BIO NETT

BioNETT

Intelligent Energy Europe

Biofuels Handbook

Best Practice Tools and Pilot Projects

Produced as part of the Bio-NETT Project

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CTI

Foreword

This Handbook aims to spread the knowledge and information on biofuels attained during BioNETT Project. It seeks to increase awareness and improve know-how of both the biofuels supply chain actors and end-users and in addition, to stimulate investments on biofuels production and promote projects on biofuels use in private and public fleets.

The result is an easy to use booklet containing seven (7) sections with useful information for potential investors, producers and users of biofuels.

The "Biofuels" section deals with the main issues of raw material production and processing and biofuels production, distribution and use. Moreover, the contribution of biofuels and the environmental benefits from their use are addressed.

The "Third Party Financing Opportunities" section comprises an easy to use database on the available financing opportunities for development of energy crops, investments in biofuels and biogas production and promotion of alternatives fuels in nine (9) European Member States: Bulgaria, Greece, Ireland, Italy, Latvia, Poland, Spain, Sweden and United Kingdom.

In the "Biofuels Strategies" section the main European and BioNETT Member States strategies and policies to support and promote biofuels are described.

The "Sources of Technical Advice and Information" section deals with key issues of biofuels production and use: Development of business plans, Scale and technologies selection, Contract agreement among biofuels chain actors, Health and safety issues, Upgrading of biogas, By-products utilisation, Shifting from fossil fuels to biofuels, Life cycle analysis and Biofuels sustainability issues.

In the "Technology ranges and implementation" section three pioneer projects of biofuels use in vehicle fleets, which have inspired BioNETT partners, are described: biodiesel use in Taxi fleet 878 in Graz, bioethanol use in Municipal FFVs fleet of Stockholm and biomethane use in public buses in Lille.

The "Pilot Biofuels Projects" section presents twenty (20) pilot projects promoting production, distribution and use of biofuels in BioNETT partners' countries: Bulgaria, Greece, Ireland, Italy, Latvia, Poland, Spain, Sweden and United Kingdom. These projects have been facilitated or supported by BioNETT Project.

At the last section a list of useful reference documents on biofuels is provided.

The Project Consortium is deeply indebted to the work performed by the late Dr Crispin Webber, who inspired and initiated the present project.

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LIST OF ACRONYMS AND ABBREVIATIONS

AD	Anaerobic Digestion of organic material which produces biogas
AENOR	Spanish Association for Standardization and Certification
AERTA	Spanish Association of Enterprises for Collection, Treatment and Recycling of Oil and Fat
AES	Alternative Energy Sources
ANATOLIKI S.A.	Local Development Agency of Eastern Thessaloniki, Greece, Partner of BioNETT Project
ARGEM	Energy Management Agency of Murcia Region, Spain, Partner of BioNETT Project
Art.	Article
Artic.	Article
B5	Biodiesel-diesel blend (5% biodiesel- 95% mineral diesel)
B10	Biodiesel-diesel blend (10% biodiesel- 90% mineral diesel)
B20	Biodiesel-diesel blend (20% biodiesel- 80% mineral diesel)
B25	Biodiesel-diesel blend (25% biodiesel- 75% mineral diesel)
B35	Biodiesel-diesel blend (35% biodiesel- 65% mineral diesel)
B100	100% biodiesel
BAFF	Bio Alcohol Fuel Foundation
BAPE	Baltic Energy Conservation Agency, Poland, Partner of BioNETT Project
BDI	Biodiesel International, Austrian company
BDS	Bulgarian Institute for Standardization
BGK	Bank of National Economy of Poland
BGN	Bulgarian Lev, Bulgarian currency
BS	British Standard
BSI	British Standards Institute
BSR	BSR Svenska AB, Swedish hi-tech company
BTX	Benzene, Toluene, Xylene
CAP	Common Agricultural Policy
CEN	European Committee for Standardization
CEN/TC 335	Technical Committee developing the Standard for Solid Biofuels
CEN/TC 383	Technical Committee developing Sustainability Criteria for Biomass
CEO	Chief Executive Officer, the highest-ranking corporate officer or administrator
CGN	Compressed Natural Gas
CH_4	Methane
CHP	Combined Heat and Power
CIEMAT	Centre of Energy, Environmental and Technological Investigations, Spain
CIF	Cost, Insurance and Freight, means that the cost of goods, freight or transport and marine insurance are included in the selling price
CIT	Corporate Income Tax
CNG	Compressed Natural Gas
CO	Carbon monoxide

Co_2	Carbon dioxide
COD	Chemical Oxygen Demand
COM	Communication from the Commission to the Council and European Parliament
CONCAWE	Conservation of Clean Air and Water in Europe, The oil companies' European association for environment, health and safety in refining and distribution
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSF	Community Support Framework
CTI	Italian Thermotechnical Committee, Italy, Partner of BioNETT Project
CWA	CEN Workshop Agreement
DCMNR	Department of Communications, Energy and Natural Resources of Ireland
DDGS	Distillers Dry Grains Soluble, by-product of fermentation process used to produce bioethanol
DfT	Department for Transport, UK
DG-TREN	Directorate General for Energy and Transport
DIN	German Institute of Standardization
DIN 51605	German vegetable oil fuel standard
DLR	Institute of Robotics and Mechatronics
DPF	Diesel Particulate Filter
E 5	Bioethanol-petrol blend (10% bioethanol- 90% petrol)
E 20	Bioethanol-petrol blend (20% bioethanol- 80% petrol)
E 25	Bioethanol-petrol blend (25% bioethanol- 75% petrol)
E 85	Bioethanol-petrol blend (85% bioethanol- 15% petrol)
E 95	Bioethanol-petrol blend (95% bioethanol- 5% petrol)
E 100	100% bioethanol
EAFRD	European Agricultural Fund for Rural Development
EC	European Commission
ECU	Engine Control Unit
EEA	European Environmental Agency
EEC	European Economic Community, the former name of EU
ELOT	Hellenic Organization for Standardization
EMAS	EU Eco-Management and Audit Scheme
EN 14214	European biodiesel standard
EN 15376	European bioethanol standard (under development)
EN 228	European unleaded petrol standard
EN 590	European mineral diesel standard (permits use of up to 5% biodiesel as blend)
Eqv.	Equivalent
ESS	Energy Agency for Southeast Sweden, Partner of BioNETT Project
ETBE	Ethyl Tertiary Butyl Ether, used as oxygenate petrol additive
ETSU	East Tennessee State University

EU	European Union
EUCAR	European Council for Automotive R& D
EUR	Euro, European Union currency
Exkl	Excluded
FAEE	Fatty acid ethyl esters
FAME	Fatty acid methyl esters
FFV	Flexi-Fuel Vehicle, this can operate on a range of biofuel mineral fuel blends
GHG	Green House Gas, gas that contributes to greenhouse effect
GO 0,2	Gasoil 0,2% sulfur
H_2S	Hydrogen Sulphide
Ha	Hectare
HC	Hydrocarbon, organic compound consisting entirely of hydrogen and carbon
HMRC	Her Majesty's Revenue and Customs, non ministerial department of the British government responsible for collection of taxes
IBC	Intermediate Bulk Container
ICS	International Classification for Standards
IDA	Industrial Development Authority of Ireland
IEA	International Energy Agency
IEE	Intelligent Energy Europe Programme
IPI	Institute of Industrial Promotion of Italy
I.S.	Irish Standard
ISB	Invest to Save Budget
ISO	International Organization for Standardization
JRC	Joint Research Centre of European Commission
K	Potassium
KLT	Public transport company of city of Kalmar, Sweden
KFB	Swedish Transport & Communications Research Board
LCA	Life Cycle Analysis
LDS	Lotos Diesel Service
LFA	Less Favoured Areas
LGA	Latvian Guarantee Bank
LIP	Local Investment Programme
LLC	Latvian Guarantee Bank, acronym in Latvian
LNG	Liquefied Natural Gas
Ltd	Limited Liability Company
LVL	Latvian Lats, Latvian currency
LVS	Latvian Standards
MEA	Municipal Energy Agency, Rousse, Bulgaria, Partner of BioNETT Project

MFV	Mixed Fuel Vehicle
MOT	Mineral Oil Tax
MTBE	Methyl Tertiary Butyl Ether, used as oxygenate petrol additive
MWRA	Mid Western Regional Authority, Ireland
N	Nitrogen
N.	Number
NDP	National Development Plan
NELEEAC	North East London Energy Efficiency Centre, UK, Coordinator of BioNETT Project
No	Number
NOx	Nitrogen oxides
Nm^3	Normal cubic meter, unit of volume at standard temperature and pressure
NMHC	Non-Methane Hydrocarbon
NSAI	National Standards Authority of Ireland
NSCA	Formerly Environmental Protection UK
NWE	North West Europe
OCP	Operational Competitiveness Programme
OECD	Organisation for Economic Cooperation and Development
OEMs	OEMs are the industry's brand name auto manufacturers
P	Phosphorous
p.	Pound Sterling, UK currency
PA	Public Authority
pH	Measure of the acidity or alkalinity of a solution
PKN	Polish Committee for Standardization
PLN	Polish Zloty, Polish currency
PM	Particulate Matter, consists of airborne particles in solid or liquid form
PN	Polish Norm
POT	Plant Oil Transformer, developed by Global Oil GmbH
PPC	Portable Program Carrier
PPO	Pure Plant Oil
R & D	Research & Development
RCM	Region of Central Macedonia
REACM	Regional Energy Agency of Central Macedonia, Energy Agency within the structure of ANATOLIKI S.A., Partner of BioNETT Project
Reg.	Regulation
RES	Renewable Energy Sources
RME	Rape Methyl Ester
RMS	Riga Managers School, Latvia, Partner of BioNETT Project
RTFO	Renewable Transport Fuel Obligation

RUE	Rational Use of Energy
S.A.	Anonymous Society/corporation
SAC	Scottish Agricultural College
SAVE	EU Programme on promotion of energy efficiency and encouraging of energy-saving, predecessor of IEE Programme
SCVA	Swedish Private Equity & Venture Capital Association
SEEG	South Styrian Cooperative for Energy and Protein Production
SEI	Sustainable Energy Ireland, formerly the Irish Energy Centre
SEK	Swedish Krona, Swedish currency
SEKAB	Svensk Etanolkemi AB, Swedish ethanol importing company
SIS	Swedish Standards Institute
SME	Small Medium Enterprise
SS	Swedish Standard
STCC	South Tiperrary County Council, Ireland
SVO	Straight Vegetable Oil
SWEA	Severn Wye Energy Agency, UK, Partner of BioNETT Project
TEA	Tiperrary Energy Agency, Ireland, Partner of BioNETT Project
THC	Total Hydrocarbon
TOE	Tonne of Oil Equivalent
TS	Technical Spesification
TTW	Tank-to-Wheels
UCO	Used Cooking Oil
UK	United Kingdom
UNE	Spanish Standard
UNI	Italian Organization for Standardization
URL	Uniform Resource Locator, a string of characters used to represent a resource available on internet, a web-site
US / USA	United States of America
UV	Ultraviolet
VAT	Value Added Tax
VOC	Volatile Organic Compound
VRT	Vehicle Registration Tax
VVT	Technical Research Centre of Finland
WI	Work Item
WTW	Well-to-Weels
WWF	World Wide Fund for Nature, non governmental organisation

BioNETT Project

Bio-NETT

Developing Local supply chain networks, linking biofuel producers with public sector users

This project is co-financed by Intelligent Energy Europe Programme. IEE is the EU's tool for funding actions to improve market conditions and move towards a more energy intelligent Europe. The objectives of the Programme are:

- Fostering energy efficiency and the rational use of energy sources
- Promoting new and renewable energy sources and energy diversification
- Disseminating energy efficiency and new energy sources in transport

Project Description

BioNETT intends to develop a supportive framework for encouraging the growth of local markets for biofuels as low carbon fuels for Local Authorities and other sectors transports fleets across the EU.

Bio-NETT will enable and support attitude changes and capacity building within public sector organizations, the agricultural sector (including young farmers and rural women) and the wider supply chain. This will help to recognize the benefits of sustainable practices about the development and use of biofuels.

Objectives

Biofuels need networked markets if they are to achieve their potential, and Bio-NETT aims to bring together these markets on a regional level. By linking suppliers and users in both the countryside and the town, the project will build up markets by developing skills and providing potential sources of financial support. It will also help raise awareness among public and private sector fleet managers and spread knowledge at local, national and European level. Each partner participating in the project will contribute to the exchange of information on biofuels. The project will capitalise on current trend in the public and the private sector for the use of biofuels, which has already generated a positive response to the project's goals.

Results

- Ten regional biofuel networks have been set up.
- Five biofuels transport projects established, representing a potential carbon dioxide emission reduction of 1.500 tonnes of CO_2 per year.
- Publication of best practice tools and project documentation; 500 project brochures and 100 CD-ROMs distributed per partner establishing a biofuel information exchange centre.
- Identification of two pilot projects in the production, distribution or use of biofuels in each partner's country and, where possible, proceeds with implementation.
- Production and dissemination of technical tools for encouraging the production and the use of biofuels in public transport (for example, business plan model, list of third-party financing sources, vehicle conversion kit).

Duration

Start	01/01/2006
End	31/08/2008

Budget (EUR)	1.148.305
50% EU Contribution	574.152,5

BioNETT

BioNETT Partners

NELEEAC - North East London Energy Efficiency Advice Centre, UK, *Coordinator*

The North East London Energy Efficiency Advice Centre (NELEEAC) was launched in 1994 for the purpose of providing free and impartial energy advice to residents and businesses within the London Boroughs of Newham, Redbridge, Waltham Forest, Enfield, Barking & Dagenham, and Haringey. NELEEAC serves one of the largest regions in London, within a diverse community. The centre employs dedicated staff from different backgrounds and cultures, hence enabling energy efficiency advice to be provided in a variety of ethnic languages. The impartiality of advice provided by the centre is a significant feature of its operations.

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ANATOLIKI S.A - Regional Energy Agency of Central Macedonia, GREECE

The Region of Central Macedonia and the Local Development Agency «ANATOLIKI S.A» established the Regional Energy Agency of Central Macedonia (REACM) in 1997, through the European Union's SAVE programme. The REACM operates within the structure of the local development agency ANATOLIKI S.A.. Its main activities include: Data Acquisition for Energy Production & Consumption, Support to the Regional and Local Authorities in energy policy planning, Dissemination and Promotional Activities for RES and RUE Technologies, Training and Continuing Education, Support to Local Industry, SMEs & Commercial, Evaluation of RES and RUE Investment Proposals for Industrial and Residential applications.

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MEA - Municipal Energy Agency, Rousse, BULGARIA

Municipal Energy Agency Rousse, operates in the Rousse Region and Rousse Municipality of Northern Bulgaria. It was established in 2001 as a 'not profit' organisation. Its main activities include education and campaigns for promotion of RUE and RES. Moreover, MEA works in close cooperation with the Municipality, Rousse University "Angel Kantchev ", local enterprises and other stakeholders from both public and private sector on the fields of biogas and biofuels promotion, RES and energy efficiency applications, development of Municipal energy programmes and strategies. Main target groups of its activities are Administrators of Municipal Organisations, Researchers, Schools, Managers of Public Services, Private Companies, Citizens & Consumers and others.

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ESS - Energy Agency for South East Sweden, SWEDEN

Energy Agency for South East Sweden is working in commission of the Swedish Energy Agency and the regional authorities of the two counties of southeast Sweden Kalmar and Kronoberg. The Agency has 13 employees and offices in each county. Its main task is to promote the development of more sustainable and efficient regional energy infrastructures. All the energy and environmental work carried aims to create positive effects on the regional public and private real estate, forestry and agricultural sector and thereby regional finances. The agency is operating as well as a regional hub and centre for information and development in the entire sphere of energy. Strategic energy planning and assistance in implementing energy policies are all vital parts of its work.

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BAPE - Baltic Energy Conservation Agency, POLAND

Baltic Energy Conservation Agency was established in 1996. Agency actively co-operates with energy and environmental companies in Poland and Europe by participating in many Polish, bilateral and European projects, programs and networks. This brings access to the most recent know - how as well as opportunities for dialogue and efficient flow of information. Its main activities are focussed on energy efficiency, RES implementation, energy policy and planning. BAPE provides assistance to local and regional authorities, heating companies, RES producers and users, private companies and energy end-consumers by energy auditing, planning and feasibility studies. Information dissemination, promotion, education and trainings in this field are also of high importance for BAPE.

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TEA - Tipperary Energy Agency , IRELAND

The TEA was initially established under the EU SAVE programme in

March 1998. Its mission is to 'lead and support Co. Tipperary to reduce its CO2 emissions by stimulating and contributing to the implementation of best practise in the field of sustainable energy'. The TEA has extensive knowledge and experience in energy auditing, integration of renewable energies, feasibility studies etc. The Services it provides include

- Sustainable Energy Service to Local Authorities
- Energy Efficiency Services for Public Buildings
- Sustainable Eneregy Design and Implementation Service
- Renewable Energy Development Service
- Building Energy Rating Design Service
- Sustainable Transport Promotion Service
- Monitoring and Analysis Service
- Information and Awareness Programme

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RMS - Riga Managers School, LATVIA

RMS was founded in 1993. It is one of the leading consulting companies in Latvia. Currently RMS consists of four departments: RMS-Consulting, RMS-Forum, RMS-Recruitment and RMS-Development. RMS-Consulting offers a wide range of consultancy products from training seminars to corporate projects focusing at the areas of strategy, business engineering and re-engineering, marketing, personnel, organizational development and behaviour. It uses both foreign techniques tailored and adapted to Latvia environment and original methods and techniques developed by local professional consultants with long experience in working with leading Latvian and foreign companies. RMS has started to work actively in the area of renewable energy in 2003 with its involvement in EU Projects.

