, Internet: http://www.liquid-biofuels.com/FinalReport1.html [14.1.2003]

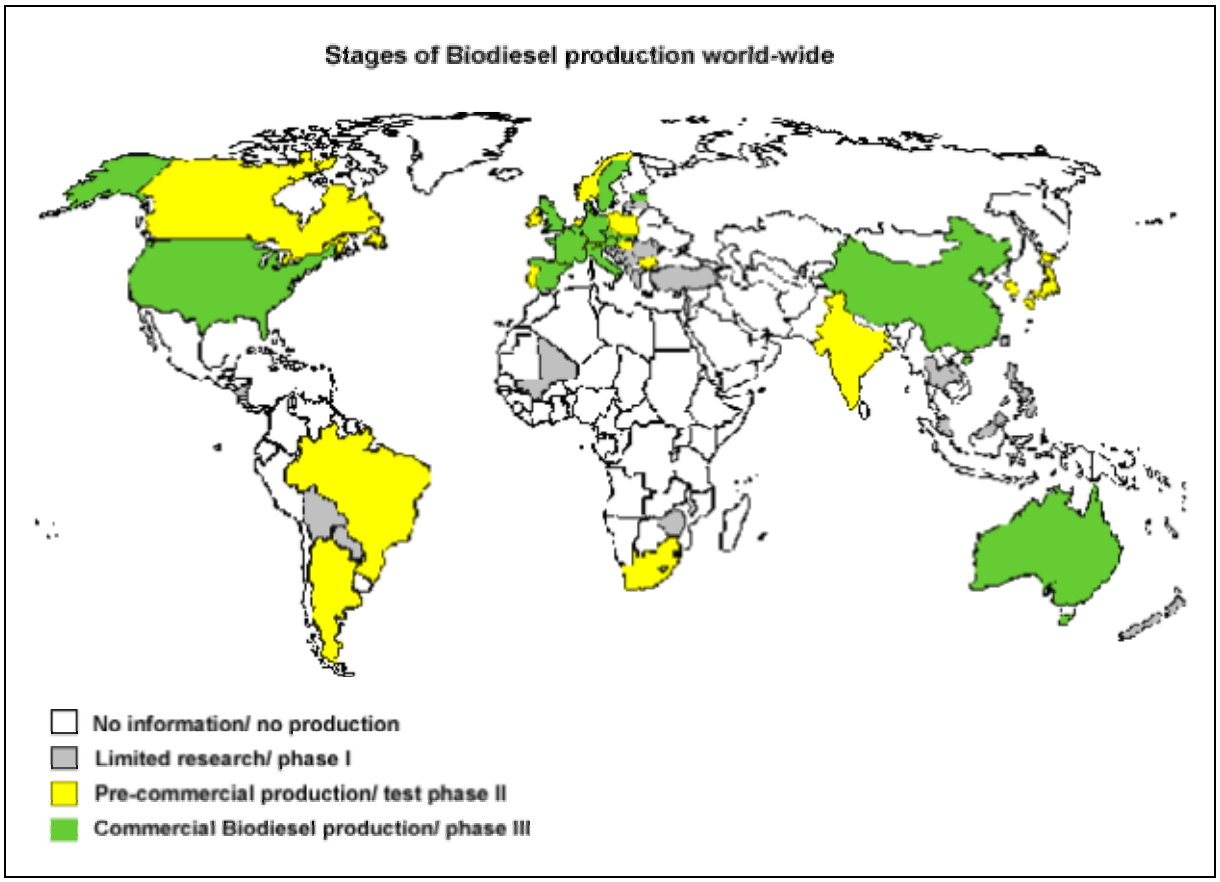

Fig. 38: Stages of Biodiesel involvement world-wide, by country

Source: Research by the author

The development of commercial production in the main regions affected is depicted in Fig. 39.