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SWEA - Severn Wye Energy Agency Limited, UK

Severn Wye Energy Agency (SWEA) is a local SAVE Agency based in the Forest of Dean in the South West region of the UK. SWEA is a registered charity that works to promote rational use of energy and renewable energy sources across all sectors, working with a wide range of stakeholders. The organisation was founded in 1997.Sustainable energy work carried out by SWEA includes: advice provision, training and awareness work, promotion of rational use of energy and renewable energy sources, working with municipalities to develop energy and climate change strategies, development of incentive schemes for sustainable energy, multi-disciplinary research on sustainable energy.

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ARGEM - Energy Management Agency of Murcia Region, SPAIN

ARGEM is a SAVE Agency established in 2001. It is constituted like an organization of funded nature aiming to educate users and to diffuse the principal of rational use of energy, energy saving measures and good practices of energy efficiency. ARGEM major goals are: to give an effective answer to the necessities of spreading the use of Renewable Energies within the territory of the Autonomous Community of the Region of Murcia, to increase awareness of all social groups on the necessity of using the energy efficiently, to promote their participation in good practices of energy saving, to boost the development of Renewable Energies Sources and to encourage their use elaborating information material and launching information campaigns and other relevant activities .

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CTI - Italian Thermotechnical Committee, ITALY

CTI, established in Milan in 1933, affiliated to UNI (Italian Standardization Body), is assigned the responsibility to carry out standardization work in the various sectors of thermal energy production, distribution and utilization. CTI, on behalf of UNI, co-operates with ISO and CEN for standardization purposes concerning, among others, Biofuels (CEN TC 335 and BIONORM Project) and Biomass (CEN TC 383 Biomass Sustainability). CTI is also a research organisation which is extremely active in the different fields and topics related to sustainable energy systems. CTI has recently developed several studies on renewable energies, for the application of biomass technologies and for promotion of biofuels for transportation and on the development of energy sustainability in particular regions within Italy and also in other areas of the world (e.g. Sri Lanka).

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Biofuels

What are biofuels and why are they important?

Biofuels are the generic name used for transport fuels derived from crops such as oil seed rape, wheat or sugar beet, and from waste organic material such as waste oils, food residues and animal manure slurries. There are three main biofuels:

- Biodiesel - this is a diesel like fuel that can be used in most conventional diesel vehicles generally as a blend with mineral diesel. The fuel is made from vegetable oils such as rapeseed or sunflower oil, or waste food oils.
- Bioethanol - this can be blended in small amounts with petrol and used in conventional petrol vehicles. Higher blends of bioethanol can be used, but only in specialist vehicles. The fuel is made from fermenting sugars from crops such as sugar beet or wheat to make ethanol.
- Bio-methane - is the product of anaerobic digestion of organic waste such as animal manures or food residues. The gas produced from the digestion of the waste is upgrade to 95% methane and can then be used in vehicles designed to run on natural gas.

Biofuels have low life cycle greenhouse gas emissions compared to fossil fuels and are an indigenous source of fuel. These two properties are important in terms of addressing two issues in European energy policy: climate change and the need to reduce transport carbon emissions; and Europe's need to reduce its dependence on oil imports. As a result, tax and other incentives are now available in many EU States that can reduce the operational costs for biofuel vehicles.

In addition biofuels help with the diversification of agriculture and the rural economy and can contribute to cleaner urban transport and improving local air quality.

Feedstock markets and land-use issues

Biodiesel

In Europe 70% of biodiesel is commercially produced from oil seed rape, the remainder being produced from sunflower, waste vegetable and animal oils (from the food industry). Biodiesel can also be made from other oils such as palm oil, which is imported from countries such as Malaysia. There are currently approximately 40 processing plants in the EU mainly located in Germany, Italy, Austria, France and Sweden. EU biodiesel production in 2005 exceeded 3,180 thousand tonnes, an increase of 65% on the previous year.

The biodiesel fuel yield per hectare of land depends on the crop used, but the average for the EU is currently around 1.230 litres per hectare (based on 2,9 metric tonnes crop per hectare and 427 litres per metric tonne). With only modest improvements in annual yields expected, it is estimated that if biodiesel is to displace 5% of EU mineral diesel use by 2010, around 15% of the total EU cropland area would be required - this area exceeds the expected cropland that will be dedicated to oil-seed production. Therefore to meet EU targets for biodiesel there will be pressure to bring more land under cultivation for fuel crops, such as set-aside land, and there is also likely to be an increase in imported oils such as palm oil.

Bioethanol

Brazil and the USA have historically been the main producers of bioethanol using sugar cane and corn as the main feedstock's. In Europe, however, bioethanol is commercially produced using cereals wheat (50%) and barley (20%), and sugar beet (30%). EU bioethanol production in 2005 exceeded 910 million litres, an increase of 73% on the previous year. The main European centres of production are in Spain, Germany, Sweden and France.

The bioethanol fuel yield per hectare depends on the crop used; the average for the EU is currently around 2.790 litres per hectare (based on 7,0 metric tonnes crop per hectare and 400 litres per metric tonne). It is estimated that if bioethanol is to displace 5% of EU petrol use by 2010, around 5% of the total EU cropland area would be required. This is well within the expected cropland that will be dedicated to biofuel production, making the meeting of biofuel targets in terms of land use considerably easy for ethanol than biodiesel.

Bio-methane

The main feedstocks that are used in producing bio-methane through anaerobic digestion (AD) are:

- Sewage waste
- Agricultural manures
- Food waste from domestic or commercial premises
- Garden or horticultural wastes

In addition specific crops such as forage grass can be used for the AD process. However, the most common feedstock is sewage waste, with AD being integrated into the sewage

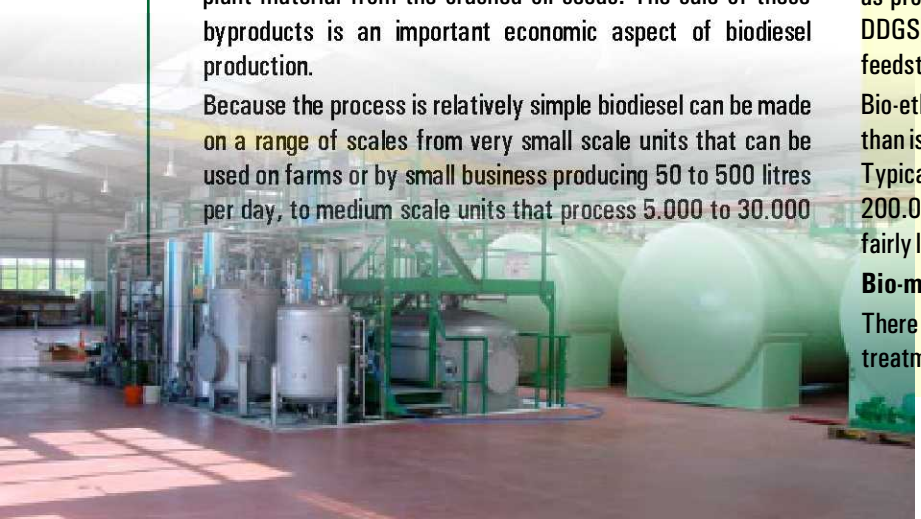
treatment process. The other waste sources are generally more dispersed and so there can be issues around collection. Waste from farms can be treated on site in small digesters, as is common in Germany, but it is more efficient if the waste manures can be collected from several farms and treated at a larger site. To use food waste it needs to be segregated from other waste streams and so the AD plant may be integrated into a municipal waste management facility. The main development potential for bio-methane is seen to be from animal slurries and food waste. However, there is strong competition to use the resulting gas for heat and electricity production.

Production and processing

Biodiesel

The biodiesel fuel itself is a methyl ester produced from the feedstock oil, so for example biodiesel produced from oil seed rape is know as Rape Methyl Ester (RME). The processing of methyl esters is relatively simple. The feedstock oils are filtered and pre-processed to remove water and contaminants and are then mixed with an alcohol (usually methanol) and a catalyst (usually sodium or potassium hydroxide). This breaks up the oil molecules (triglycerides) into fatty acid methyl esters and glycerol. The industrial production of biodiesel has two valuable byproducts: glycerine, used in the manufacture of pharmaceuticals; and cattle cake made from the remaining plant material from the crushed oil seeds. The sale of these byproducts is an important economic aspect of biodiesel production.

Because the process is relatively simple biodiesel can be made on a range of scales from very small scale units that can be used on farms or by small business producing 50 to 500 litres per day, to medium scale units that process 5.000 to 30.000 tonnes per year, up to industrial scale units that process 100.000 tonne plus. This scaling of the production process allows for local scale production, through co-operative production with a number of feedstock suppliers working together up to major industrial schemes.



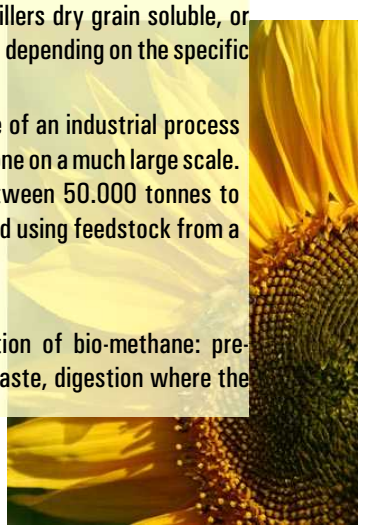
Bioethanol

The production process for ethanol depends on the feedstock. Where a sugar-based feedstock is used, such as sugar beet, the crop is first crushed and soaked to separate the sugar component. Yeast is then added to the 'mash' to ferment the sugars so producing alcohol and carbon dioxide. The liquid fraction is then distilled to produce ethanol to the required concentration. Where the ethanol is to be blended with petrol, the remaining water is removed to produce 'anhydrous ethanol'. Where a cereal feedstock is used, the production process first starts by separating, cleaning and milling the crop. Enzyme amylases are used to convert the starches into fermentable sugars. From this point on, the process is similar to that for sugar crops, although fossil fuels (usually natural gas) tend to be used for process heat. The grain-to-ethanol process also yields several co-products, such as protein-rich animal feed (e.g. distillers dry grain soluble, or DDGS) and in some cases sweetener, depending on the specific feedstock and process used.

Bio-ethanol production is much more of an industrial process than is biodiesel and so tends to be done on a much large scale. Typical ethanol plants would be between 50.000 tonnes to 200.000 tonnes per year. They would using feedstock from a fairly large area.

Bio-methane

There are 3 stages to the production of bio-methane: pre-treatment to sort and prepare the waste, digestion where the



waste material is broken down to produce the biogas, and upgrading where by the raw biogas is upgraded by removing the CO_2 and other contaminates to produce a high methane content fuel (about 95% methane).

The digestion process itself takes about 15-20 days depending on the feedstock and the technology being used. The amount of biogas produced, and the level of methane in the biogas, depends both on the feedstock and the conversion technology. In general sewage and manures tend to produce less gas that food waste. A basic digesters treating sewage waste may produce 100m^3 of methane per tonne of waste, whereas the more sophisticated centralised plant treating a range of waste may generate around 300m^3 of methane per tonne of waste. As well as biogas the AD process produces a digestate, the remaining solid and liquid material, which is a valuable fertiliser. This material can be spread back to the land for improving agricultural land and replacing fossil-based fertilisers.

Like biodiesel biogas production from AD can be done on a range of scales. Smaller farm scale units are relatively common in Germany for treating animal manures and producing heat and power. There are also a growing number of larger centralized plants treating a range of organic inputs and providing bio-methane for vehicles.

Distributing biofuels

Liquid biofuels, biodiesel and bioethanol, can in general be distributed in the same way as petrol and diesel using the same distribution systems. When used in low blends, 10% or less, there are absolutely no differences when distributing these fuels. However, for higher blends there are a few key issues to be aware of:

- Biodiesel should only be stored for between 3 and 6 months as beyond this time it can attract algal and fungal growths that will contaminate the fuel.
- Biodiesel has a higher waxing point than mineral diesel and so begins to cloud at temperatures around freezing, therefore additives or heating may be needed in cold conditions to ensure the fuel flows easily.
- Bioethanol is hydroscopic, i.e. it attracts water, and so it is important with high blends to ensure that there is not water entering the distribution and dispensing systems.
- Both biodiesel and ethanol can over time corrode certain elastomers, rubber compounds and metals, so care may need to be taken with these components in the refueling infrastructure.

Bio-methane is generally stored and used at or near its production site as it is more difficult to transport than a liquid fuel. To be used on a vehicle it is compressed or liquefied and stored in tanks. The gas is compressed either as it is being pumped into the vehicle, know as slow fill as it takes several hours, or it is pre-compressed and stored in cascade storage for rapid refuelling.

If bio-methane is to be transported the most efficient methods are either by injecting it into the natural gas distribution network as has been done in Sweden or by liquefying the fuel and transporting it by tanker. Gas mains distribution is an ideal solution as it allows the use of an existing network and provides for backup supply with natural gas. Transporting liquefied gas is generally done when the fuel is being used in liquefied form or away from a mains distribution network.

Using biofuels in a vehicle fleet

Biodiesel

While very few manufacturers have designed vehicle engines that can operate on pure biodiesel, much research suggests that many 'conventional' diesel vehicles can tolerate biodiesel blends of up to 30%. Given that a large proportion of conventional diesel is already a 5% biodiesel blend (B5), many drivers will have already used biodiesel without being aware of the fact. There is anecdotal evidence that suggests that many diesel engines run more smoothly on biodiesel fuels, which have good lubricating properties even at small percentage blends. As pure biodiesel is a mild solvent, the biofuel can also clean the fuel lines and fuel tank; it is often recommended that the fuel filter be cleaned a few months after switching to biodiesel blend.

However, practical issues concerning the use of biodiesel fuels have emerged. As most biodiesel blends as low as B20 are more viscous than mineral diesel, the fuel can 'gel' in cold

weather conditions so leading to starting problems. Poor quality straight and modified waste vegetable oils can also clog fuel lines and fuel filters, or form an emulsion in the return fuel line from the fuel injectors to the tank. Possible technical solutions include the use of a heated fuel filter or by the use of a heated fuel tank (standard in some car models). A more serious potential drawback is biodiesel's incompatibility with certain types of elastomers and natural rubber compounds. Certain engine parts (e.g. rubber hoses) are usually therefore replaced with non-rubber alternatives for high percentage biodiesel blend operation. It should also be noted that biodiesel generally has slightly lower volumetric energy density than fossil diesel which results in biodiesel vehicles requiring more fuel per kilometre (by up to 10%).Due to the potential engine compatibility issues listed above, most light-duty diesel vehicle warranties are still only valid for use with biodiesel blends of up to 5%. To manage these potential problems, national and EU biodiesel standards have been developed: EN590 provides the specifications for all EU diesel fuels, and permits the blends of up to B5 (although increasing this to B10 blends is under discussion); and EN14214 is the biodiesel standard being developed by the European Committee for Standardisation.

Bioethanol

Bioethanol is a liquid fuel and can be handled in a similar way to conventional fuels. The fuel has a high octane rating enabling high engine compression ratio that increase engine efficiency and performance. Compared to petrol, bioethanol has low volumetric energy density that results in bioethanol vehicles requiring more fuel per kilometre (by up to 50%). Bioethanol can either be used in its pure or 'hydrous' form (4% water by volume) in dedicated vehicles, or as an 'anhydrous' bioethanol-petrol blend. Low percentage bioethanol blends (e.g. 5% known as 'E5') can be used by most conventional petrol engines (and is covered by most manufacturer's warranties) and may even slightly improve their performance. That said, Brazil has successfully demonstrated that distribution and use of medium percentage blends (E20-E25) is possible on a national scale.

To convert a conventional spark-ignition engine vehicle to pure bioethanol requires the adjustment of the timing and electronic control systems, and the fitting of a larger fuel tank due to the fuel's low energy density. As bioethanol can corrode certain elastomers and metals, some engine components may also need to be replaced. Bioethanol is also difficult to vaporise at low temperatures; E95 & E100 vehicles can therefore be difficult to start in cold weather. For this reason, bioethanol is usually blended with petrol to improve ignition (E85 is a common high percentage blend).

One of the most significant recent advances is the development of Flexible Fuel Vehicles (FFVs) that are able to operate on a range of percentage petrol-bioethanol blends up to E85. The engine management system automatically detects which fuel is being used and adjusts the timing accordingly. Ford, Volvo and Saab have launched FFV models into the European market- and a network of filling stations selling E85 fuel is being steadily developed across the EU. Less common but technically feasible is the use of bioethanol in heavy-duty engines - the fuel can either be used neat (E95) with an ignition additive, or as 'E-diesel', the biofuel being atomised and added to the air intake before mixing and combusting with conventional fossil diesel fuel.