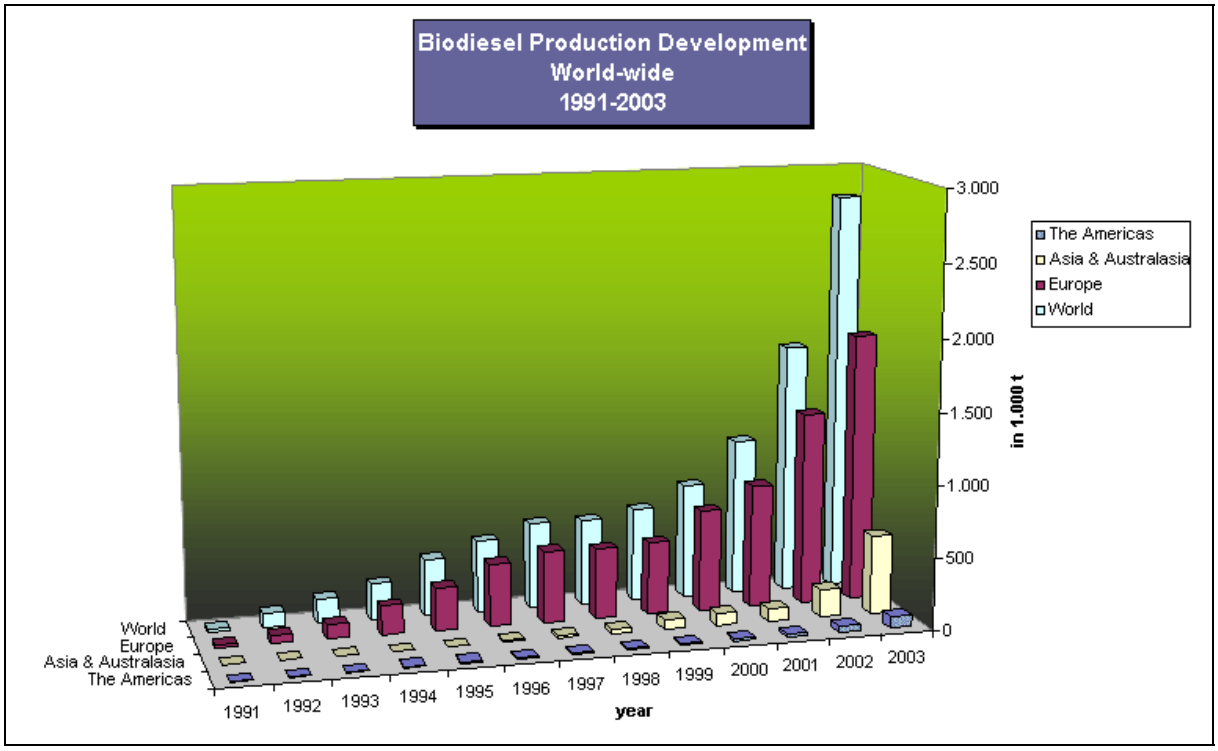

Fig. 39: World production 1991- 2003 (in 1.000 t)

Source: 1991-2000: KÖRBITZ, W.: New Trends in Developing Biodiesel, presentation at Asia Bio-Fuels, Singapore, April 22-23 2002, via e-mail to the author;
2001-2003: Research by the author

Besides those countries already producing, several countries have been identified as having entered phase I and II; in the following, commercial Biodiesel production will be considered in the years to come:

Region/ Country	Details
Africa	
South Africa	Driven by the increasing concern about possible oil embargoes there was considerable interest in the use of esterised sunflower oil as a diesel replacement in the late 70s and early 80s. However, the sunflower option was never implemented. There are currently two Biodiesel production plants which do not sell fuel commercially, and the construction of one more is being negotiated[396]
Asia	
India	Actually there are only research and demonstration plants, but a 100 ton/day unit in Hyderabad is expected to come up shortly. Policy statements are expected from the Government shortly[397]
Japan	The City of Kyoto introduced Biodiesel made from recycled frying oil into 220 garbage wagons in 1997, and has used the B20 mixture for 81 city buses since 2000. If all the edible-oil wastes are recycled and reused as Bio Diesel Fuel (BDF), the market of about 30 billion yens may probably be created. To realize such a market, however, it is necessary to establish an integrated recycling system involving citizens, companies and local administrations[398]
Philippines	In 2001, the Philippine Coconut Authority had launched a nation-wide program to develop the use of coco Biodiesel as an alternative fuel. Actually setting more on natural gas vehicles but the use of Biodiesel is starting to be tested[399]
South Korea	Biodiesel is about to be approved as alternative fuel. Some tax exemption will be given in 2-3 years. Actually there are two small scale Biodiesel production plant with a total capacity of 8.000 t/a. Anyhow one full scale plant (100.000 t/a) is in construction. Biodiesel is provided to some vehicles operated by several municipal governments for the test operation. The test operation will be done by July 2004. If successfully done, Biodiesel will be supplied for all kinds of diesel vehicles[400]
Thailand	Various mixes of vegetable (coconut and palm) oil blended with diesel oil or kerosene have been introduced in the past year as “Biodiesel”; most of them did not meet official standards for commercial use. Tests are being effectuated with “real” Biodiesel from recycled cooking oils (called “super-Biodiesel”)[401]
Europe	
Denmark	Despite the missing political support (no tax exemption for Biodiesel, whereas fossil diesel is tax exempt for busfleet use) and a clear preference for the use of crude oil as alternative fuel, one company started operating in 2001. Actually it is mainly sold as heating oil, and the future development is highly dependent on the political involvement thus unclear, as Denmark is still hesitating even after the EU proposals[402]
Hungary	There is a programme for Biodiesel (2000-2010) in Hungary but it does not seem to be implemented. One plant was completed when official regulations were passed. Four cornerstones were laid; two plants were built.[403]

396 HUGO, F. (SA Biodiesel (Pty) Ltd): In response to the e-mail questionnaire sent by the author, South Africa 2002

397 UDIPI (SuTRA, Sustainable Transformation of Rural Areas, Indian Institute of Science): In response to the e-mail questionnaire sent by the author, India, Bangalore 2002

398 NEDO (New Energy and Industrial Technology Development Organization): In response to the e-mail questionnaire sent by the author, Japan, Toshima-ku Tokyo 2002

399 PCIERD (Philippine Council for Industry and Energy Research and Development): In response to the e-mail questionnaire sent by the author, Philippines, Bicutan, Taguig 2002

400 LEE, J. (KIER, Korea Institute of Energy Research): In response to the e-mail questionnaire sent by the author, South Korea, Yuseong-gu/Daejeon 2002

401 NEPO (Energy Policy and Planning Office, Ministry of Energy): In response to the e-mail questionnaire sent by the author, Thailand, Bangkok 2002

402 ANSO, N. (Folkecenter for Renewable Energy): In response to the e-mail questionnaire sent by the author, Denmark, Hurup Thy 2002

403 SZUPPINGER, S. (Center for Environmental Studies): In response to the e-mail questionnaire sent by the author, Hungary, Budapest 2002