Bio-methane

Bio-methane can be used in the same vehicles as natural gas or fossil methane. The three main vehicle technologies that are used for these gas vehicles are:

- Bi-fuelled vehicles - comprises a spark ignition engine that is fitted with both a gas and a petrol fuel system. The vehicle is then capable of running on either fuel.
- Dedicated gas vehicles - these are vehicles using a spark ignition engine that runs solely on

gas and has been optimised for this purpose. This is the technology frequently used in heavy-duty vehicles such as buses and replaces a conventional diesel engine.

- Dual-fuel vehicles - these are diesel vehicles that use a compression ignition diesel engine and run on a mixture of gas and diesel, typical 70% gas and 30% diesel.

The gas fuel is stored on the vehicle in one of two basic forms - compressed or liquefied. Use in the compressed form, such as compressed natural gas (CNG), is the most common form of fuel storage on the vehicle. The gas is stored at high pressure, some 200 bar, in tanks. However, the amount of energy stored in compressed gas is significantly less than the energy stored in the same volume of liquid fuel such as diesel. An alternative is to store the gas in liquefied form commonly known as liquefied natural gas (LNG). The gas is both cooled and compressed to become a liquid, which is again stored in high-pressure tanks on the vehicle. This then increases the amount of fuel that can be stored in a given volume.The main operational issues around the use of bio or fossil methane relate to the range and refuelling infrastructure. Compared to a diesel vehicle a spark ignition gas vehicle will be some 15% - 20% less efficient, add to this a reduction in energy stored in the compressed gas, and the vehicle range can drop by some 50% for a given fuel storage volume. This issue has been tackled to some degree by the use of liquefied gas storage on vehicles. In addition the availability of refuelling points will be a key issue for the practical operation of vehicles using the fuel. In practice depot based fleets such as trucks and buses are often the first to adopt the fuel. Availability of gas-fuelled vehicles will vary from country to country, reflecting the development of the gas vehicle market in that country, but in general there is a wide variety of vehicles available. For example passenger cars are available from European OEMs including Fiat, Opel, PSA, Ford, VW, Mercedes and Volvo.

Energy and emissions benefits of biofuels

The great promise of energy crop biofuels is their potential to be 'carbon-neutral' on a life cycle basis; all the carbon dioxide emitted during processing and use of the fuel being balanced by the absorption from the atmosphere during the fuel crop's growth. In practice the process of growing the crops requires the input of fossil fuels for fertilisers, harvesting, processing and fuel distribution. The actual extent of total life cycle greenhouse gas emissions is therefore strongly dependent on the crop grown, the fuel processing employed and the energy value of any processing by-products.

For biodiesel using existing processing methods, studies show that greenhouse gas emissions can be reduced by between 40%-60% (sourced from rapeseed). More efficient process technologies under development are projected to result in life cycle greenhouse gas emissions reduction of at least 90%. For bioethanol using existing processing methods, studies show that greenhouse gas emissions can be reduced by between 20%-40% (sourced from grain). Bioethanol from sugar beet leads to a 40%-55% reduction. In Brazil where sugar cane is used as the fuel feedstock the GHG reduction is around 80-90%.

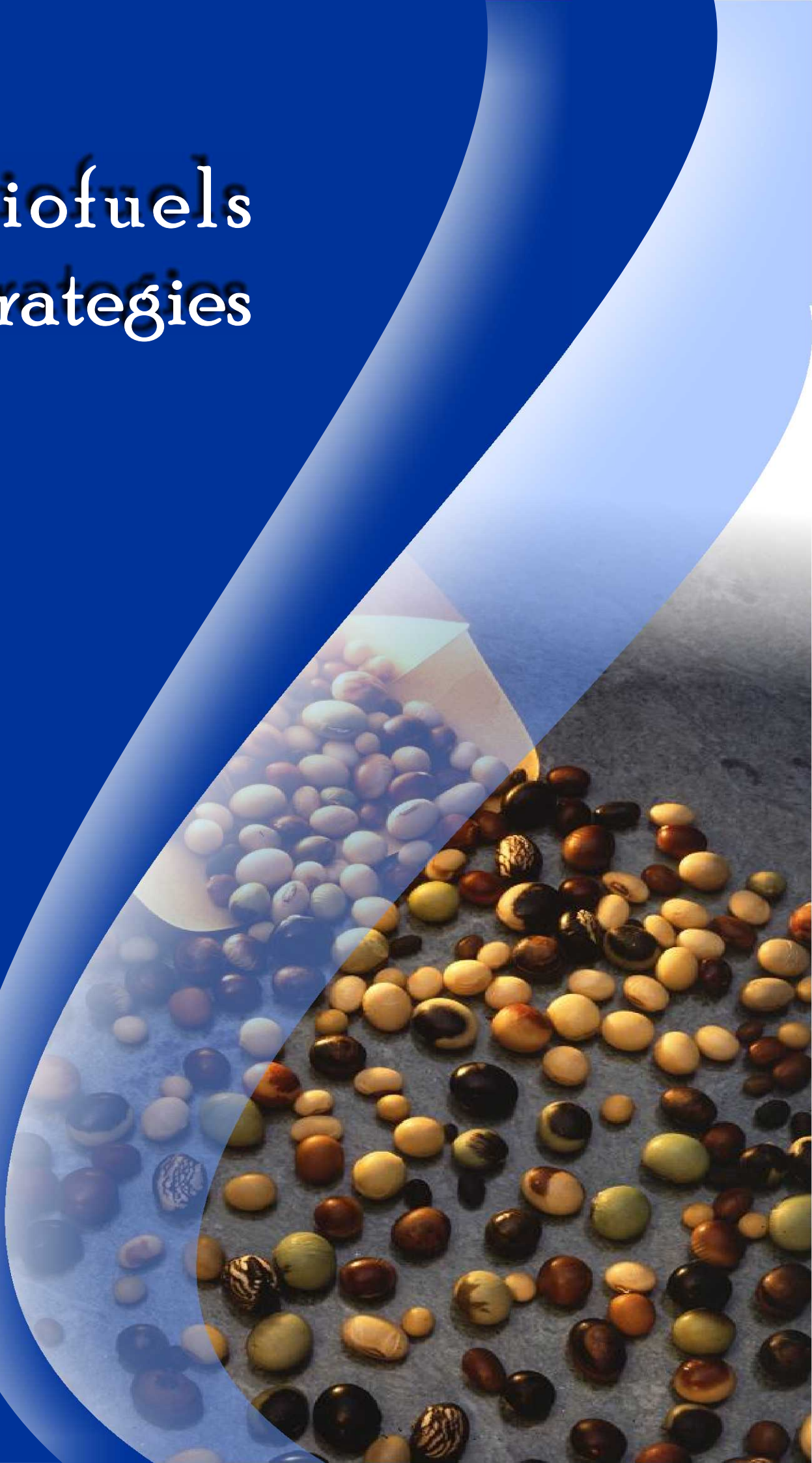
For bio-methane, vehicle CO_2 emissions are about 20% lower than petrol and about 5% lower than diesel. However, the true benefit of bio-methane is seen when it is considered on a life cycle basis for two reasons: firstly, it is a renewable fuel and secondly, by processing organic wastes it is removing a potential source of methane emissions when this waste decomposes naturally. When these two effects are combined it can reduce greenhouse gas emissions by more than 100%. Depending on the feedstock used for producing the biogas the CO_2 emissions reduction can range from 75% (using municipal waste) to 200% (using liquid farm manure).

Biofuel vs fossil fuel energy and emissions comparison

Biofuel	Fuel use (lit/100km)	LCA GHGs[4] (gr/km)	Vehicle Nox (gr/km)	Vehicle PM (gr/km)	Vehicle CO (gr/km)	Vehicle HC (gr/km)	Fossil Fuel Baseline
Biodiesel[1]	▲5%-10%	▼40%-60%	▲slight increase	▼reduced	▼reduced	▼reduced	Diesel
Bioethanol[2]	▲50%	▼20%-55%	▲slight increase	▼reduced	▼reduced	▼reduced	Petrol
Biomethane[3]	N/A	▼75-200%	▼reduced	▼reduced	▼reduced	▲slight increase	Diesel

Notes: [1] Data shown for Rape Methyl Ester (RME); [2] Data for grain and sugarbeet ethanol; [3] Data for municipal waste/liquid farm manure; [4] GHG-greenhouse gases, all data from Concawe 2005

Biofuels strategies



European Union

Policy support for biofuels in Europe

Transport and energy policy for Europe was set out at the Transport White Paper and Energy Green Paper in 2005. Regarding reducing carbon emissions and improving security of supply these documents set out a key policy target of: **"20% of all transport fuels to be from alternative sources by 2020"**. In the short to medium term these alternatives are expected to be biofuels and compressed natural gas, in the longer term the vision is for hydrogen to play a major role. To support the development of biofuels in meeting this target, a **Biofuels Directive** (2003/30/EC) was established in 2003 and set an indicative target of 5.75% by energy of all road transport fuels placed on the market to be biofuels by 31 December 2010.The most common approaches to meeting this Directive by Member States have been the use of tax incentives for biofuels and the setting of obligations on fuel suppliers. To support the use of tax incentives the Commission has put in place the **Energy Taxation Directive** (2003/96/EC), which allows Member States to use differential taxation policies for biofuels to stimulate demand.

On 10 January 2007, the Commission presented the Strategic European Energy Review. As part of the Review, the Renewable **Energy Road Map** [COM (2006) 848] set out a long term vision for renewable energy sources in the EU. It proposed that the EU establish a legally binding (mandatory) target of 10% for the share of renewable energy in transport petrol and diesel.

In 2003 an agreement was reached for reform of the **Common Agricultural Policy (CAP)**, moving away from crop-based subsidies to single farm payments. The move was expected to make farmers more responsive to the market and seek greater diversification to strengthen the rural economy. This in itself promotes a move to look at non-food crops such as biomass for energy and biofuel purposes. In addition, while farmers cannot cultivate food crops on set-aside land, they can use this land for non food-crops including biofuels.

Alongside the single farm payment, the reform provides for Energy Crop Aid to further support the development of the bioenergy market. Regulation (EC) 1782/2003 (Chapter 5, Art. 88-89) set this aid at €45/ha up to a maximum of 1,5 million ha across Europe.

However, in its proposals for a **"Health Check" of the CAP**, the Commission proposed to abolish the energy crop premium and the compulsory set-aside. More specific, on 20 May 2008, the Commission made a proposal for a Council Regulation on modifications to the CAP (COM (2008) 306 final). It is stated that due to the recent developments in the bioenergy sector, in particular, to the strong demand for such products on international markets and the introduction of binding targets for the share of bioenergy in total fuel by 2020, there is no longer sufficient reason to grant specific aides for energy crops. Therefore abolition of Regulation (EC) 1782/2003 is proposed. However Chapter 5 of this Regulation, concerning Energy Crop Aid, shall continue to apply for 2009.

The Biofuels directive

The Biofuels Directive (2003/30/EC) was established in 2003 and set an indicative target of 5,75% by energy of all road transport fuels to be biofuels by 2010 and an interim target of 2% by 2005. These national indicative targets, once adopted, are not mandatory. While they constitute a moral commitment on behalf of Member States, there is no legal obligation for them to achieve the levels of biofuel use they have chosen to target.

Progress up to 2006 against the Biofuels Directive, was reviewed in the Biofuels Progress Report, presented by European Commission on January 2007 (COM(2006) 845 final). According to this report, by 2005, only Sweden and Germany have made the most progress and are expected to meet the targets. Other countries have made less progress and some are unlikely to meet the targets. Overall the 2005 target of 2% has been missed and there is concern that the overall 2010 target is not likely to be achieved. For these reasons, the Commission is looking at potential ways to strengthen the Directive.

On 23 January 2008, the Commission proposed a common framework (Directive) for the promotion of energy from renewable sources ((COM2008) 19 final). The proposed Directive sets mandatory targets for the share of energy from renewable sources in transport of at least 10% by 2020 (Artic.3) and establishes environmental sustainability criteria for biofuels and other bioliquids (Artic.15). More specific requires a minimum 35% GHG's emissions saving from the use of biofuels or other bioliquids and the production of raw material from land with no recognised high biodiversity value or high carbon stock. Furthermore, it foresees introduction of diesel blend with 7% and 10% biodiesel by the end of 2010 and 2014 respectively and promotion of biofuels from wastes, residues, cellulosic and lignocellulosic material.

European biofuels strategy

Aiming to support the development of biofuels for the transport market, the Commission has developed an "EU Strategy for Biofuels" (COM (2006) 34 final). The strategy comprises 7 main policy axes:

1) Stimulating demand for biofuels in addition to the revision of Biofuels Directive, favourable treatment of 2nd generation biofuels and promotion of public procurement of clean and efficient vehicles are encouraged.

2) Capturing environmental benefits three specific issues being covered here are ensuring the optimal GHGs' benefits and the sustainability of biofuel feedstock cultivation, getting CO_2 accounting into transport activities and reviewing the limits on biofuel blends in the current fuel standards.

3) Developing the production and distribution of biofuels focusing on encouraging the inclusion of biofuel production in rural development policies at the regional level and discouraging discrimination against biofuels by industry.

4) Expanding feedstock supplies looking at allowing sugar crops for biofuel use on set-aside land, using the cereals surplus for biofuel production, reviewing the energy crops aid scheme, monitoring the impact of biofuels on commodity and by-product prices, financing an information campaign for farmers at forest holders, bringing forward a Forestry Action Plan and reviewing waste and animal waste by-products legislation to allow greater use in biofuels.

5) Enhancing trade opportunities especially for bioethanol and amend the "biodiesel standard".

6) Supporting developing countries the development of a biofuels assistance package and support for developing national biofuel platforms and regional biofuel action plans are envisaged.

7) Support for research and development aimed at promoting 2nd generation technologies and the bio-refinery concept. Establishment of a European Biofuels Technology Platform has been encouraged to support these developments.

Biofuels strategies in Bulgaria

In 2003, an energy strategy for Bulgaria has been adopted. The strategy has been developed along several axes energy legislation, institutional framework, tax and price policy for the creation of a RES market, national and regional programmes for energy efficiency and RES, as well training for the reduction of the energy consumption and the use of RES. The fuels are mentioned in a number of laws.

Energy legislation:

- Energetics Law, DV, No 107/09.12.2003. It introduces the requirements of the two European Directives definition of the goal for energy production from RES and a system for green certificates.
- Energy efficiency Law, DV, No 18/, 05.03.2004.
- Waste control Law, DV, No 80/03.10.2006.
- Decree No 3/01.04.2004 for wastes classification, DV,No 44/2004.
- Law for amendment of Energetics Law, DV, No 55/06.07.2007.
- Project for encouraging utilization of RES, of alternative energy sources and biofuels put forward for voting in the national assembly.
- Law for improvement of air quality , DV No/2007.
- Decree of the Council of Ministers that set the quality requirements for liquid fuels and their test methods. (PMS No156/15.07.2003.) In compliance with EU decrees - 96/62EC, 1999/30/EU, 98/70/EU, 2003/17/EU and 99/32/EU. It allows an ethers' content of up to 15% and ethanol's content up of to 5% in fuel and a methyl ester content up to 5% in diesel.
- Law for the finances and Law for the excises customs duties, DV No31/13.04.2007.

On 15th November, 2007 the Bulgarian Government ratified a National long-term programme for stimulation of biofuels consumption in transport, for the period 2008-2020. This programme was adopted with regard to the EU Resolution of 09/03/2008, which aims to bring the share of biofuels to 10% of the total petrol and diesel consumed in the transport sector, by 2020.

Increase biofuels use in vehicles is part of the strategy to meet Kyoto Protocol targets. Moreover, a higher biofuels use could contribute in fuels and energy saving and in energy security of intermediate and long-term plans. A gradually expansion of bioduels share is expected in the next years. A 44.000 tonnes consumption is expected in 2008, 133.00 tonnes in 2010 and 370.00 tonnes in 2020.

Biofuels play an important role in Bulgarian agricultural and energy policies. Subsidies granted to farmers aim to support development of an energy farming industry. Subsidies and tax reduction makes Bulgarian production more cost-competitive and this way benefit Bulgarian farmers.

German companies provide Bulgarian farmers with seeds for rapes cultivation, under condition to purchase the yield at a fixed ex-farm price. These kinds of agreements are very attractive to farmers. In 2007, 30.000 ha were cultivated with rapes (23.000 ha in 2006) giving a total yield of 93.018 tonnes, while cultivation of a total area of 40.000 ha and a total yield of 100.000 tonnes is expected in 2010. Half of this yield will be used for biodiesel production. The production of biodiesel from rapeseeds is expected to be 11.100 tonnes in 2010 and to get twice higher within 4 years. It is also expected that demand for biodiesel will be higher than supply.

The Bulgarian Petrol and Gas Association's proposed a gradually increase of biodiesel content in diesel blends, in Bulgarian market (see Table below, % in volume). However, this proposal requires changes in the maximum acceptable content of biodiesel in diesel blends.

2008	2009	2010	2011	*2012*	2013	2014	2015
1,00%	1,00%	2,00%	3,00%	4,00%	5,00%	6,00%	7,00%

Biomass option

Although Bulgaria has a huge biomass potential, manufacturers don't use the crop residues for fuel production. Approximately 4,8-5,2 million tonnes per year remain at fields, after harvesting of crops, as biomass. Local farmers still burn the harvest residues at fields to avoid increased cost of using agricultural equipment. Moreover, the Bulgarian rural population traditionally uses biomass firewood and coal for heating purposes. In the period 1997-2004, the biomass utilisation has 3,4 times increased, while consumption of all other types of energy and oil has remained constant.