Malta	There is one company producing 6.000 t/a of Biodiesel which is sold as an additive in 5 l jerry cans[404]
Netherlands	Until now, the government´s negative attitude towards Biodiesel has inhibited any development. Nevertheless, ultimately the first commercial plant with an impressive production capacity of 100.000 t/a is under construction and should be operating by 2004[405]
Poland	There is no Biodiesel market in Poland because of lack of legislation in that matter; nevertheless, there are already three production units producing for internal needs and selling to public transport companies; one 50.000 t/a unit is planned to start production this year.[406] Legislation designed to dramatically increase Polish biofuel consumption has been vetoed by the President Kwasniewski because it was seen as too drastic. The biofuels bill would have forced Polish fuel suppliers to make biofuels account for at least 4,5% of their total domestic fuel[407]
Romania	One company is heavily involved in promoting Biodiesel; they are about to build a 10.000 t/a plant which is planned to be completed at the end of this year[408]
Spain	One production plant has been in operation since 2002 with 6.000 t/a capacity, although the clear political support for commercial production is still missing: within the actual framework tax exemption is possible for pilot projects only. Nevertheless, there are three additional plants in construction (two medium scale, one big scale with 50.000 t/a capacity) and two additional projects in design stage[409]
Sweden	Alternative motor fuels were never a subject of broad political discussions; the limiting factor for the market is feedstock availability, and tax regulations are revised annually. One company is producing, and there are plans for a second production unit with 26.000 t/a production capacity[410]
The Americas	
Argentina	As Argentina is one of the world's biggest producers and exporters of oilseeds, such as soybean and sunflower, it has enormous potential for Biodiesel production. Unfortunately, the country's current socio-economic crisis is hindering investment decisions and is the main barrier to be overcome. There are seven existing production units with capacity ranging from 10 – 50 t/d, and at least 11 projects, ranging from farmers cooperatives to big scale production with 30 million US$ investment, are pending. Only one small-scale unit is effectively producing at the moment[411]
Brasil	At the moment the PROBIODIESEL (Programa Brasileiro de Desenvolvimento Tecnológico de Biodiesel) programme is being created, which will set up the regulatory framework for Biodiesel production. Currently there are four companies able to start production, but as commercialization has not yet been authorized, there is no dedicated production plant yet.[412] There is one company that is

[404] PSAILA, P. (EORC-Edible Oil Refining Company): In response to the e-mail questionnaire sent by the author, Malta, Marsa 2002

[405] OUDEN, P. (ATEP): In response to the e-mail questionnaire sent by the author, Netherlands, Willemstad 2002

[406] MORZEWSKA, L. (Biorafineria Bogatynia Sp. z o.o.): In response to the e-mail questionnaire sent by the author, Poland, Bogtatynia 2002

[407] ABI (Austrian Biofuels Institute): Biodiesel Courier, e-mail newsletter, January 23, Austria 2003

[408] OPREA, M.: In response to the e-mail questionnaire sent by the author, Romania 2002

[409] LOPEZ, C. (IDAE- Institute for Energy Saving and Diversification): In response to the e-mail questionnaire sent by the author, Spain, Madrid 2002

[410] BERG J. (Agro Oil A.B.): In response to the e-mail questionnaire sent by the author, Sweden, Stockholm 2002

[411] BEAUMONT (Secretary of Environment and Sustainable Development, Argentina): In response to the e-mail questionnaire sent by the author, Argentina, Buenos Aires 2002

[412] BASTO, L., The COPPE School of Engineering (Rio de Janeiro, RJ): In response to the e-mail questionnaire sent by the author, Brasil, Rio de Janeiro 2002

	producing Biodiesel as an additive to its product called “AEP 102”, which is fossil diesel blended with alcohol and 2 percent of SME (soy methyl ester)[413]
Canada	Currently there is one demonstration plant that started production in April 2001. The technology was provided by the University of Toronto. Ultimately, STM, the public transport company of Montreal, announced a test phase with 150 buses running on Biodiesel for one year. With the tax incentive introduced by the Ontario government, it is likely that one or two Biodiesel plants will be commercially viable[414]

Tab. 45: Countries on the cusp of commercial Biodiesel production

Source: As cited in the table

For these countries, further development should be easier because of the examples and experiences of the countries already in phase III.[415]

5.32 Feedstock

The world consumption of oils and fats rose from 81,8 million t in 1991/92 to 120,6 million t in the year 2001/2002.[416]
The global production of oilseed was approx. 320 million t in 2001/2002, whereas the most important oilseed world-wide is soy, followed by rapeseed (Fig. 40).

[413] TORRES, E. (Chemical Engineering Department, Salvador, Bahia): In response to the e-mail questionnaire sent by the author, via e-mail to the author, Brasil, Salvador BA 2002

[414] LEVELTON ENGINEERING: Assessment of Biodiesel and Ethanol diesel blends, greenhouse gas emissions, exhaust emissions and policy issues, Ottawa 2002, p. 95

[415] ÖSTMAN, A.: Implementation of alternative fuels in certain countries, Consultant Task 2000; IEA Bioenergy, Task 27, Vienna 2000, p. 2, Internet: http://www.liquid-biofuels.com/FinalReport1.html [14.1.2003]

[416] BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 7

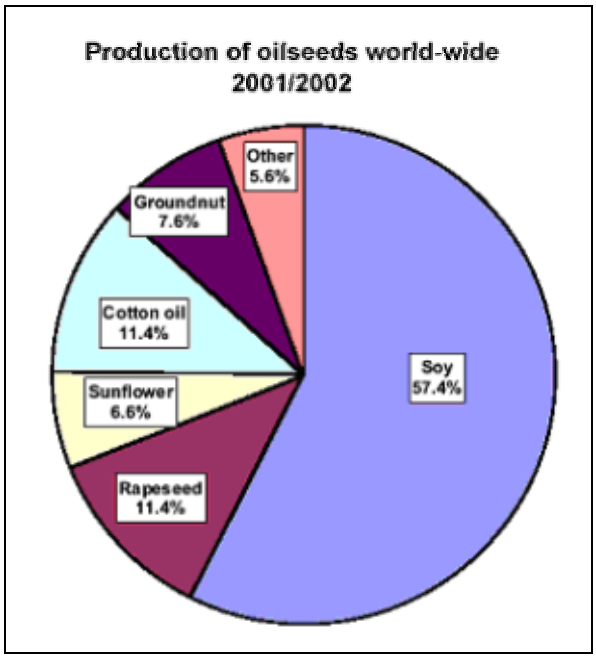

Fig. 40: World production of oilseed, 2001/2002 (totalling 320,72 Million t)