Measures to stimulate use of 2nd generation biofuels should be adopted, mainly due to the negative impacts of 1st generation biofuels. Many countries promote research on development and use of 2nd generation biofuels from wastes' biomass.

According to a study of the Belgian consultative company BLACK & VEATCH, the theoretical potential of biofuels production in Bulgaria is 3.608 ktoe, while the technical potential 380 ktoe. The agricultural wastes are the most promising raw material for biofuels production. Unfortunately this resource is fragmented in small quantities among a high number of companies. Hence, the high transport cost and organizational barriers hinder creation of centralized biofuels plants.

To stimulate introduction of biofuels, operation of three certified laboratories is planned.

Greek Biofuels Strategy

Law 3423/2005, as it was amended by Law 3653/2008 (Artic.55), is they key part of Greek national strategy in biofuels. Law 3423/2005, in compliance with Directive 2003/30/EC, aims to bring the share of biofuels and other renewable fuels in the Greek market to 5,75% of the total petrol and diesel consumed in the transport sector, by 31 December 2010.

Biodiesel and bioethanol are considered the most suitable biofuels for the case of Greece, while use of pure vegetable oil has been investigated as well. The main biofuel on Greek transport market is biodiesel in up to 5% blends. Biodiesel in Greece is produced in accordance with norm ELOT EN 14214 adopted with the Greek Joint Ministerial Decision 334/2004.The raw material used are mainly imported oils (rapeseed oil, soybean oil etc.). However, the development of local sunflower and rapeseed cultivations is foreseen, to meet national needs. (3rd Biofuels Progress Report for Greece)

The introduction of bioethanol in Greek transport market is envisaged for the period 2010-2016 (Law 3653/2008, Artic. 56). The use of bioethanol in gasoline blends is not considered suitable for Greek climate. Therefore its conversion to ETBE (Ethyl Tertiary Butyl Ether) and subsequently ETBE's use in gasoline blends is proposed. Moreover, according to the norm ELOT EN 228:2004 bioethanol can be used in up to 5% blends, while ETBE in up to 15%. Sugar beets, maize and cereals are the traditional crops most suitable for bioethanol production, while sweet sorghum seems a very promising new crop. (3rd Biofuels Progress Report for Greece)

The main instrument of national startegy is the long-term "Programme of biofuel quantity distribution", for biofuels produced up to 2010, set by Law 3423/2005 (Artic. 6.4). However, for the years 2005-2008 the biodiesel quantity to be distributed has been decided on an annual basis under a quota scheme. The biodiesel quantities distributed were 51.000 klit for 2005, 91.000 klits for 2006 and 114.000 klits for 2007, while for 2008 123.000 klits will be distributed (Joint Minesterial Decision D1/A/14639/ 23.06.2008).

To enhance cost competitiveness of biodiesel comparing to conventional diesel, exemption from special consumer's tax has been given to the biodiesel produced under the "Annual distribution Programme". Tax exemption is abolished for 2008, as it was considered that the burocracy created has hindered the vigorous operation of biofuels national market.

Financial and legal instruments of national biofuels strategy include support of biofuels crop production and of investments on biofuels plants, as well as obligatory use of all biodiesel produced under the "Annual programme of biofuel quantity distribution", in the existing biorefineries (in up to 5% blends)(Law 3423/2003).

To stimulate national production of raw material, the biodiesel produced under contract agreements between the farmers and the oil-seed companies is in priority included in the annual distribution programme. Moreover, the subsidy of €45/ha of energy plant cultivation, foreseen in New CAP Reform, is granted to farmers. The aid will only be granted in respect of areas whose production is covered by a contract between the farmer and the seed processing industry except where the processing is undertaken by the farmer on the holding. Furthermore, a subsidy of €60/ha of energy plant cultivation will be offered to the biodiesel production facility for seed processing.

As part of the national strategy to promote biofuels, any investment in the field is subsidized from the National Development Law on promotion of investments (Law 3299/04 as amended by Law 3522/2006). Subsidies up to 35% are granted according to region and the type of the enterprise (in case of SMEs an additional 10-20% is granted). Moreover, the "Greek Operational Programme for Competitiveness" for 2007-2013, supports investments for biofuels production.

Ireland Biofuel Policy

Biofuels Directive

The EU Biofuels Directive (2003/30/EC) sets indicative targets of 2% market penetration by 2005 and 5,75% market penetration by 2010. Ireland is developing a biofuel industry from a very low threshold. It is committed to achieving a 5,75% target by 2010 and has endorsed the 10% target by 2020, recently agreed by the EU under the new Energy Policy for Europe. Ireland is committed to achieving, and if possible exceeding, the 10% target.

Biofuels Excise Relief Program

In 2005, DCMNR launched a pilot biofuels Mineral Oil Tax (MOT) Relief scheme which resulted in 8 projects receiving excise relief for the production of 16m litres of biofuels over two years. In 2005, 1,3 million litres of biofuels were placed on the market compared with petrol consumption of 8,074 billion litres and diesel consumption of 6,588 billion litres (SEI Energy in Transport 2006 Report).

Under the 2006 Mineral Oil Tax Relief scheme sixteen biofuels projects have been granted excise relief in the following categories:

- Biodiesel complying with diesel standard EN590 and sold at regular diesel pumps.
- Biodiesel in higher blends of up to 100% in specific fleets of vehicles whose engine warranties cover these blends.
- Bioethanol made from wheat, barley, whey and other feedstock, blended with petrol and sold in blends up to 85% in petrol, which can be used in flexible fuel vehicles.

The 2006 Finance Act allowed for a 50% VRT reduction in such vehicles. A number of companies have now launched flexible fuel vehicles on the Irish market.

Under the Scheme which will cost in excess of €200 million over five years, 1,63m litres of biofuels will be placed on the market by 2008, representing 2,2% of the predicted fuel market for that year.

2009 Biofuel 5.75% Obligation Target

The Ministerial Bioenergy Taskforce (Department of Finance, Department of Agriculture, Department of Communications Marine and Natural Resources, Department of Environment Heritage and Local Government, Department of Transport) has endorsed a move by Ireland to develop an obligation scheme that will oblige fuel distributors to achieve an average of 5,75% biofuels (on an energy basis) of their total annual fuel business by 2009. Under current standards up to 5% blends of biofuel in both diesel and petrol can be used in engines without any modifications. The balance of the 5,75% and 10% targets can be achieved by use of higher biofuel blends in modified engines and suitable captive fleets. The basic design of obligation schemes is that supply companies have to account for their fuel mix on an annual basis and that if they do not reach the obligated limit, to pay a fixed amount penalty per litre of target not achieved.

VRT Relief

The 50% VRT relief for Hybrid Vehicles has been extended to flexible fuel vehicles to complement the biofuels excise relief scheme. The Department of Finance and the Department of Environment, Heritage and Local Government have launched reviews of VRT and Motor Tax, with a view to rebalancing these tax systems to provide greater encouragement for consumers to opt for vehicles which produce lower CO_2 emissions. It is anticipated this review will be complete prior to the budget in December 2008.

Biofuels strategies in Italy

Biofuels strategies in Italy

The main goals of Italian bioenergy development programmes are to decrease fossil fuels dependency on import (more than 80% of total primary energy consumption in 2000 equal to 188 Mtoe), and to fulfil the commitment of Kyoto Protocol to reduce CO2 emissions by a factor of 6,5% with respect to the 1990 level, and avoid about 100 Mt CO_2 within 2010-2012. Several National Programmes and Laws were issued to promote the use of renewable energy sources (RES).

On the liquid biofuels side, due to the non cost-competitiveness of biofuels compare to fossil fuels, Italian legislation has laid down specific provisions intended to reduce the final cost of biofuels, setting proper tax relieves. In particular, fiscal measures have been targeted on biodiesel and vegetal-based ethanol, substitution products for diesel oil and petrol respectively.

With the Legislative Decree N.128, May 30th of 2005, the Italian Government absorbed European Directive 30/2003. It promoted the use of biofuels or other renewable fuels to replace diesel or petrol for transport, but with targets lower than those suggested in the Directive. The following goals are foreseen in terms of calorific values of the fossil fuel replaced: 3,0 % by the end of December 2009.

In spite of this basis, the biofuels strategy defined by Italian Government in the last years was not very consistent and showed continuous changes year by year.

Currently the situation is still very fluid and the Government recently established has not defined yet a new strategy. Due to this situation the market seems to be in a steady state and final users are concerned about the future of biofuels.

In 2008 the situation is:

- A four-year plan 2007-2010 reduces the excise duty for a quota of 250.000 tonnes of biodiesel per year to 20% (€83,2/1.000litres) of the diesel fuel excise duty (€416/1.000 litres). The same plan makes obligatory the National Chain Agreements between farmers and manufactures of biodiesel for the production of a share of 70.000 tonnes per year (on the total 250.000 t/y) granted an excise duty reduction.
- A three-year plan 2008-2010 reduces the excise level for:
  - Bioethanol (€289,22 /1.000 litres)
  - ETBE (€298,92 /1.000 litres)
  - Additives and reformulates produced from biomass:
    1. for lead-free petrol: €289.22 per 1. 000 litres
    2. for diesel oil, excluding biodiesel €245.32 per 1.000 litres
- Total excise exemption, up to €1.000.000/year, starting in 2007, for PPO for energy purposes in Agriculture, but prohibition of PPO use in vehicles.

A remarkable new step for achieving the goal of 3% by the end of 2009, is the recent National Decree N. 100, April 23rd 2008 that, for the first time in Italy, introduces a strong penalty for missing the goal. A penalty of €600 to €900 is imposed to each 41 GJ of fossil fuels (about 1.000 litres) not replaced by biofuels. A penalty is expected to change significantly the market of biofuels in the medium term.

Biofuel Strategy of Latvia

Biofuel production strategy:

- Stimulation of the demand for biofuels
- Set up of production and distribution schemes for biofuel
- Enlargement of raw material stocks
- Market promotion
- State aid to research and development of production
- Complex recyclable use of biomass: biofuel, heat, electricity

National indicative target

Latvia has set as indicative targets 1,25% of biofuels in 2005, 4,25% in 2008, 5% in 2009 and 5,75% in 2010.

Policy measures for biofuels

In order to promote the use of biofuels, the Cabinet of Ministers has developed the programme **"Production and use of biofuels in Latvia (2003-2010)"** which was accepted on December 19, 2003. A new agricultural production sector would be developed and the requirements for utilisation of its products, biofuel and by-products, would be set. A full legislative framework for biofuels is under preparation.

On July 22, 2004, the Cabinet of Ministers issued the Decree No. 511 on the strategy for implementation of the programme **"Production and use of biofuels in Latvia"**, which stated the competences of Ministries as regards the implementation of the programme .

In order to encourage the development of biofuels, on 17 March 2005, ***The Biofuel Law was*** adopted; its goal has been to encourage biofuels market and thus to support the use of environmentally friendly renewable energy sources.

Since 2005, the state grants direct support to biofuel producers. Financially supported quotas for the production of biodiesel and bioethanol are set every six months.

Motivation for the target

Latvia expects to meet its targets,as there is a quite high interest of entrepeneurs in production of biofuels. Moreover, the report mentions that there are no specific technical or climatic barriers in the Latvian fuel market, that could significantly affect (negatively) the use of biofuels. Latvia's motivation for promoting biofuels is mainly based on strengthening the agricultural sector.

The "Biofuel Production and Use in Latvia for 2003-2010" programme serves as a framework document for forecasting biofuel use and the related production and trade issues. A biofuel share of 5,75% of total consumption in 2010 will require the consumption of 75 thousand tonnes of biofuel, i.e. 32 thousand tonnes of bioethanol and 43 thousand tonnes of biodiesel. Latvia is also increasing its biodiesel production capacity, in order to process imported rapeseed oils.Consumer interest in use of bio-fuel is raised.

The Latvian Ministry of Economics has developed an action plan to enact the Law on Bio-Fuel which identifies concrete tasks and the responsible institutions for their implementation.

In order to promote production and utilization of bio-fuel in Latvia, a scheme has been introduced according to which support for the production and utilization of bio-fuel is offered in two ways: as reduction of the excise tax and as direct support to bio-fuel producers.

In Latvia the support is given directly to bio-fuel producers and the annual supported quota is granted in proportion to production capacity. The financially supported quota will be granted to enterprises until 2011. The Energy Development Guidelines for 2007-2016 have determined that the proportion of bio-fuel in transport must reach 10% in 2016 and 15% in 2020.

It is planned that in autumn 2007, the high-production bio-diesel fuel plant SIA BioVenta with capacity of 100.000 tonnes per year will launch its operation, and this will definitely influence the attainment of the previously mentioned targets. Parallel to this, there are also several activities aimed at raising consumer interest in using biofuel. The Ministry of Economics has produced a number of publications, booklets and books on biofuel.

A Consultative Council on Biofuel Development has been established which will co-ordinate the work of institutions involved in the enactment of the Biofuel Law. The main tasks of the council will be to analyse the situation of biofuel sector in the state, to make recommendations on the development of biofuel industry, to prepare proposals for the necessary normative acts regarding the biofuel sector, as well as to prepare resolutions on the projects of respective normative acts, analysing the special purpose programmes and guidelines for the biofuel sector and make comments on these.

Poland Biofuels Strategy

Increase of use of biofuels in transport is considered as important element of sustainable development, leading to increased safety of fuels supply as well as lowering environmental impact of transport sector. The key part of the national strategy is setting goals of biofuels share in total transport fuel supply till 2014. Annual biofuels levels in fuels production and trade are biding to all business entities and charges shall be imposed on those missing the target. The main financial tool stimulating production and trade of biofuels is removing excise duty from bio-components as well as other tax reduction tools for biofuels producers. Final biofuel price shall be competitive in comparison with traditional fuel price at pump station.

Financial and organisational elements of the national strategy include support firstly to biofuels crop producers, using general EU and national sources, than to biofuels producers in form of grants. Biofuels market shall be stimulated by steps increasing demand for biofuels in towns (special ecological zones and parking fees), reduction of environmental fees, support to biofuel-driven fleets, together with commitment of using biofuels in state-level fleets during the next years. Elements of financing have been included in the new EU funding programmes. Those financial and organisational actions shall be supported by research and development activities and awareness rising and educational campaigns.

Necessary amendments in legal system shall be introduced in order to implement the program and its funding. Charges collected from entities not fulfilling required level of biofuels in fuels volume shall be administered by the National Environmental Fund and used for support of biofuels production. Special funds shall be allocated for supporting local initiatives and actions increasing demand for biofuels.

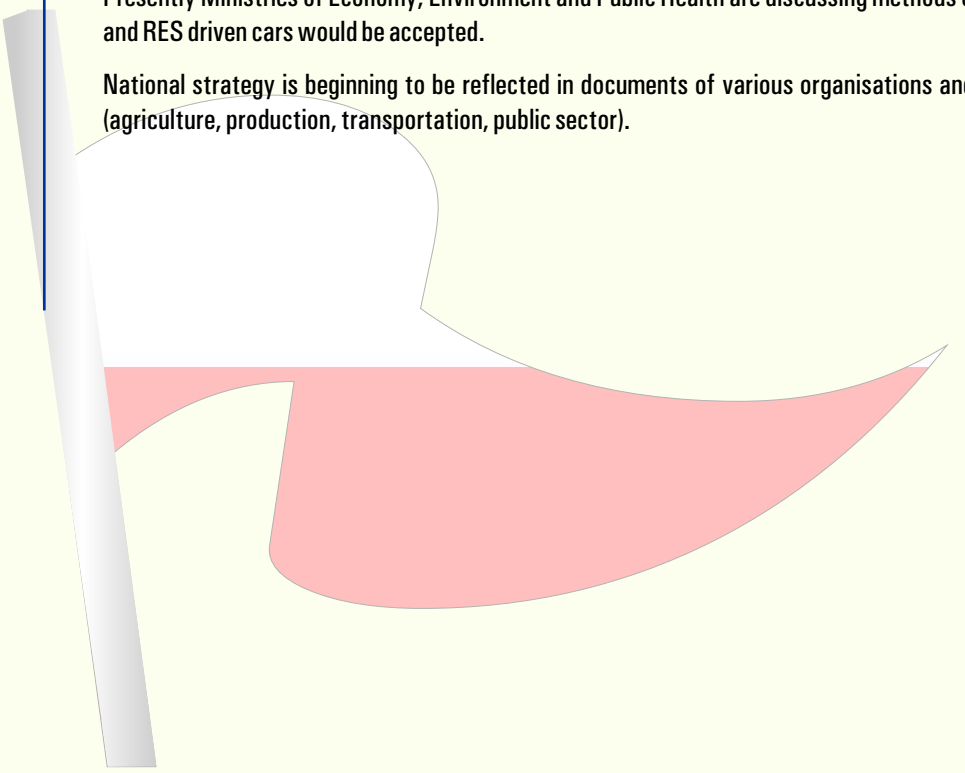
Financial support is expected to be available within EU Structural Funds both at the national as well regional levels.

Implementation of the national strategy shall be monitored by the Ministry of Economy based on quarterly reports. Corrective actions shall be undertaken.

Following EU leaders March Summit of 2008, Poland is declaring reaching minimum 10% share of biofuels in transport fuel mix.

Presently Ministries of Economy, Environment and Public Health are discussing methods of establishing zones, where only biofuels and RES driven cars would be accepted.

National strategy is beginning to be reflected in documents of various organisations and institutions in the whole biofuels chain (agriculture, production, transportation, public sector).



Poland

Spanish Biofuels Strategy

The objective of the Renewable Energies Plan (2005-2010) is to reach 2,2 Mtoe, four times more than the target of the last Plan (2000-2010), and a share of 5,83% in total fuel consumption. This goal exceeds the requirements set by Directive 2003/30/CE for a 5,75% of the total petrol and diesel consumed in the transport sector, by 2010.

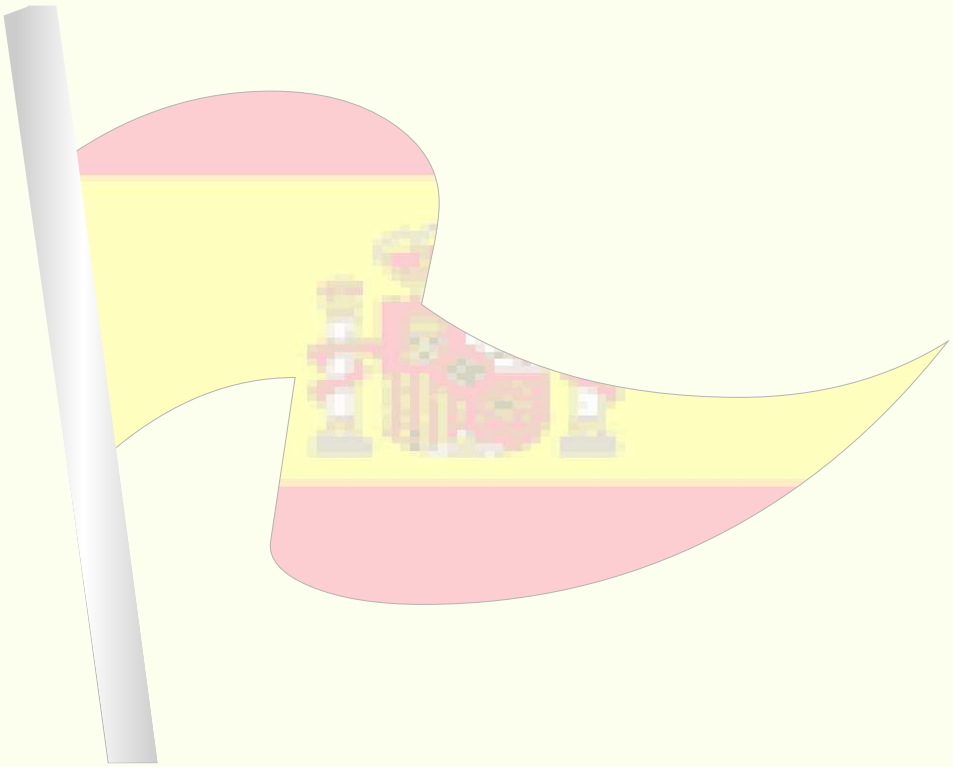
The Spanish National Government has prepared a new law that makes obligatory the biofuels consumption by use of imposed mixtures. Unfortunately, this new law is in a draft form since 2007. However, it seems that the final version will be published by the end of this year, 2008.

This document, firstly determines which fuels could be called biofuels, and these are: bioethanol, biodiesel, biogas, biomethanol, biodimethylester, bioETBE, bioMTBE, pure oil, biohydrogen, and other synthetic biofuels.

The new law obliges the suppliers of petrol products, to sell a certain quantity of biofuels within the conventional fossil fuels. The quantities required can be seen at the following table:

	2008	2009	2010
Biofuels Ratio	1,90%	3,40%	5,83%

This ratio is calculated by relating the biofuels sold with the total amount of fuels sold during a determined period. This new law allows the fuel stations to blend on their holdings, in order to fulfill the requirements set.



Spain

Biofuels Strategies, Sweden

In order to achieve the biofuels directive Sweden has adopted several incentives for increasing the use of eco-cars and biofuels. Public vehicles purchased should be eco-cars, but the national government can only recommend to regional and local authorities to buy eco cars.

The national objective is that at least 85 % of the cars purchased in government administration will be eco-cars.

- Biofuels are tax free, excepted from VAT. Petrol and diesel have a fuel (CO_2 and energy) taxation of SEK 6,61 and SEK 5,20 respectively per liter, exkl VAT

  At the fuel stations the price is (by 13/05/2008):
  - Biogas SEK 10,0 (€1,10) per liter petrol eqv. (12,05 kr/Nm^3)
  - Petrol SEK 13,39 (€1,44) per liter
  - Ethanol (E85) SEK 8,29 (€0,90) per liter
  - Diesel SEK 14,49 (€1,56) per liter
  - RME SEK 10,45 (€1,11) per liter
- Beneficiary cars (owned by the employer, used even in private by the employee) have reduced beneficiary tax by 40% for gas and hybride cars, and 20% for ethanol cars.
- Private persons get SEK 10.000 (€1.100) in eco-car reward (Hybrid, gas, ethanol and efficient (< 120g CO_2 / km))
  - In May 2008, 100.000 Swedish ethanol cars were sold.
- Compulsory supply of biofuels at fuels stations if they sold more than 3.000 m^3 diesel or petrol per year. (> 3.000 m^3 sold petrol or diesel during 2006, > 2.500 m^3 sold petrol or diesel during 2007, > 2.000 m^3 sold petrol or diesel during 2008, > 1000 m^3 sold petrol or diesel during 2009)
  - Normally Ethanol, E85, is offered as it is cheaper to install.
  - In October 2007,1.000 ethanol pumps was established. E85 is now offered in more than every four petrol station.
  - Natural or biogas is offered at 75-80 filling stations.
- From the 1 July it is allowed to convert your petrol car to an ethanol one (flexi fuel vehicle). Cost ~ € 1.000
- 30 % contribution of the cost to install a public biogas filling station.
- Eco-cars enjoy free parking (decided locally in each municipality) and free of congestion charge in Stockholm.
- National funding for R&D in 2nd generation biofuels.

UK Strategies and Policies for the Development and Support of Biofuels

Renewable Transport Fuel Obligation (RTFO)

Biofuel strategies for the UK are now headed by the Renewable Transport Fuel Obligation (RTFO) which will be launched in April 2008. Announced in November 2005, the RTFO aims to be the UK primary mechanism to develop a market for biofuels, in order to ensure that carbon savings will be made and that the objectives of the EU Biofuels Directive will be delivered.

It will also be the first legal requirement on transport fuel suppliers to ensure that a certain percentage of their overall fuel sales are from a renewable source (as opposed to incentives only as it was before).

Prior to the RTFO, the UK started implementing measures to encourage the use of biofuels in order to fulfill its obligation towards the Directive 2003/30/EC.

The main initial incentives, as decided in the budget 2002 were:

- A 20-pence per litre duty incentive on biodiesel, implemented in July 2002.
- The same duty incentive introduced for bioethanol, in January 2005.

Both duty differentials were extended until 2008 (under the Alternative Fuels Framework that required a 3 year certainty).

Budget 2004 announced:

- Support for the industry through regional selective assistance grants.
- Enhanced Capital Allowance scheme which provides businesses with enhanced tax relief for equipment in the cleanest biofuels processing plants. This scheme is managed by the Carbon Trust.

However, the RTFO now requires transport fuel suppliers to ensure that 5% of total fuel sales are from renewable sources by 2010-2011. This 5% target represents around 2,5 billion litres of biofuels per annum, and would achieve a saving of 1 million tonnes of carbon (which roughly corresponds to removing 1 million cars from the roads).

The RFTO sets the following gradual targets, for all types of biofuels for transports (which will be mainly biodiesel and bioethanol):

Financial Year	2008/09	2009/10	2010/11
Level of obligation	2,5%	3,75%	5,00%

The main measure of implementation of the RTFO (as decided in the budget 2007) is the extension of the 20 pence per litre duty differential for biofuels to 2009-2010, and a buy out of 15 pence per litre in the first year of the obligation that fuel suppliers must pay if they fail to meet their biofuels targets. The support for biofuels thus equates a reduction of 35 pence per litre incentive for this first year.

There are also duty incentives for motorists to use alternative fuels (road fuel gases and biofuels).

Agricultural Incentives

Incentives for farmers are the following:

- The Single Payment for biofuel crops grown on set-aside land can be received;
- An annual aid payment of €45/ha is available for growing biofuel crops on non set-aside land.

UK Targets

The UK targets are slightly below the requirements set by the EU Directive (whose reference value is of 5, 75% for all petrol and diesel by the end of 2010), but a number of technical barriers and practicalities had to be taken into account, such as vehicles warranties that do not allow more than a 5% biofuels blend at the moment.

The RTFO needs confidence that biofuels are made in a sustainable way to ensure that the maximum carbon emissions are saved. The government wants to be certain that raising the share of biofuels above 5% will "represent an effective use of the UK biomass resources".

Therefore, the RTFO sets the first carbon and sustainability reporting requirement, which will be managed by a consortium of organizations, known as the Low Carbon Vehicle Partnership.

The carbon and sustainability reporting will ensure that obligated companies calculate and report on the greenhouse gas savings of the fuel they use on a life-cycle or well-to-wheel basis (this takes into account the level of carbon savings achieved over the whole life of the fuel and the sustainability of the supplies).

Third party financing opportunities

Bulgaria

Community Grants

Fiscal measures for landowners and farmers

Scale : Local, Regional

Direct payments for the landowners/farmers are available through the Ministry of Agriculture (http://www.mzgar.government.bg/mz_eng/default.asp). The payments are granted in five of the measures of the Bulgarian "Rural Development Programme:

- Modernization of farms
- Adding value to agricultural and forestry products
- Diversification of economic activities
- Support for formation and development of micro-enterprises
- Common services for the economy and the population of the village areas

Opportunities for investments are foreseen in production, processing and utilisation of energy crops and animal primary and secondary biomass. It supports as well the modernization and the establishment of plants for production of bioenergy from agricultural and forest products biomass.

For the measure "Modernization of farms" the following subsidies are granted, as a part of the total eligible investments, for projects aproved by the 31 December 2009.

- 65 % - for young farmers in less favoured areas (LFAs)
- 60% - for the farmers in the LFAs and young farmers in Natura 2000 areas and out of LFAs
- 55 % - for the young farmers in the other areas
- 50 % - for the rest of the farmers

For further information on "Rural Development Programme" please visit the following web-site:

http://www.mzgar.government.bg/mz_eng/RuralAreas/BG-RDP-2007-2013%20third%20official%20version-eng.doc

Subsidies for energy crops

Scale : Local, Regional

Currently the agricultural subsidies for energy crops are BGN 90 per hectare(€ 46,01).

Since 2007, an additional subsidy of 9 levs per decare (0,1 ha) of energy crops has been granted to farmers. Added to the 15 levs granted by the general system of direct payments, the farmers are finally granted 24 levs per decare, 50-100% more than the relief funds for the rest of the farmers. In case of technical crops cultivated in mountain or desolated areas, additional incentives are granted by the European Fund for developent of the rural areas.

Sources of Private Capital

Bultera Venture

Scale : National

EcoPetroleum Company, URL: http://www.ekopetroleum.com/

Astra BioPlant, URL: http://www.bulmarket.bg/contacts.htm

Bulgarian-Russian joint venture Bultera, which main business is construction and real estates.

European Sources

- ICS International Consulting SP
- Verbio Vereinigte Bioenergy,
  URL: http://www.verbio.de/en/desktopdefault.aspx
- AG-Germany,
  URL: http://www.verbio.de/en/desktopdefault.aspx
- Green Fuel Corporation S.A.
  URL: http://www.greenfuel.es/green-fuel-corporacion.php?idioma=GBR
- Coener Systems Group-Spain,
  URL: http://www.sofiaecho.com/article/spanish-coener-to-invest-60m-euro-in-biofuel-production-in-pleven/id_27372/catid_67

Non-European Sources

Petro-Group Israel, URL: http://www.petro-group.co.il/

Loan Finance

No special loans and credit lines for biofuels.

Plants investments projects from Bulgaria or abroad are designed in line with the requirements set by the Bulgarian Ministry of Environment and Waters

URL: http://www.moew.government.bg/index_e.html.

Biofuels use is indirectly supported by green cars market, but there are no specific incentives or promotional campaign to raise the awareness among end users.

Financial Incentives

Tax Exemptions

Scale : National

The Bulgarian Law on Excise Tax and Tax Registered Storage Areas (from 15 November 2005) specified a zero taxation rate for 100% biodiesel (Art. 32 and 33), applicable from 1 January 2006. As of 1 January 2007, the new amendments in the Excise Duty and Tax Warehouse Act [SG, issue

105/22.12.2006] entered into force. These amendments have been in accordance with the European policy for promotion of biofuels production and use, and introduced zero excise duties for biodiesel and bioethanol motor fuel.

Bulgaria has abolished excise duties on bioethanol and biodiesel, and plans to reduce tax of fuels blends. Blending of biodiesel or bioethanol in up to 5% diesel or petrol blends is obligatory, since 2008.

The new Renewable and Althernative Energy Sources and Biofuels Act, proposed by the Ministry of Economy and Energy envisages the introduction of zero excise duties also for the biodiesel component in blends and for bioethanol. This will be accompanied by a planned increase of excise duties on conventional fuels.

For further information on new Renewable and Alternative Energy Sources and Biofuels Act, please visit the folowing web-site:

http://www.mi.government.bg/eng/norm/rdocs/mdoc.html?id=212967,

Subsidies for oleaginous crops

Scale : National

Other existing support measures, related to biodiesel, are the agricultural subsidies for growing oleaginous crops. For example, subsidies for rapeseed cultivation in 2006 amounted to BGN 35/ha (€17,90). Currently the agricultural subsidies for energy crops are BGN 90/ha (€46,01).

Greece

Financial Incentives

Sunsidies for cultivation of energy crops (Joint Ministerial Decision 36781/2007)

Scale : National

A subsidy of €45/ha for energy crops is granted to farmers. The aid is given for areas whose production is covered by a contract between the farmer and the processing industry, except where the processing is undertaken by the farmer on the holding. An additional subsidy of €60/ha of energy plantation is granted to farmers in case of seed processing facilities.

Responsible for energy crops subsides is the Ministry of Agriculture Development and Food Security (www.minagric.gr).

For further information visit the folowing web-sites:

EC Regulation 1973/2004 (Chapter 8), available in Greek:

http://www.minagric.gr/greek/agro_pol/KAP/Kanonismoi/02004R1973-20070101-el.pdf

Joint Minesterial Decision 36781/2007, available in Greek

http://nomothesia.ependyseis.gr/eu-law/getFile/YA+36781+2007.pdf?bodyId=339028

or contact the Direction of Agricultural Development of your Prefecture Authority.

National Development Plan (NDP) (Law 3299/2004, as it was modified by 3522/2006 Article 37)

Scale: National

The NDP is an open type (no time frame limitations) financing tool for the support of investments. Biofuel production is an eligible sector of investment.For the investments fall under the provision of the Law the following types of incentives are foreseen: Cash grant (covers part of the investment cost), Leasing subsidy and Wage subsidy (for employment created by the investment) up to 35% or Tax allowance up to 100%.

The amount of incentive, granted under the NDP, depend on the geographic region within the country. In the Region of Central Macedonia 30% is foreseen for Cash grant, Leasing and Wage subsidies and 100% for tax allowance. However, incentives for investment in Prefecture of Thessaloniki are much lower: 15% for Cash grant, Leasing and Wage subsidies and 50% for tax allowance.

Additional incentives up to 10% and up to 20% are envisaged for small and medium enterprises respectively. The amount of additional incentive depends on the geographic region within the country and the type of investment.

The NDP is administered by the Ministry of Development (www.ypan.gr)

For more information about New Development Law (3299/2004) please visit the following web sites:

http://www.ggb.gr/el_ec_newsitem355.htm (Law 3299/2006, available only in Greek)

http://www.mnec.gr/export/sites/mnec/el/nomothesia/law/Documents/3522-2006-276-A-06.pdf (Law 3522/2006, Available only in Greek)

http://www.elke.gr/default.asp?V_DOC_ID=2384&V_LANG_ID=0

(Summary of New Development Law in English)

Operational Competitiveness Programme (OCP), 2007-2013

Scale: National

The Operational Programme "Competitiveness" comes under the 4th Community Support Framework (4th CSF) 2007-2013. It incorporates a group of actions and subsidies designed to improve the competitiveness of the Greek economy in the framework of the national development strategy for 2007-2013.

The Operational Programme includes 5 priority axes. The 4th priority axis, which aims to "integrate the national energy system and improve its sustainability", supports actions for RES utilization and energy saving, including investments in biofuels production.

The Operational Competitiveness Programme is administered by the Ministry of Economy and Finance.

For more information about OCP please visit the following web site:

http://www.espa.gr/ (Available only in Greek)

http://www.hellaskps.gr/en_2007-2013.htm (Available in English)

or contact:

Information Office-Ministry of Economy and Finance
Nikis 5-7 Athens
Tel: (+30) 210 3332588
E-mail: info.kps@mnec.gr

Or contact CFS Managing Authorities:
http://www.hellaskps.gr/documents/contacts_csf.htm

Ireland

Business Grants

Support for new businesses

For new businesses there are grants available from the county enterprise boards depending on the number of people to be employed. Support is provided in feasibility studies, marketing and capital costs.