Source: Oil world, Hamburg Internet: http://www.oil-world.com [2.1.2003]

With respect to Biodiesel production, it is rapeseed that is still the feedstock most commonly used (Fig. 41).
RME or Rapeseed-oil-methyl-ester was the first type of Biodiesel fuel produced commercially, characterised as a single-feed-stock product of then questionable quality.
These days new varieties (e.g. LZ 7632) are reaching high levels of up to 87 % oleic-fatty-acid which makes rapeseed by far the biggest source of feedstock for Biodiesel production. It has become even more interesting as rapeseed breeders have succeeded in improving yield levels of up to 2,9 t oil / ha in Northern Germany when applying "precision farming".[417]

[417] KÖRBITZ, W.: New Trends in Developing Biodiesel, presentation at Asia Bio-Fuels, Singapore, April 22-23 20002

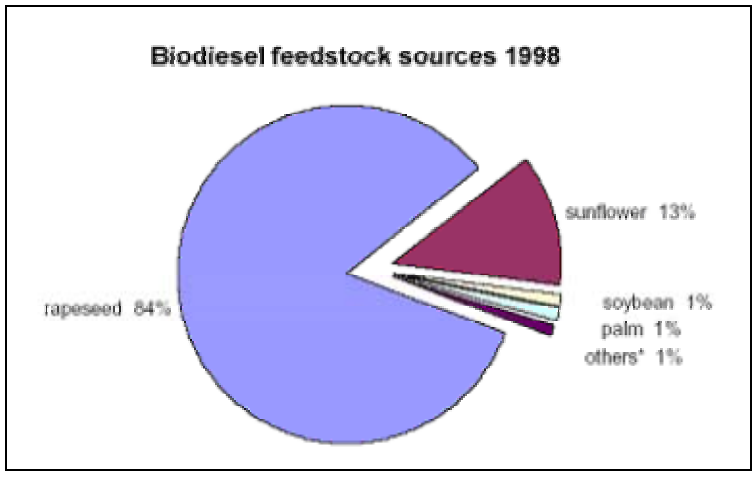

Fig. 41: Biodiesel feedstock sources 1998

Source: ABI (AUSTRIAN BIOFUELS INSTITUTE): "World-wide Trends in Production and Marketing of Biodiesel"; ALTENER – Seminar "New Markets for Biodiesel in Modern Common Rail Diesel Engines", University for Technology Graz, Graz Austria 22 May 2000

In addition to RME being established in the market place, the search began for additional and alternative feedstocks. A detailed screening process came up with some defining restrictions (e.g. stability of oil, winter operability, Conradson Carbon residue).

As the availability and supply pattern of the various raw materials may vary in volume and price (as it does currently in the EU, where a lack of guaranteed supply of agricultural EU raw materials at competitive prices is blatantly obvious)[418] and as recipes of blends have to be varied as well for climatic conditions, it is a tremendous commercial advantage if production recipes can be changed quickly, even on a daily basis. In a modern plant the cheapest blend of the day can be selected by a quick switch of recipes which are stored and installed automatically, thus improving the profitability of a Biodiesel plant significantly.[419]

5.33 Quality standards / quality management

Standardisation is the key factor for developing a consumer market. This insight and the consequent work to provide a stable and standardised quality product in close co-operation with the vehicle industry led to a long list of warranties given by car producers regarding the trouble-free use of Biodiesel in selected models. Tab. 46 tries to give an indicative overview of existing warranties:

[418] Internet: http://europa.eu.int/comm/energy_transport/atlas/html/biodbarr.html [10.9.2002]

[419] AUSTRIAN BIOFUELS INSTITUTE (ABI): "World-wide Trends in Production and Marketing of Biodiese"; presented at the ALTENER – Seminar "New Markets for Biodiesel in Modern Common Rail Diesel Engines", University for Technology Graz, Graz Austria 22 May 2000

Brand	Type	Model
Audi	personal cars	all TDI-models since 1996
BMW	personal cars	model 525 tds / 1997 and 3er + 5er since 2001
Case - IH	tractors	all models since 1971
Claas	combines, tractors	warranties exist
Faryman Diesel	engines	warranties exist
Fiatagri	tractors	for new models
Ford AG	tractors	for new models
Holder	tractors	warranties exist
Iseki	tractors	series 3000 and 5000
John Deere	tractors	warranties since 1987
John Deere	combines	warranties since 1987
KHD	tractors	warranties exist
Kubota	tractors	series OC, Super Mini, O5, O3,
Lamborghini	tractors	serie 1000
Mercedes-Benz	personal cars	series C and E 220, C 200 and 220 CDI, a.o.
Mercedes-Benz Nissan	lorry, bus personal car	series BR 300, 400, Unimog since 1988, a.o. type Primera since 2001
Same	tractors	since 1990
Seat	personal cars	all TDI-series since 1996
Skoda	personal cars	all TDI-series since 1996
Steyr	tractors	since 1988
Steyr	boats	series M 16 TCAM and M 14 TCAM
Valmet	tractors	since 1991
Volkswagen	personal cars	all TDI- series since 1996
Volkswagen	personal cars	all new SDI-series (EURO-3)
Volvo	personal cars	series S80-D, S70-TDI and V70-TDI

Tab. 46: Existing Diesel vehicle warranties for Biodiesel operation

Source: KÖRBITZ, W.: New Trends in Developing Biodiesel, presentation at Asia Bio-Fuels, Singapore, April 22-23 20002

5.34 Marketing strategy / distribution system

The creation of a home grown production of Biodiesel is primarily a political decision, because the planting of oil seeds has to be supported by subsidies.[420]

The success of an implementation strategy depends on the specific parameters of a single country. Taxation, agriculture, structure of mineral oil economy and consumer attitudes are of importance.

[420] Internet: http://www.biodiesel.org/resources/reportsdatabase/reports/gen/gen-248.pdf [12.2.2003]

The high dependence on factors which cannot be influenced and vary strongly with time suggests strong fluctuations regarding the market situation and profitability.

The present market is dominated by fossil diesel and this is the competitive product to be replaced. Having with Biodiesel, on the one hand, a product which, at its best, can grow to approx. an 8 % market share, but, on the other hand, an environmentally friendly fuel which shows clear and substantial advantages, it is the job of professional marketing to screen all the market segments carefully and define those niches in which the distinctive benefits of Biodiesel are needed most, fully recognised by the customer and valued.

Market niche	Impact on : global air pollution	Impact on: local air pollution	Bio-degradability	Water -toxicity
City bus & taxi fleets	+	+ + PM, CO, SOx, NOx		
Underground mining	+	+ + + PM		
Drinking water zones	+		+ + +	
Lakes & waterways	+	+	+ +	**+ + +**

Tab. 47: Marketing: examples of market segmentation and niches of risk reduction

Source: KÖRBITZ, W.: New Trends in Developing Biodiesel, presentation at Asia Bio-Fuels, Singapore, April 22-23 20002

The marketing task is to target most profitable niches and to promote Biodiesel to customers there. Additionally, environmentally driven regulations, e.g. limitation on certain emissions, regulations for minimum biodegradability, laws for zero-toxicity to water-life, can carve out specific market segments in which only Biodiesel fulfils the rules and can obtain a dominant market position. In spite of these market opportunities there exist strategies of blending Biodiesel with fossil diesel (e.g. France), where the end-user is not aware of the product and its advantages.[421]

5.4 Summary / forecast

In the past few years the production of Biodiesel has taken an upward course which even experts did not expect.[422]
Twelve countries have been identified for accommodating commercial Biodiesel production, nine of them in Europe (Austria, Belgium, Czechia, France, Germany, Italy, Slovakia, Switzerland, and the U.K.), one in the Americas (the USA) and two in Australasia (Australia, China).

[421] KÖRBITZ, W.: New Trends in Developing Biodiesel, presentation at Asia Bio-Fuels, Singapore 2002, via e-mail to the author

[422] BOCKEY, D., KÖRBITZ, W.: Situation and Development Potential for the Production of Biodiesel – an International Study, UFOP and ABI, Berlin / Vienna 2003, p. 7

The next decades will anyhow bring a tremendous increase in fossil fuel consumption for transport: The transportation sector will overtake industry as the largest energy user by 2020, according to a study by the International Energy Agency, IEA. Energy used for transportation is projected to increase at an annual rate of 2,1 percent, which is the biggest growth of all end-use sectors.[423]

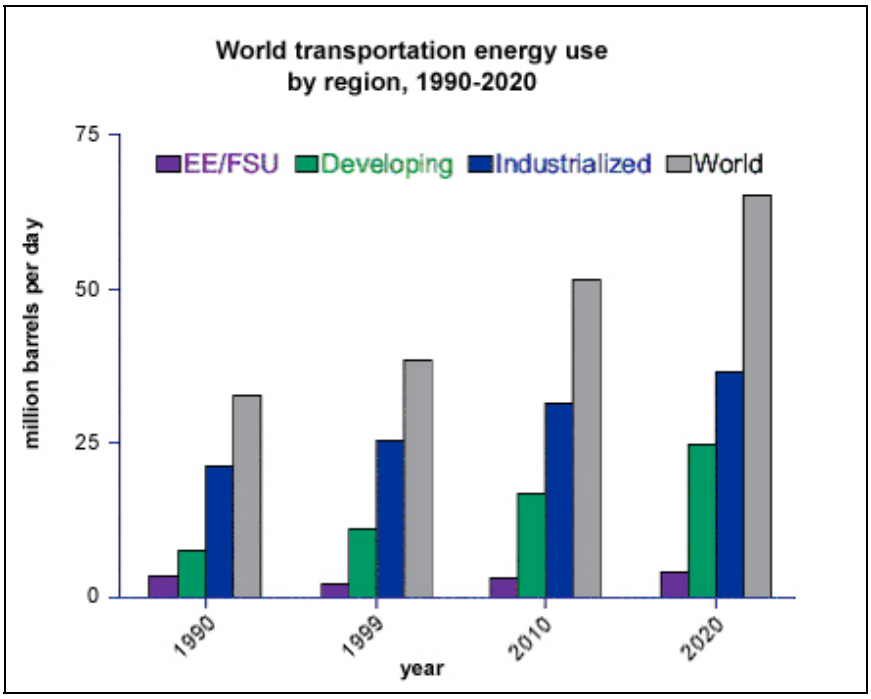

Fig. 42: World transportation energy use by region 1990, 1999, 2010 and 2020

Source: 1990 and 1999: Derived from Energy Information Administration (EIA), International Energy Annual 1999, DOE/EIA-0219(99), Washington DC, February 2001;
2010 and 2020: EIA. World Energy Projection System (2002)

Additionally, Diesel fuel consumption and market share are expected to rise significantly in the decades to come, with the main increase in developing Asia (nearly triplicating its actual demand) followed by North America:

[423] ABI (Austrian Biofuels Institute): Biodiesel Courier, e-mail newsletter, October, Austria 2002 , via e-mail to the author, Internet: http://www.iea.org/statist/index.htm [1.2.2003]