Grants provided by County Enterprise Boards one for each county in Ireland. In Tipperary there are 2 enterprise boards for North and South Tipperary. Reference the attached website for further information on the county enterprise boards: http://www.enterpriseboards.ie/

Support of larger projects

For larger projects development authorities such as the Industrial Development Authority, Enterprise Ireland, Shannon Development provide support to developing projects towards business and plant set up costs.

Links to Shannon development and the IDA are as follows: http://www.shannon-dev.ie/, http://www.idaireland.com

Community Grants

Support of rural based enterprises and activities

Scale: Local, Regional

Funding from leader groups who can assist in developing rural based enterprises which support the local economy. There are Leader groups in each county in Ireland who support local rural based initiatives in their respective areas.

In Tipperary the Tipperary Leader Group administer Leader funding and reference the attached link for their website: http://www.iol.ie/ ~ tippleader/tippleader/tippleadergroup.htm

Sources of private capital

Business Expansion Scheme

Investors can be attracted by registering under the Business Expansion Scheme for new businesses. This scheme offers tax incentives for investors to invest money in start up businesses. This programme is administered by Enterprise Ireland and the website is as follows: http://www.enterpriseireland.com/Grow/ Finance/Business_Expansion_Scheme.htm

Financial Incentives

Energy plantations

Scale: National

Support to energy plantations: energy plantations €45/ha plus €80/ha from the Irish government.

The Department of Agriculture administers these grants and their website is as follows: http://www.agriculture.gov.ie/index.jsp?file=schemes/bioenergy/bioenergy.xml

Mineral Oil Tax Relief programme

Scale: National

Excise relief on biofuels produced by companies that were approved under the Mineral Oil Tax Relief programmes in 2005 and 2006. For further details of these programmes reference the attached Government link for the department of Communications, Marine and Natural Resources: http://www.dcmnr.gov.ie

Flexible Fuels Vehicles

Scale: National

Finance Act 2005 allows for a 50% VRT reduction on flexible fuel vehicles which can achieve blends of bioethanol with petrol of up to 85%. This relief is in place until 31 December 2007 when it will be reviewed and may be extended to other vehicles. This scheme has been extended to July 2008. From July 1st 2008 there will be a €2.500 relief payment on the VRT payable for flexifuel and hybrid electric vehicles.

This scheme was unveiled by the Department of Finance. Reference the attached link for details of the scheme unveiled in 2005:

http://www.taxireland.ie/documents/finbilllistofmeausures06.pdf

The updates to the scheme in 2008 are in the attached link: http://www.finance.gov.ie/documents/publications/financebill2008/Listofitems08.pdf

Indicative targets for biofuels use in Ireland

Scale: National

Biofuels obligation announced by government that biofuels represent 5,75% of Ireland's transport fuel market by 2009. For further information on this target reference the attached link of the Department of Communications Marine and Natural Resources: http://www.dcmnr.gov.ie

Research & Development in biofuel

Scale: National

Support to R&D in biofuels, particularly second generation biofuels.

Use of pure plant oil in public and hauliers fleets

Scale: National

The Department of Transport is running a pilot programme offering 75% grant aid for public authorities and hauliers converting their vehicles to run on pure plant oil.

For further information on this project reference the attached link: www.biofuelsfortransport.ie

Italy

Business Grants

Grants to industrial production

Scale: Regional, National

No special grants for Biofuels production plants on industrial level. Production of biofuels is comparable to any other industrial production.

The authorities responsible for this action are under the Ministry of Economic Development-Department of Competitiveness (Ministero per lo sviluppo economico. Dipartimento per la competitività).

- Direzione generale per il sostegno alle attività imprenditoriali
  Via Giorgione, 2/b - 00147 Roma

  Tel.: +39 06 54927 / 06 54927906
  Fax: +39 06 59601226
  E-mail: segreteria.dgcii@sviluppoeconomico.gov.it
- Direzione generale per le piccole e medie imprese e gli enti cooperativi
  Roma - Vicolo d'Aste 12 - pal.B
  Recapito postale: Via Molise 2 - 00187 Roma
  Tel.: +39 0647055276 / 0647055277
  Fax: +39 0643532356
  E-mail: segreteria.dgec@sviluppoeconomico.gov.it

The IPI-Institute for Industrial Promotion is a Technical Agency of the Ministry.

URL: http://www.ipi.it

Community Grants

Funding of Biogas plants

Scale: Local, Regional

Public funding for establishment of Biogas plants at regional level, in the framework of special programmes, aims to support multifunctionality in Agriculture. This local scheme of incentive is based on Rural Development Policy (i.e. European Agricultural Fund for Rural Development (EAFRD)). Each Region in Italy defines a specific Rural Development Policy.

Regions are the Public Authorities responsible for administration of these funds. Contact point can be found on Regions' websites: www.regione.NameREGIONE.it (e.g. www.regione.lombardia.it, www.rezione.lazio.it etc.)

Agriculture Department for each region is the technical body responsible for the Regional Rural Development Policy.

Loan Finance

Biogas plants

Scale: Local, Regional

Special guarantee funds performed by local and national Banks according to the Regional Public Funding Schemes. Local authorities sign special agreements with local/national banks in order to support the construction of biogas plants. Within these schemes banks offer special loans with a low rate of interest. The Policy Regions are the PA responsible for Rural Development.

Biofuels production plants

Scale: Local, Regional

No specific loan for biofuels production plants (Biodiesel or bioethanol).

Financial Incentives

Support to energy crops

Scale: National

Incentive to energy crops of €45/ha (Carbon credit according to Reg. CE 1782/2003, Art. 88)

Rural Development subsidies

Scale: Regional

Specific subsidies are defined at Regional level within the Rural Development Plans. Regions are responsible for administration of subsidies.

Excise duty reductions

Scale: National

- Excise duty reduction (20% of diesel excise duty on a Biodiesel content base) only for Biodiesel- Diesel blends (B5 to B25) and up to a total amount of 250.000 t/year of Biodiesel produced or imported at national level. A part of this quantity has to be produced within local/national biofuels chains.
- Excise duty on pure vegetable oil only for electricity production but not for use as fuel in vehicles. In Italy the use of pure vegetable oil for vehicles is currently forbidden.
- Excise duty for bioethanol:€289,22 /m^3
- Excise duty for Bio-ETBE: €298,92 /m^3

Indirect incentives

Scale: National

The production of bioenergy by farmers is considered an "agricultural activity". Thus, it is aministrated (VAT, taxes, administrative management) the same way as other agricultural activities, i.e. milk, meat and vegetables production.

The *Public Authority responsible* for Excise reduction and VAT is the Agenzia delle Dogane under the Ministry of Finance.

For further information the producers should visit the following website: www.agenziadogane.it.

Regional and provincial offices are available on the whole national territory.

The same Agenzia is responsible for the allocation of the annual production quota among producers.

Latvia

Business Grants

Financial support to biofuels

Aid programme: "Procedure for allocation of the national support for production of the annual and necessary minimum of biofuels, and quotas for financial support for biofuels" 2005.2010.

Responsible authority: Ministry of Agriculture (http://www.zm.gov.lv)

Aid category: Environmental Aid

Budget: Total: LVL19 million/milj. (LVL500.000 in 2005; LVL18.5 00.000 in 2006 - 2010)

For further information please visit the following web-site: (http://www.fm.gov.lv/image/file/220_vii.pdf)

Community Grants

Capital grants

- Grants to biofuel producers increase cost competitiveness of Latvian market of oil plants versus the internationla market.
- Financial aid to rapeseed cultivation areas.
- Subsidies for development of oil seed industry for crops grown in Latvia.
- Reduced excise duty rates.
- The government granted subsidies for the development of oilseed processing plants.

Responsible for the Administration of these grants are the Ministry of Economics of Republic of Latvia http://www.em.gov.lv and the Ministry of Environment http://www.vidm.gov.lv.

Infrastructure and Services Programme

Infrastructure and Services programme supports fuel conversion projects aiming to reduce the impact of energy production on the environment. This program is financed by the European Investment Bank and the European Bank of Reconstruction and Development.

Responsible for the Administration of this grant are the Ministry of Economics of Republic of Latvia http://www.em.gov.lv and the Ministry of Environment http://www.vidm.gov.lv.

Loan Finance

Commercial banks and other financial institutions.

Latvian Guarantee Agency LLC

Since 2003, Latvian Guarantee Agency LLC (hereinafter LGA), as supervisory institution of the Ministry of Economy of the Republic of Latvia, fulfills the tasks defined in the national economic policy for the support of small and medium-sized enterprises (SMEs), which help businesses to attract new investments for further expansion of their activities. LGA provides the opportunity to SMEs to obtain a real financial assistance or collateral for implementation of innovative business ideas, and a guarantee security for credit or leasing transactions with Latvian commercial banks.

For further information please visit the following web-site: http://www.lga.lv

Financial Incentives

Finacial supported quota

- €270 per 1.000 liters of biodiesel fuel produced in the framework of the financial supported quota.
- €14,2 per 1.000 liters of pure seed oil produced in the framework of the financial supported quota.
- €328 per 1.000 liters of bioethanol produced in the framework of the financial supported quota.

Rape plantations

Aid to rape crops (€45 /ha)

Rapeseed oil production

Aid to producers of rapeseed oil for biofuel production purposes, that we use as raw material rapeseeds produced in Latvia: Zero excise-duty; price supports €80 - €95/t (60% of full cycle price).

Poland

Business Grants

Investments in biocomponents production

Scale: National

Grants to business investing in biocomponents production (selection based on competitive procedures), both preparation of documentation and investments in production plants:

- Projects over € 5 million,
- Total volume of different grants (EU and national) €180 million.

SMS investments in biofuel chain

Scale: National

Support to development of rural areas, SMS investments in biofuel chain, minimum €30.000, maximum €6 million per project.

Operational Programme Infrastructure and Environment

Scale: National

Priority 9.5. Production of biofuels from renewable sources.
Grants supporting building production plants of biocomponents and biofuels; Total financial support € 234,97 million.
Maximum grant support 30% of eligible costs.
Minimum project value PLN 20 million (about € 5,5 million).
First applications expected June-September 2008.
For further information please visit the following web-site:
http://www.mrr.gov.pl/ProgramyOperacyjne+2007-2013/Infrastruktura+i+Srodowisko/
(Ministry of Regional Development, Ministry of economy, available in Polish)

Community Grants

Zones for ecological transport

Scale: Local, Regional

Creation of special zones in town centres and environmentally important areas only for public ecological transport (lost incomes of municipalities covered from the National Environmental Funds).

Removal/reduction of parking fees

Scale: Local, Regional

Removal/reduction of parking fees for biofuel cars (lost incomes covered from the National Environmental Funds).

Reduction of environmental fees

Scale: Local, Regional

Reduction of environmental fees (applied presently for each company vehicle).

Loan Finance

Scale: National

Special guarantee fund of Bank of National Economy (BGK) to support EU grants.

Financial Incentives

Energy plantations

Scale: National

Support to energy plantations: 50% of plantation costs, supplement to energy plantations €45/ha.

Reduction/Removal of excise duties and taxes

Scale: National

- No excise duty on pure biofuels.
- Excise duty on fuels with bio-components reduced equally to the level of applied tax (under EU notification procedure).
- Reduction of CIT (19%) for biofuels producers.
- Fuel tax removed (pure biofuels) or proportionally reduced for fuels with bio-components.

Research and Development

Scale: National

Support to Research and Development in biofuels.

Awareness raising

Scale: National

Support of awareness rising and educational campaigns (covered by the National Environmental Funds).

Vehicles using biofuels

Scale: National

Support of vehicles using biofuels, especially for separate fleets vehicles using high-biocomponent fuels (covered by the National Environmental Funds)

Source: *Funding possibilities in the total biofuels chain "Long-term programme of biofuels promotion for 2008-2014" (Ordinance by the Council of Ministers; Official Journal 24.08.2007).*
For further information please visit the following web-site:
http://isip.sejm.gov.pl/prawo/index.html
(Available only in Polish)

Spain

Business Grants

Financing of biogas vehicles

Scale: Regional

Vehicles using biogas: 60% of the total investment amount(max. €12.000 /vehicle).

Regional grants are managed by the Regional Administration.

For further information please visit the following web-site:

http://www.argem.es/servlet/integra.servlets.Multimedias?METHOD=VERMULTIMEDIA_2593&nombre=E42007_PLAN_DE_MOVILIDAD_SOSTENIBLE.pdf

or contact Agencia de Gestion de Energia de la Region de Murcia (ARGEM):

Tel: +34 968 22 38 31

Community Grants

Financing of biogas vehicles

Scale: Regional

Vehicles using biogas: 60% of the total investment amount(max.€ 12.000/vehicle)

Regional grants are managed by the Regional Administration.

For further information please visit the following web-site:

http://www.argem.es/servlet/integra.servlets.Multimedias?METHOD=VERMULTIMEDIA_2593&nombre=E42007_PLAN_DE_MOVILIDAD_SOSTENIBLE.pdf

or contact Agencia de Gestion de Energia de la Region de Murcia (ARGEM):

Tel: +34 968 22 38 31

Sources of private capital

Investments financing

Project financing: up to 80% of the total investment amount. Only some specialised banks like Banco de Sabadell and others.

For further information please visit the following web-site:

https://www.bancsabadell.com/en/XTD/INDEX/?url=https://www.bancsabadell.com/en/NUESTROS_NEGOCIOS/DIVERSIFICADOS/BS_CAPITAL/?menuid=9717&language=en

Loan Finance

Investments financing

Up to a maxiumum 80% of the total investment amount, coming from the banks.

Financial Incentives

Tax exemption

Biofuels are tax exempt.

Sweden

Loan Finance

Almi Företagspartner AB

Scale: Regional

Almi Företagspartner AB loan fund supports SMEs with potential for significant growth. Small loan up to €11.000 might be given by Almi alone. Above that amount financial risks are shared with commercial banks/investors.

For further information please visit the following web site: www.almi.se/almi_in_english.html

Svenska Riskkapitalföreningen

Scale: National

The Swedish Private Equity & Venture Capital Association (SCVA) is an independent, non-profit association that supports the interests of companies and individuals active in the Swedish private equity and venture capital industry. The Association's objective is to promote an efficient private equity and venture capital market, as well as to promote entrepreneurship.

For further information please visit the following web site: www.svca.se

Financial Incentives

Investment grants for biogass stations

Scale: National

30 % investment grant for biogas filling stations up to SEK 1.140.000 (~€115.000).

For further information please contact Sweedish Environmental Protection Agency (Naturvårdsverket): magnus.ostling@naturvardsverket.se or visit the following web-site: www.naturvardsverket.se

Purchasing of eco-cars

Scale: National

Investment contribution of SEK 10.000 (~€ 1.100) for individuals buying eco cars (ethanol, gas and hybrid cars).

For further information, please visit the following web-site: www.vv.se/templates/page3____21943.aspx#Eco_car_subsidy

Tax reduction for eco-cars

Scale: National

20-40 % reduction of beneficial car taxation,
20 % reduction for ethanol cars,
40 % reduction for gas and hybrid cars.

For further information, please visit the following web-site: www.skatteverket.se/fordigsomar/arbetsgivareinfotxt/miljobilar.4.18e1b10334ebe8bc8000111.html

Or contact Skatteverket Headquarters

E-mail: huvudkontoret@skatteverket.se
Tel: +46 8 764 79 87

Facilitate eco-cars

Scale: Local

- Eco cars (ethanol, gas and hybrid cars) are free of charge from digestion fees. (Stockholm)
- Free or reduced parking fee in the cities.

Legal incentives

Mandatory sale of renewable fuels

Scale: National

Fuel stations are obliged to offer at least one renewable fuel. (Started for fuel stations that sold more than 3.000 m^3 fuel in 2006 and declining to the ones that will have sold more than 1.000 m^3 fuel in 2009)

For further information please visit the following web-site: http://www.regeringen.se/content/1/c6/05/18/00/8b325734.pdf

Conversion of petrol cars

Scale: National

Allowance converting petrol cars into ethanol (FFV) started on 1 July 2008).

For further information please visit the following web-site: http://www.regeringen.se/sb/d/10143/a/105106

Or contact the Ministry of Environment: registrator@environment.ministry.se

Switchboard: Tel. +46 8 405 10 00

United Kingdom

Business Grants

Grant for Research and Development (R&D)

Scale: Regional

Up to £500.000 (60%) for research and development of a technologically innovative product or process. For further information, contact one of the Regional Development Agencies in England: www.englandsrdas.com

For example: www.southwestrda.org.uk (South West of England Regional Development Agency); www.emda.org.uk (East Midlands Development Agency); www.lda.gov.uk (London Development Agency).

Shell Springboard Funding for Climate Change Innovation

Scale: National

Funding for SME's with innovation for green house gas reduction max £40.000. Further info at http://www.shellspringboard.org/

Community Grants

O2

Scale: National

It is your community grants up to £1.000 for community projects. Further info at http://www.o2.com/cr/community_fund.asp

E-On Source Fund

Scale: National

Up to £30,000 for innovative technology to deliver energy savings.

E-ON +44 024 7618 1945 or source@eon-uk.com

Cotswold District Council Community Projects

Scale: Local

Fund up to £15.000 for community projects Cotswold District Council.

Further info at http://www.cotswold.gov.uk/nqcontent.cfm?a_id=4124 01285 623 169

Gloucestershire Environmental Trust

Scale: Local

Up to £30.000 local community projects.

Further info at http://www.glos-environment-trust.co.uk/ 01452 739006

Selective Finance for Investment in England

Scale: Local

London financial support to assist businesses with new investment projects that lead to long-term improvements in productivity, skills and employment in Assisted Areas.

Further info at www.london-innovation.org.uk/server.php?show=nav.008003005

South East Community Loan Fund

Further info at www.seeda.co.uk

Sources of private capital

South West Ventures Fund

Scale: Regional

Up to £250.000 Venture capital funding available.

Further info at http://www.southwestventuresfund.co.uk/

MMC Ventures

Scale: National

Up to £500.000 investment for entrepreneurs to develop business ideas.

Further info at http://www.mmcventures.com/

NESTA Ventures

Scale: National

Invest directly in early-stage companies.

More info at http://www.nesta.org.uk/

Loan Finance

Accelerator Fund

Scale: Regional

Loan fund that supports SMEs in the South East with potential for significant growth.

Finance South East scheme at the South East England Development Agency www.financesoutheast.com / 01276 608510 (email: mail@financesoutheast.com)

Business Angels - Greater London

Scale: Regional

The London Business Angels provides financial support, as well as marketing, financial and strategic management expertise to both start-up and growing businesses. Further info at www.lbangels.co.uk

Elderstreet Investments
Scale: Regional
This venture capital fund provides early stage and development capital for growing businesses.
Further info at www.elderstreet.com

Carbon Trust Venture Capital & Interest free loans
Scale: National
Further info at http://www.carbontrust.co.uk/climatechange/investors/vc_investors.htm 0800 085 2005

Carbon Trust Enhanced Capital Allowances
Scale: National
Further info at www.eca.gov.uk

Financial Incentives

Selective Finance for Investment in England (SFIE)
Scale: National
Up to £2million (35%), further info at www.london-innovation.org.uk

Removal of road fuel duty
Scale: National
HMRC announced that users of less than 2.500 litres a year will now no longer need to register with Customs and Excise and pay road fuel duty as of the 30th of June.
Further info at http://www.hmrc.gov.uk/

RTFO Certificate scheme
Scale: National
In April 2008 the Renewable Transport Fuels Obligation (RTFO) certificate scheme will mean a price reduction for heavier users of fuel. The certificate scheme will be in addition to current 2.500 litre limit exemption. Further info at http://www.dft.gov.uk/pgr/roads/environment/rtfo/

Treasury Invest to Save Budget (ISB)
Scale: National
ISB provides the initial financial backing to public sector projects that demonstrate the capacity to achieve sustainability.
Further info at http://www.isb.gov.uk/hmt.isb.application.2/index.asp

Sources of technical advice and information

Business Plan Development

Many individuals considering entering the biodiesel field are looking to start new businesses. A necessary first step for all new businesses, especially if external funding is sought, is the development of a business plan. While much of the material in the business plan will be well-known to individuals already engage in successful businesses, we have worked to give special attention to those aspects that relate specifically to biodiesel companies.

Why Write a Business Plan?

It is extremely important to the success of your operation that you, the owner/CEO, write the business plan. Often times the process of writing a business plan is more beneficial than the plan itself. It is also a living document that changes as the company evolves.

Parts of a Business Plan

The business plan should consist of eleven separate sections, each one beginning on a new page.

1. Business Request Page
2. Table of Contents
3. Executive Summary
4. Business Description
5. Management
6. Market Analysis
7. Marketing Plan
8. Product of Services
9. Manufacturing Plan
10. Financial Data
11. Supporting Documents

A business plan may be a document written to persuade a lender or lenders to provide capital for your venture. A business plan is an essential management tool for your business. It may serve as the implementation plan for a strategic plan. The business plan outline in this handout applies to an entrepreneur or a businessperson seeking money for a new business startup or a business expansion.

Ten Key Points to Remember When Writing a Business Plan

- Be honest. Do not be overly optimistic or try to hide limitations or weaknesses.
- Write in easy to understand terms. Avoid jargon and terms that are unfamiliar to people outside of your industry.
- Describe your company's image. You need to convince the reader you understand all aspects of the business.
- Provide the reader with an understanding of your business and how you will use the loan.
- Evaluate the company's management team. This is a major focus of the plan. Point out the strengths and weakness and how you are going to address these weaknesses.
- Answer these three strategic planning questions:
  - Where are we now?
  - Where do we want to be?
  - How do we get there?
- Quantify your market, sales, production, and cost data. Do not generalize. Be specific. Use data to help tell the story.
- Begin each major section on a new page with the appropriate title (for example, Marketing Plan).
- The actual content of the business plan will vary depending on the nature and complexity of the business, the stage of development, and the type of financing needed.
- The business plan may be used as a sales document. The content and quality of the plan should be representative of your company.

Centralized *vs* Decentralized Biofuels Production

Starting a business in biofuels field an investor has to make a critical decision; small-scale decentralized plants or large-scale centralised ones. In general biodiesel production is considered economically feasible in both local and central scale, while bioethanol production only in large industrial scale. However, combination of decentralized and centralized systems is also possible, i.e. decentralized production of vegetable oils used in a central plant for biodiesel production.

Decentralized production of biofuels contributes at the diversification of agricultural economy and in increasing farmers' income. Moreover, it gives the opportunity to individuals or groups of people (farmers, communities, transport companies etc.) to meet their fuels needs producing their own fuels.

In the following paragraphs the possibility of centralized versus the possibility of decentralized biofuels production is investigated, for the case of Latvia. However, the results of this study could apply in several European Member States.

Moreover, two alternative decentralized biodiesel production approaches are presented; the potential to combine biofuels production with Biogas from anaerobic digestion in farm settings and the potential of small-scale biodiesel production.

Centralized versus decentralized production of biofuels in Latvia

A review of the existing biofuels investments and technical solutions used in Latvia, certifies that production of biodiesel is viable both in small decentralized plants and in large plants, but production of bioethanol is cost-efficient only in large centralized production plants.

The majority considers small-scale decentralized plants as opportunity to extend their enterprise and increase their income. Following the motto "from the region to the region", a lot of rapeseed oil enterprises started fuelling their tractors and slight cars with rapeseed oil.

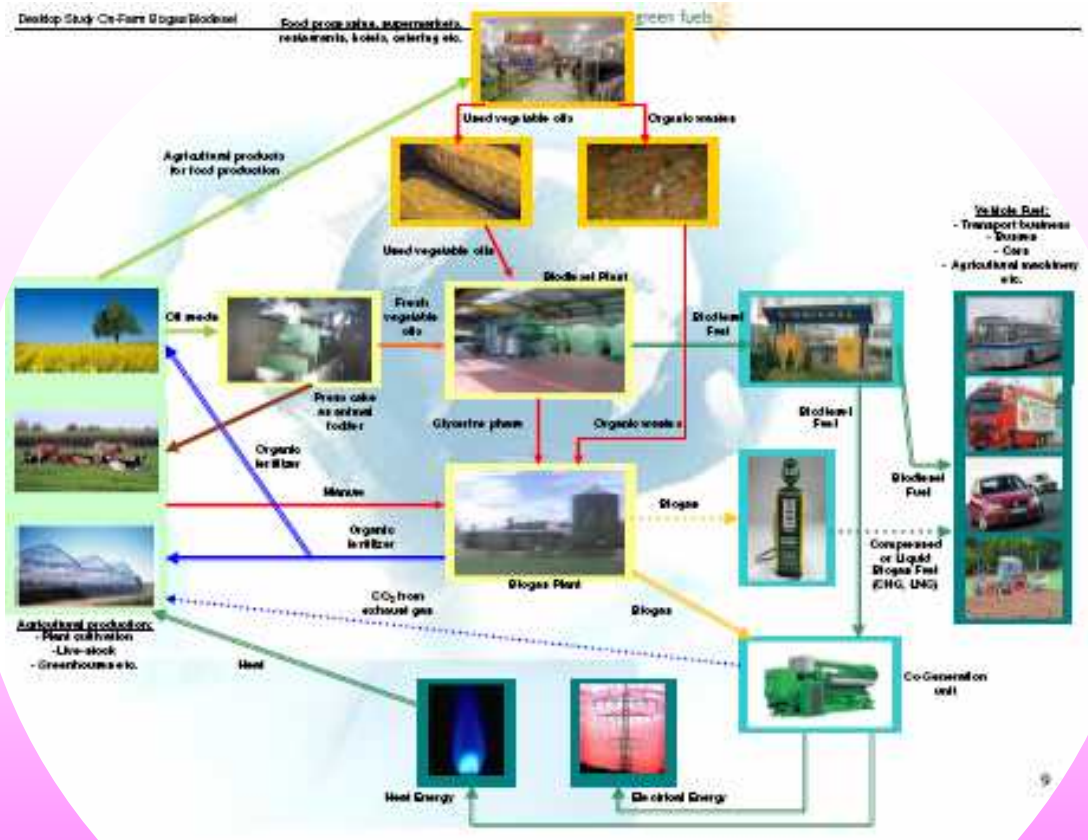
Moreover, several oil industries expressed their interest to utilize their by-products (press cake).

In Latvia, both rapeseed oil and biodiesel production in decentralized plants could be profitable and prosperous. It is possible to grow energy crops on an individual farm or on neighbouring-farms (or by members of a cooperative) and then deliver the seeds (clean and dry) in the decentralized plant. In the plant the raw material (seeds) are processed to oil and further to biodiesel.

The by-products of oil and biodiesel productions process are further utilised. The seed cakes produced are used as fodder for cattle on producers' farms, while glycerine is delivered to the neighbour CHP plant for energy production . A closed, zero-wastes production cycle is formulated that contributes in generation of employment and increase of income.

Disadvantages of decentralized biodiesel production

- Difficulties to storage the produced oil. It's necessary to consider, that period of storage is limited to 3-4 months.
- Risk to be offered low purchase prices of vegetable oil/ biodiesel by monopolist purchasers.
- High production cost due to the limited quantity of oil or biodiesel produced.
- Fuel of lower quality due to lack of competition among producers.



Advantages of decentralized biodiesel production

- Meet partially the local needs in fuels.
- Generation of employment.
- Increase of income, diversification of local economy.
- Rape cultivation improves soil quality for subsequent crops.

In the coming years, it is expected that very large centralized rape processing plants will be established in Latvia, which will both produce oil and biodiesel. Cooperation among centralized and decentralized production plants will be an interesting perspective. The decentralized oil production plants could sell their commodities to centralized oil industries for refining and production of biodiesel.

Moreover, cooperatives of small decentralized rapeseed oil producers could jointly export their production to biodiesel production industries in neighbour countries.

Combined on farm biodiesel/biogas generation

The "Desktop study on the potential for on farm renewable energy systems using biodiesel and biogas", conducted by Green Fuels Ltd (http://www.greenfuels.co.uk/) aims to identify new business opportunities for farmers due to combined on-farm biodiesel/biogas generation from locally grown energy and fuel crops and agricultural wastes The fundamental reason for considering the combination of these two technologies is that the use in biogas production of the glycerine from the biodiesel process provides a significant (up to a 100%) increase in the production of gas for electricity generation. This combination is commonly used throughout Germany.

The study investigates the potential of the combined on-farm biodiesel/ biogas generation for the case of Gloucester in UK. The opportunity has been to identify as many as possible sustainable closed loop processes of extraction and consumption. The proximity to the source of raw material is another critical point. For the case of Gloucester, due to the tonnages of material involved it was essential that the key location is as close as possible to the source of manure. Other materials can be hauled to this location. It is not essential that the biodiesel plant is co-located as the main links are the use of glycerine in biogas and some biodiesel if a dual fuel combined heat and power generator is used. It is important that the biodiesel plant is located as centrally as possible to the land area producing the oilseed rape. However, in case of Gloucester the distance between the two plants could be less than a mile. The benefit of this proximity is apparent with the use of the organic fertiliser produced by the biogas plant which can be utilised within the arable land use. The diagram attached at page 54 shows possible approaches as well as the interaction of the different components of a decentralised mass-energy cycle.

The study showed that the financial viability of a combined technology for the benefit of a rural enterprise with current levels of fuel prices is secure for medium scale equipment and marginal but positive for small scale equipment.

Small scale biodiesel production

New technologies allow small-scale biodiesel production. These technologies are suitable for group of peoples or companies that wish to reduce the cost of fuels consumption or to increase their income by producing their own biodiesel. For instance, farmers, communities, fuel supply companies, transport companies, etc.

AGERATEC, a Swedish company, has developed a system for small scale biodiesel production. AGERATEC's systems can produce biodiesel using a great variety of raw materials. They can easily shift from one raw material to another and they have a production capacity between 1.000 and 66.000 litres of biodiesel per day.

The oil processing plant is assembled on its own platform and thus is possible to install it directly on site. After installation the plant is connected to the storage tanks and to electric system. AGERATEC's systems don't produce wastes, as they not consume any water. The only by-product is glycerine. Besides, these systems have high energy efficiency, consuming 55 watts per lit of biodiesel. The total cost of biodiesel production is about €0,15 - €0,20 for a small-scale system, and €0,10 - €0,13 , for a medium system.

For further information:

Http://www.ageratec.com/index.asp?page=&lang=EN

Contract agreements among biofuels chain actors

Contract Agreements among the chain actors are essential to ensure both the economic sustainability of the whole biofuels supply and use chain, as well as the equitable distribution of cost and benefits across this chain.

Moreover, contract agreements have been used as legislative tools to encourage local energy crops cultivation and utilization of local raw material in biofuels production. For instance, Council Regulation 1782/2008 (Artic. 90) set as requirement for granting the Energy Crop Aid of €45/ha, the existence of contract agreements between the farmer and the processing industry.

Biofuels production is a new industrial sector that brings together stakeholders which had no economic relations in the past. At this primary stage templates of contact agreements may help them to better arrange and organize their professional relations. Thus, in this section the main issues to be considered and included in a contract agreement between farmers and processing industries or between vehicle fleet managers and biofuels suppliers are listed.

Contract for purchasing of raw material for production of biofuels

The following points are essential in a contract agreement between farmers and processing industries. These points are not listed in order of importance.

- Duration of the contract, usually a crop season.
- Type of crop and area to be cultivated, type of raw material to be delivered to the processing industry. At the example below, 10 ha will be cultivated with rapes and 20 ha with sunflower.

Location	*Type of crop*	*Total cultivated area (ha)*	*Type of raw material to be delivered*
	Rape	10	Rape seeds
	Sunflower	20	Sunflower seeds

- Commitment of the producer to apply all the necessary cultivation and treatment techniques to ensure production of high quality raw material.
- Draft schedule for delivering of raw material to be produced. The quantities to be produced are estimated based on the average productivity of each crop.

Type of raw material to be delivered	*Productivity (kg/ha)*	*Quantity (tn)*	*From....To....*
Rape seeds	3.000	30.000	May -July 2008
Sunflower seeds	2.500	50.000	July -August 2008

- Commitment of producer to deliver the total quantity of raw material to the processing industry.
- Commitment of processing industry to purchase the total quantity of raw material produced from the contracted cultivated area and to use it for production of specific energy products.
- Type of energy products to be produced by the processing industry, i.e. biodiesel, bioethanol.
- Quality Standards of raw material to be produced, i.e. Humidity (%), Impurities (%), Oil content (%), Acidity (%).
- Purchase price of raw material.

  Purchase price could be a fixed price agreed on the contract or a price calculated according to a methodology agreed on the contract. The methodologies adopted in Spain for estimation of purchase price of rapeseeds and sunflower seeds are illustrated at the page 54, under the title "Seeds purchase price calculation methodology".
- Payment modes and deadlines of payments, after the delivering of raw material by farmers to processing industry.
- Legal bidders in case of non fulfilment of agreement by the contracted parties.

Tenders and Contracts for Public Bodies procuring biofuels for their vehicle fleets

The following 7 points are essential to factor into tender and contract detail. These points are not listed in order of importance.

1. Biodiesel/PPO compatibility in vehicles

a) PPO - To run vehicles on PPO they will require a conversion kit to be able to handle the more viscous nature of PPO and to avoid problems with cold starting and PPO gelling in the engine when it gets cold.

B) Biodiesel - For most new diesel engines they will require little or no modification to run on biodiesel as its viscosity is quite similar to that of mineral diesel. It is more corrosive and so should not be used on diesel engines with rubber gaskets and seals as it will corrode them. Diesel Engines generally built from the 1995 onwards should be fine to run on biodiesel but verify that the gaskets and pipe work are made from corrosion resistant materials.

2. Warranty

a) PPO - Currently no vehicle manufacturer will provide warranty cover to run a car on PPO. Typically the vehicles run on PPO have exceeded their warranty period. PPO conversion kit suppliers do offer warranty cover typically 12 months for any issues caused by their conversion kit.