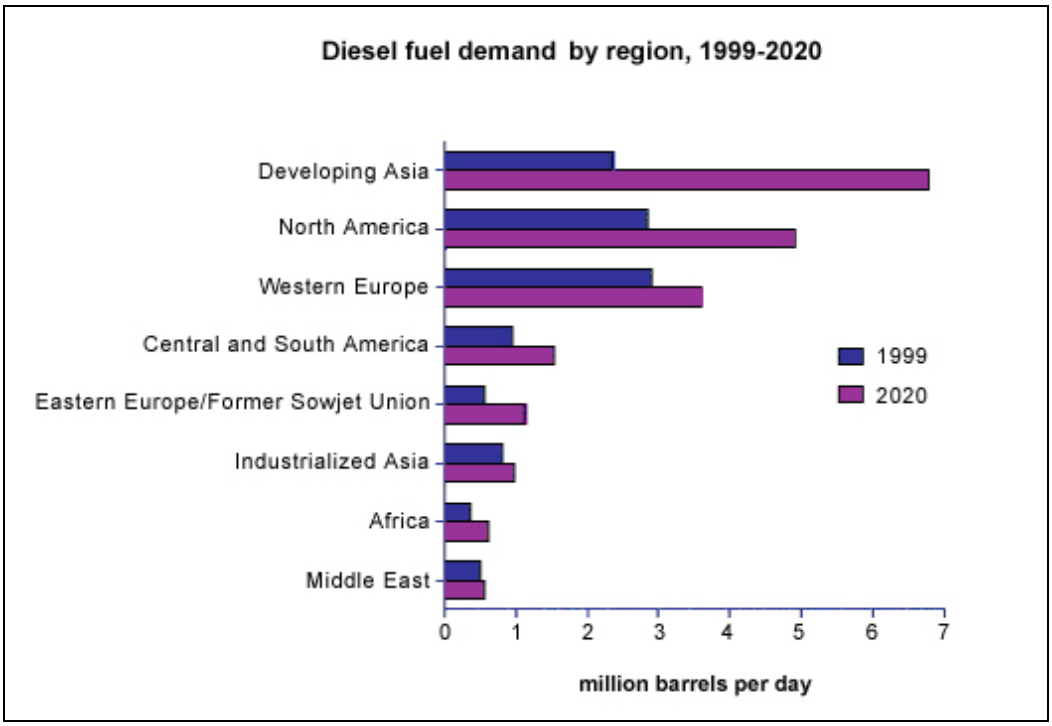

Fig. 43: Diesel fuel demand by region, 1999 and 2020 (in million barrels per day)

Source: 1990 and 1999: Derived from Energy Information Administration (EIA), International Energy Annual 1999, DOE/EIA-0219(99), Washington DC, February 2001;
2020: EIA. World Energy Projection System (2002)

As a result, emissions of carbon-dioxide are predicted to grow reaching a total volume 70% above today's level by 2030.[424]

The basic requirements for Biodiesel to reach a bigger share of this growing diesel market include:[425]

- Clear political involvement for the long-term
- Identifying niche markets that would benefit most from the use of Biodiesel
- A positive marketing campaign
- Building on the Biodiesel experience available
- Demonstration projects to provide practical experience of biofuelled vehicles.
- Favourable taxation policies - a carbon tax would favour biofuel development
- Concerted action by agents in all sectors, including agricultural producers, oil extractors, the transesterification industry and end-users
- Research into reducing Biodiesel production costs
- Research into optimising engine design, either to use Biodiesel or to allow greater flexibility in the fuels used

[424] ABI (Austrian Biofuels Institute): Biodiesel Courier, e-mail newsletter October, Austria 2002, via e-mail to the author, Internet: http://www.iea.org/statist/index.htm [1.2.2003]

[425] Internet: http://europa.eu.int/comm/energy_transport/atlas/html/bioofuture.html [13.2.2003]

- Investigation of new plant species for producing feedstock for Biodiesel
- Research into increasing crop yields without compromising on environmental impact

In the author´s eyes, all these supportive actions and actors are crucial for a further development of the Biodiesel sector as well as for initial actions in new countries.
As the predicted fuel consumption shows, special attention has to be put on the Asian countries.
The European Union could lead the way demonstrating a successful implementation of mandatory usage of biological fuels. As shown in Fig. 44 below, the very challenging goal of replacing 5,75 % of national diesel fuel consumption by 2010 will require improved efforts in all participating countries:

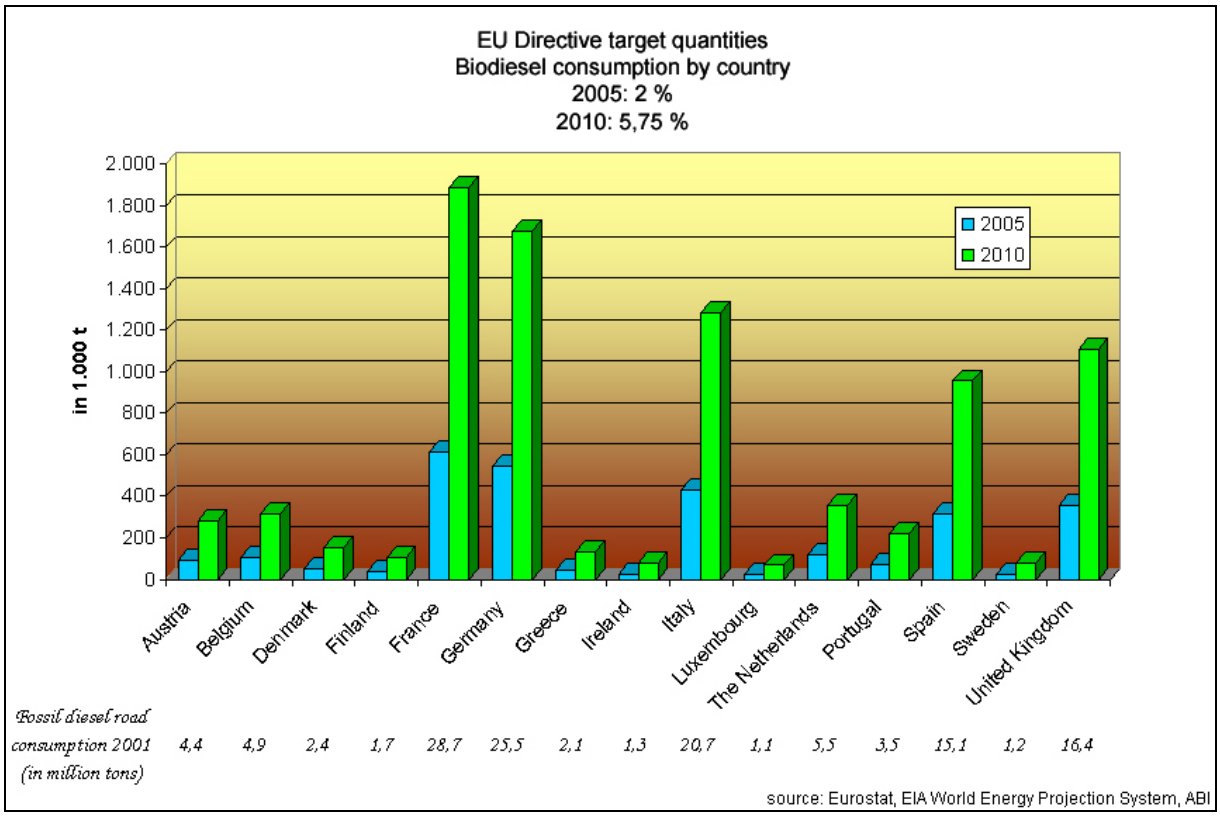

Fig. 44: EU Directive targets for Biodiesel consumption 2005/2010

Source: ABI (Austrian Biofuels Institute): In response to the e-mail questionnaire sent by the author, Austria, Vienna 2003

The advantages are clear: environmental benefits, supply security, and availability in the long term. What Biodiesel cannot do is to substitute fossil diesel fuel entirely. Therefore the main focus should be put on market niches like the urban transport sector where all these advantages can develop their full potential.
The future of Biodiesel will rely on a significant extent on enhanced R&D efforts: it will have to compete with synthetic fuels especially designed to the needs of the modern diesel motor; also, Biodiesel will have to comply with the more and more

severe emissions regulations. The latest coup by the German FAL[426], an electronic sensor in the car tank that is able to identify the type of fuel in the tank and adapt the injection properties is a promising step in this direction.[427]

And finally, there may be additional potential regarding the co-operation with other alternative fuels. Brazil, based on its long-year tradition in using alternative fuels is already testing all kinds of blends with ethanol and low sulphur diesel as well as Biodiesel produced by chemical reaction with natural alcohol sources.

The maximum potential never lies in one technology or solution. Only the combination of various techniques in all sectors will lead to the desired effects of reducing the burden for the environment and society. The perfect mix between healthy competition and sound co-operation is once again the aim of this game to maximise the win-win situation for the main actors involved.

[426] FAL-Federal Agricultural Research Center, Internet: http://www.fal.de

[427] ABI (Austrian Biofuels Institute): Biodiesel Courier, e-mail newsletter, August 29, Austria 2003

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7. APPENDIX

7.1 Appendix I: .doc-version (Microsoft Word) of database questionnaire

BASIC DATA

Name of company

Your name	**First name**	**Function**

Headquarter address	**Area-code**	**City**	**Country**

Biodiesel plant address	**Area-code**	**City**	**Country**

E-mail	**Website**	**Fax**
	http://	

Number of employees in Biodiesel production	**Total Biodiesel turnover**	**Currency**

PRODUCTION DATA

Type of plant

☐ research ☐ demonstration ☐ commercial

Process technology provider

Type of process technology

Pressure	☐ ambient	☐ other bar	
Process	☐ batch	☐ semi-continuous	☐ continuous
Catalyst	☐ KOH	☐ NaOH	☐ other

Biodiesel production start-up date

month year

Total annual Biodiesel (in 000 ☐ tons ☐ gallons ☐ liters per year)

	1998	1999	2000	2001	2002 est.	2003 est.	2004 est.	2005 est.
Capacity								
Production								

FEEDSTOCK

Type of feedstock used

	Vegetable oil	Animal fats	Waste oil and fats
% share of total			
which:	.% rapeseed % sunflower % soybean % palm oil %	% beef (tallow) % swine (lard) % chicken % %	% households % restaurants % trap fat % %
other:			

Yield

upper limit of FFA to be processed: %		1000 kg oil/fat processed to: kg Biodiesel
utilisation of FFA:	%	
	☐ heating fuel	
	☐ distillation	
	☐ Biodiesel	
	☐ waste	

PRODUCT QUALITY

Quality level of Biodiesel produced

Quality standard required?	no☐	yes☐: applied standard:
		☐Austrian ON C 1191 FAME ☐German DIN 551606 FAME ☐USA ASTM D 6751-02 FAME ☐EN 14214 FAME
		☐ Any other standard applied:

Quality level of glycerine produced

Applied standard
British Standard BS 2623 (99%) BS 2622 (88%)☐ BS 2621 (80%)☐ lower☐ ☐

Quality management

in your own analytical laboratory ☐
by external independent analytical laboratory ☐ name:

MARKETING STRATEGY

Market size

Total Diesel fuel market size: ☐ Diesel:..... …...☐tons☐gallons☐liters per year
☐ Heating oil: …...☐tons☐gallons☐liters per year
Your estimate of maximum possible market share of Biodiesel:…… %

Your markets & your targets therein

	sales share in %
Private cars	☐
City bus & taxi fleets	☐
Trucks (HDV)	☐
Agricultural/forestry machinery	☐
Boats/ marine sector	☐
Federal & public fleets	☐
Others:…… …….	☐

Physical distribution channels

		sales share in %
☐ direct distribution to customer		
☐ indirect distribution:	☐ wholesaler	
	☐ (local) retailer	
	☐ refinery, further processing	
	☐ other:	

Brand strategy

Do you use brands?	☐ no	
	☐ yes	brand name:

Final product usage

	sales share in %
100 % Biodiesel	☐
… % blend	☐
… .% blend	☐
….% for heating oil light	☐
export (regardless of final use)	☐
others:…… ……	☐

Pricing strategy (prices: Aug 2002)

	Currency	
Base price of fossil diesel at the pump:		per: ☐ ton ☐ gallon ☐ liter
Base price of Biodiesel(100 %) at the pump:		per: ☐ ton ☐ gallon ☐ liter
Base price of Diesel containing ……% Biodiesel at the pump:		per: ☐ ton ☐ gallon ☐ liter

LEGAL FRAMEWORK

Taxation policy

National level fossil diesel tax/excise duty:	Currency per: ☐ton ☐gallon ☐ liter

National level of Biodiesel detaxation:	Currency
☐fixed amount of	per: ☐ton ☐gallon ☐ liter
☐fixed percentage of	% of fossil diesel tax
☐volume limitations for tax exemption: ☐liters per year	☐tons ☐gallons
☐other tax regulation (please describe):	

Other existing supportive measures (please describe)

☐taxation (e.g.: greenhouse tax exemption):

☐regulation (e.g.: obligatory market share):

☐subsidies (e.g.: feedstock purchasing):

☐other (e.g.: free parking):

BARRIERS

Most important barriers/problems (1=most important 5=not so important)

	1	2	3	4	5
high raw material cost	☐	☐	☐	☐	☐
irregular raw material supply	☐	☐	☐	☐	☐
missing engine approvals	☐	☐	☐	☐	☐
poor distribution infrastructure	☐	☐	☐	☐	☐
inadequate quality management	☐	☐	☐	☐	☐
missing legal framework	☐	☐	☐	☐	☐
others……..	☐	☐	☐	☐	☐

Most efficient measures to remove them (1=most efficient 5=not so efficient)

	1	2	3	4	5
reasonable raw material prices	☐	☐	☐	☐	☐
obtaining more engine approvals	☐	☐	☐	☐	☐

efficient distribution infrastructure	☐	☐	☐	☐	☐
active quality management	☐	☐	☐	☐	☐
removal of tax hurdles	☐	☐	☐	☐	☐
supportive legislative measures	☐	☐	☐	☐	☐
others……	☐	☐	☐	☐	☐

We thank your for having taken the time to complete this questionnaire.

Please let us know if you are interested in one of these publications. As a thank you, we would be glad to send them to you free of charge.

☐ **Review on Commercial Production of Biodiesel World-wide (Nr.2/2003)**
Austrian Biofuels Institute (ABI), to be published in January 2003
☐ **Biodiesel-a Success Story; Development of Biodiesel in Germany**
Austrian Biofuels Institute (ABI), 2001
☐ **Biodiesel Courier** : weekly newsletter by e-mail
☐ **Review on Commercial Production of Biodiesel World-wide (Nr.1/1998)**
Austrian Biofuels Institute (ABI), 1998
☐ **New Trends in Developing Biodiesel World-wide**
Austrian Biofuels Institute, Miami 2002, 9 pages

We will send the material to the E-Mail that you mentioned on Page 1
If you want it to be sent to a different address, please fill in here:

For additional comments and information or questions about this survey, please contact:
Austrian Biofuels Institute: world.report@biodiesel.at

7.2 Appendix II: e-mail questionnaire

Biodiesel/ Study for the Liquid Biofuels Task of IEA Bioenergy

Dear Ladies and Gentlemen,

as commissioned by the Liquid Biofuels Task of IEA Bioenergy the Austrian Biofuels Institute (ABI) is going to complete a study on all world-wide Biodiesel activities, in order to give an instructive picture of this young and fast developing industry to interested decision makers.

We thought that maybe you and your department/institution could help us gathering information about the Biodiesel sector in Your country.
As we believe that this study can be of great interest -also to you-, we ask you for your support concerning the collection of necessary data. Especially we would be interested in:

- Are there Biodiesel production plants in your country (operating, in construction, planned)? Do You have contact e-mail-adresses of them?
- Legal framework concerning Biodiesel production (special regulation, tax exemptions…)?
- National capacity/ouput (estimate)?
- Market situation: who is selling Biodiesel (pumps, wholesaler), who is buying it (busfleet, taxi, private…)?
- Stakeholders: your opinion concerning the main stakeholders (R&D, Interest associations, Industry, Ministries, Governmental programs, oil processors and agricultural associations, energy agencies...) in the Biodiesel sector
- Future trends / outlook (actions taken, possible legislative development…)?
- Links to further information sources (national reports, institutions…) in your home country?

We really would enjoy if you could spend some of your valuable time to answer these few questions.

As a thank you, we can provide you access to the following reports concerning Biodiesel production:

- Review on Commercial Production of Biodiesel World-Wide, Vienna 2003 (in elaboration)
- New Trends in Developing Biodiesel World-Wide; Miami USA, May 2002, 9 pages
- Biodiesel-a success story; Development of Biodiesel in Germany, Vienna 2001
- Biodiesel Courier: weekly e-mail newsletter
- Review on Commercial Production of Biodiesel World-Wide, Vienna 1997

Please let us know if you are interested in one of these publications, we would be glad to send you the electronic version free of charge.

We are looking forward to hearing from you soon, thank you for your co-operation and with best regards

Stephan Friedrich
Austrian Biofuels Institute
www.biodiesel.at

SCHRIFTENREIHE UMWELTSCHUTZ UND RESSOURCENÖKONOMIE

DES INSTITUTES FÜR TECHNOLOGIE UND NACHHALTIGES PRODUKTMANAGEMENT
(ehemals Institut für Technologie und Warenwirtschaftslehre)
DER WIRTSCHAFTSUNIVERSITÄT WIEN

hrsg. von o.Univ. Prof. Dr. G. Vogel

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