B) Biodiesel - All diesel engines are warranted to run on blends of up to 5% biodiesel in mineral diesel. Some vehicle manufacturers will provide warranty cover for vehicles for higher blends up to 30% biodiesel with mineral diesel. Before running a vehicle that is still under warranty on biodiesel, always contact your vehicle manufacturer to find out what is the maximum blend they will allow the vehicle to run on. Exceeding that limit will nullify your warranty cover.

3. Fuel price

As in procuring mineral fuels, the fuel price should be completely transparent and should factor in transport costs and storage costs if storage is being managed by the biofuel supplier. As prices for PPO and biodiesel will vary depending on the availability of raw materials such as rapeseed, agreed prices for at least 12 month periods should be agreed. Also ensure that the biofuel supplier passes on any excise relief that is applicable to that fuel and that they are fully complying to the terms of any excise relief programme.

4. Fuel Quality

a) Pure Plant Oil (PPO)- The current recognised standard for PPO is DIN 51605 and companies should supply PPO that achieves this standard. Each delivery of PPO supplied should have a Certificate of Compliance confirming that it meets DIN 51605.

b) Biodiesel - Biodiesel should meet the European Wide

Seeds purchase price calculation methodology

Calculation of rapeseed purchase price:

$$Final\,Price = Base\,Price \bullet \left(1 + \alpha \bullet \frac{Period\,Price - Base\,Price}{Base\,Price}\right) + b \bullet (Hamburg\,Price - Base\,Price)$$

α and **b** are parameters to be defined on the contract (**α+b > 0**)

Base Price is the price of quotation Platts from GO 0,2 NWE CIF (€/tn), that is taken as reference value and is defined on the contract agreement.

Period Price is the average price (€/tn) of quotation Platts from GO 0,2 NWE CIF, during a period defined on the contract agreement

Hamburg Price is the price (€/tn) of quotation for rapeseed CIF in Hamburg market, during a period defined on the contract agreement

Calculation of sunflower purchase price:

$$Final\,Price = Base\,Price \bullet \left(1 + a \bullet \frac{Period\,Price - Base\,Price}{Base\,Price}\right) + b \bullet (Ma\,Price - Base\,Price)$$

α and **b** are parameters to be defined in the contract (**α+b > 0**)

Base Price is the price of quotation Platts from GO 0,2 NWE CIF (€/tn), that is taken as reference value and is defined on the contract agreement.

Period Price is the average price (€/tn) of quotation Platts from GO 0,2 NWE CIF, during a period defined on the contract agreement

Ma Price is the price (€/tn) of quotation for rapeseed CIF in Spanish market, during a period defined on the contract agreement

The prices calculated according to the above methods are further modified based on the quality characteristics of raw materials. Part of the purchase price correction tables used in Spain (*ORDEN APA/779/2007* of 6 March 2007) are given below.

Price Correction Table according to Humidity, Impurity and Acidity

Humidity (%)	*Price correction*
6,00 to 7,00	3
8,01 to 8,99	2
9,01 to 10,00	-1,5
10,01 to 11,00	-3

Price modification for *impurity < 2%* is linearly proportional (1:1), while for ***acidity*** is decreasing with proportion 2:1, having ***2% as base***

Price Correction Table according to Oil Content

Oil content	Price correction
38,00	-3,00
38,70	-1,95
39,60	-0,60
40,00	-
40,60	0,90
41,40	2,10
42,20	3,30
43,00	4,50

EN14214 standard. Each delivery of biodiesel supplied should have a certificate of compliance confirming that it meets this standard.

5. Fuel Delivery

Find out how the fuel will be delivered and in what minimum quantities. Ensure delivery costs are specifically included in all tender and contract documentation. Determine what method will be used for the delivery of fuel. This will impact on the type of fuel storage required.

6. Fuel Storage

Fuel Storage containers should be stored in well sealed containers to reduce air getting into it as oxygen in air causes PPO to oxidise. The containers should also be tightly sealed to prevent condensation build up in the tanks as moisture form condensation will also degrade the quality of biofuels.

Strorage tanks such Intermediate Bulk Containers (IBCs) are not ideal for storage as UV light from sun will break down PPO or biodiesel causing it to oxidise. Storage containers should be UV light resistant.

For Biodiesel the standard storage and handling procedures used for mineral diesel can be used. The fuel should be stored in a clean, dry, dark environment. Acceptable storage tank materials include aluminum, steel, fluorinated polyethylene, fluorinated polypropylene and teflon. Copper, brass, lead, tin, and zinc should be avoided due to the corrosive nature of biodiesel.

7. Shelf life

PPO is biodegradable and it has limited shelf life so it should not be stored for longer than 6 months and ideally for only 3 moths.

Biodiesel does not store well for long periods of time as it will separate, congeal and in general break down while in storage. Biodiesel without preservatives or biocides has a shelf life of 6 months in ideal conditions.

Always plan your delivery schedule to ensure that PPO or biodiesel is stored for more than 6 months.

Biofuels Standardization

To ensure a high quality level of the European biofuels market, the quality of biofuels sold in different countries should ideally be identical and the fuel must fulfill the drivability requirements of the car manufacturers and the European emission requirements. Therefore, the European Committee for Standardization (CEN) adopted Standard EN 14214 for biodiesel and Standards CWA 15293:2005 for bioethanol - E85 blends and EN 15376:2007 for bioethanol - E5 blends. All these documents are officially available on the market, even if all of them are in a reviewing state in order to open their scope to different blending rates. CEN Standards are formally adopted by National Standardisation Bodies and the mentioned documents are officially available in all European Countries and accepted by European cars manufacturers. Nevertheless National Standardization bodies may adopt their own Standards, on specific products, not available at European level to meet local or national needs and regulations. For instance in Germany a pre-standard on rapeseed vegetable oil fuel (DIN V 51605) has been adopted, while in Italy a standard for glycerine and others by-products of oil and biodiesel production process to be used as fuel in CHP plants is available.

Biodiesel Standards

EN 14214:2003

ICS: 75.160.20 Liquid fuels

Title Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods

Copyright: CEN -European Standardization Committee National Standardisation Bodies

This European Standard specifies requirements and test methods for marketed and delivered fatty acid methyl esters (FAME) to be used either as automotive fuel for diesel engines at 100 % concentration, or as an extender for automotive fuel for diesel engines in accordance with the requirements of EN 590.

This standard is in a reviewing state according with Mandate M/394 to CEN on the revision of EN 590 to increase the concentration of FAME and FAEE to 10% v/v. The new version will be available at the beginning of 2009.

EN 14214:2003/ AC: 2007

ICS: 75.160.20 Liquid fuels

Title Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods

Copyright: CEN -European Standardization Committee National Standardisation Bodies.

This Ad Corrigendum will be included in the new version of EN 14214.

Bioethanol Standards

EN 15376:2007

ICS: 75.160.20 Liquid fuels

Title Automotive fuels - Automotive fuels - Ethanol as a blending component for petrol - Requirements and test methods

Copyright: CEN -European Standardization Committee - National Standardisation Bodies

This document specifies requirements and test methods for marketed and delivered ethanol to be used as an extender for automotive fuel for petrol engine vehicles in accordance with the requirements of EN 228.

Note 1 This document gives all relevant characteristics, requirements and test methods for (bio) ethanol, which are known at this time to be necessary to define the product to be used up to a maximum 5 % (v/v) blending component for automotive gasoline fuel. If the percentage or use is expanded, the requirements need to be restudied.

Note 2 For the purposes of this document, the term "% (m/m)" and "% (v/v)" are used to represent the mass fraction and the volume fraction respectively.

A new version of EN15376:2007 is still in an early stage of review in order to open the scope to all blending rates.

CWA 15293: 2005

ICS: 75.160.20 Liquid fuels

Title Automotive fuels - Ethanol E85 - Requirements and test methods

Copyright: CEN -European Standardization Committee

This CEN Workshop Agreement specifies requirements and test methods for marketed and delivered Ethanol E85. It is applicable to Ethanol E85 for use in spark ignition engine vehicles designed to run on Ethanol E85. Ethanol E85 is a mixture of nominally 85% ethanol and petrol, called E85, but also including the possibility of having different 'seasonal grades' containing more than 70 % ethanol.

This CWA is in a reviewing state in order to be converted into a CEN EN. The new Work Item number is WI 00019349.

Rapeseed Oil as a fuel Standard

In Germany a pre-standard for rapeseed oil was adopted to allow its reliable use as automotive fuel for vehicle engines. The standard was proposed by the Bavarian National Institute for Agricultural Engineering and the Technical University of Munich (Weihenstephan) but it is now available as DIN V 51605.

For copyright reasons only a small part of the Standard is illustrated below.

Properties/Contents		*Limiting Value*	
		Min.	*Max.*
Characteristic Properties for Rapeseed Oil			
Density (15°C)	Kg/m^3	900	930
Calorific Value	KJ/kg	35000	
Sulphur Content	Mg/kg		20
Variable Properties			
Water Content	Mass-%		0.075

Glycerine Standard

UNI TS 11163

Title Vegetable oils and fats and their by-products and derivatives used as fuels for energy production. Specifications and classification

Copyright: UNI Italian Standardization Body

This technical specification defines specifications and classes of vegetable oils and fats and their by-products and derivatives to be used as fuels for plants with nominal heat output more than 3 MW.

The Standard is copyright protected. However, for dissemination purposes a small part of the standard "Specification for Glycerine to be used for heat and power production in plants different from engine" is illustrated at the Table below:

Properties	*Units*	*Limiting Value*	
		Min.	*Max.*
Glycerol)	% (ml m)	50	
Flash Point	°C	60	
Net calorific value	MJ/kg	10	
Sulphur Content	% (ml m)		0,1
Water Content	% (ml m)		50

A new version of this Italian standard is being drafted in order to open the scope to a wider range of by products and oil.

Standardization Committees

European Standards are available from CEN National Members who are responsible for selling European Standards. CEN National Members and respective national documents reference for EN14214, CWA 15293, EN 15376 are listed below.

All the European Standards can be purchased on-line from the catalogue of European Standardisations Bodies: http://www.cen.eu/catweb/cwen.htm

CEN National Members

Member State	National Standardization Authority	ULR
	CEN-European Standardization Committee	http://www.cen.eu/
	BDS-Bulgarian Institute for Standardization	http://www.bds-bg.org/
	ELOT-Hellenic Organisation for Standardization	http://www.elot.gr/
	NSAI-National Standards Authority of Ireland	http://www.nsai.ie/
	UNI-Italian Organization for Standardization	http://www.uni.com/
	LVS-Latvian Standards	http://www.lvs.lv/
	PKN-Polish Committee for Standardization	http://www.pkn.pl/
	AENOR-Spanish Association for Standardization and Certification	http://www.aenor.es/
	SIS-Swedish Standards Institute	http://www.sis.se/
	BSI-British Standards	http://www.bsigroup.com/

Member State	*CEN Biodiesel Standards*		*CEN E85 Standard*	*CEN E5 Standards*
	EN 14214:2003	EN 14214:2003/AC:2007	CWA 15293:2005	EN 15376:2007
	BDS EN 14214:2004			
	ELOT EN 14214			
	I.S. EN 14214:2003		I.S. CWA 15293:2005	
	UNI EN 14214:2004		CWA 15293:2005	UNI EN 15376:2007
		LVS EN 14214:2003 /AC:2008	LVS CWA 15293:2005 LVS CWA 15293:2007 L	
	PN-EN 14214:2005			
	UNE EN 14214			
	SS-EN 14214	SS-EN 14214/AC:2007		
	BS EN 14214:2003		CWA 15293:2005	

Health and Safety Issues

Directive 2001/58/EC *"Commission Directive 2001/58/EC of 27 July 2001 amending for the second time Directive 91/155/EEC defining and laying down the detailed arrangements for the system of specific information relating to dangerous preparations in implementation of Article 14 of European Parliament and Council Directive 1999/45/EC and relating to dangerous substances in implementation of Article 27 of Council Directive 67/548/EEC (safety data sheets)"* defines the content of Safety Data Sheets for every dangerous preparations. Each producer of dangerous material has to draft a Safety Data Sheet according to this Directive.

A copy of the Directive can be downloaded from the EUR-Lex website:

http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2001:212:0024:0033:EN:PDF

An interesting report on this subject is the Concawe Report 5/02 "Amended safety data sheet directive (2001/58/EC)" downloadable from the Concawe web site: www.concawe.org

Biofuels production, storage and use involve handling potentially dangerous products, thus a Safety Data Sheet in line with Directive 2001/58/EC must be elaborated.

Some interesting examples of Safety Data Sheets for Biodiesel and Bioethanol can be found in the following web-site:

http://www.biodieselgear.com/documentation/

The Data Sheet obtained from this file doesn't comply with Directive 2001/58, but still is a good example of Biodiesel Safety Data Sheet.

Another simple Safety Data Sheet on Biodiesel is downloadable from the following link:

http://ptcl.chem.ox.ac.uk/~hmc/hsci/chemicals/biodiesel.html

Some relevant Safety Data Sheets for ethanol can be downloaded from http://www.distill.com/materialsafety/ the online distillery network for distilleries and fuels ethanol plants.

The following data sheet is taken from an US website and it is relevant to Ethanol:

http://www.biodieselgear.com/documentation/ethanol.htm. Even if it doesn't comply with Directive 2001/58, it could still consider an interesting example of Ethanol Safety Data Sheet.

In the framework of BioNETT Project a Health and Safety Booklet for biodiesel production, storage and use has been elaborated by the NELEEAC-North East London Energy Efficiency Advice Centre. An abstract of this booklet is given below.

Health and Safety booklet for biodiesel production, storage and use

Biodiesel production process

Biodiesel is a product derived from vegetable oils or animal fats, obtained by a chemical process called transesterification. This process requires an alcohol (methanol is the most frequently used), and a strong catalyst such as potassium hydroxide or sodium hydroxide. During the transesterification process, the glycerol is freed and separated from the biodiesel (glycerol should be less than 0.24% of the final product). After the transesterification, it is very important that the fuel is washed of all reactants such as remaining alcohol, glycerol or water that would affect the quality of the biodiesel and damage the fuel injection system of the engine.

Production, storage and use of biodiesel involve handling potentially dangerous products, required health and safety guidelines to be followed. Methanol used in the transesterification process is flammable and toxic, and sodium hydroxide is corrosive and toxic.

The use and storage of biodiesel, which is combustible and corrosive, should also be done with safety in mind.

The main security measures, and precautions as regards to the materials used, are described below.

Use and storage of methanol (flammable and toxic)

Precautions should be taken with the tanks where the products are stored: avoid overfilling the tanks; making sure that tank valves from which product may be drawn are closed when not in use.

Also, to avoid the possibility of electrostatic discharge, no manual gauging or sampling should take place while tank filling operations are proceeding or 30 min afterwards.

Storage and Transport of biodiesel

Biodiesel is non-toxic, biodegradable and much less irritating to the skin than petroleum diesel. However, the same safety rules that pertain to petroleum diesel also apply to the storage, transport and use of biodiesel. The main safety issues that need to be looked after are:

Transport of biodiesel

- Biodiesel, due to its high flash point, is not considered flammable. Biodiesel is considered combustible, just as is vegetable oil (feedstock used for biodiesel production). As such, the transport of 'neat' biodiesel may be handled in

the same manner as vegetable oil. However this is not the case of low-level blend such as a B20 blend which should be handled in the same manner as petroleum diesel fuel.

Storage of Biodiesel

Tanks

- Storage tanks for biodiesel can be constructed from mild steel, stainless steel fluorinated polyethylene, fluorinated polypropylene and Teflon mainly. On the contrary, nonferrous metals such as aluminium tend to react unfavourably with biodiesel (because of the product corrosive action). Importantly, rubber elastomers cannot be used, as pure biodiesel will dissolve the rubber. This effect is lessened with lower percentage blends.
- Just as for methanol, storage tanks for biodiesel must be tight (valves closed when not in use) to avoid any exhaust of the product.
- Measures should be taken to ensure that no water enters the tanks: algae can grow in biodiesel as it does with petroleum diesel fuel. For the good maintenance of tanks, water bottoms should not be retained in the storage tanks to avoid internal corrosion.
- Measures should also be taken to ensure that the biodiesel will flow in cold weather. Cold flow improvers can be added to enhance the cold flow characteristics of biodiesel.
- To avoid the build-up of static charges when filling a tank with biodiesel under conditions which may create a flammable atmosphere in the tank ullage space by vaporization or formation of mist, the inlet velocity should not exceed 1m/s until the inlet of the tanks is completely submerged, and until the feed pipeline is free of any water or air. Subsequent inlet velocities should ensure smooth flow into the tank without causing turbulence.
- In the event where biodiesel is to be mixed with petroleum diesel fuels, the blending is not recommended if the fuel temperature is either 4,4°C or below.

  Also, splash blending is usually recommended. If splash blending of biodiesel and petroleum diesel is made in a large tank, the biodiesel should be introduced after the diesel fuel has been place in the tank because biodiesel is heavier than diesel fuel and would essentially stay at the bottom of the tank otherwise.

Buildings

- Like petroleum diesel fuel, biodiesel should be stored in a clean, dry and dark environment. Buildings should be adequately ventilated by natural openings or mechanical means, therefore preferably not below ground level, unless sufficient ventilation to prevent the accumulation of flammable or toxic vapour is provided.
- Areas where flammable or combustible products are handled and stored are considered as hazardous areas, as risks of fire and explosion (explosive air-gas mixture) occur. For an explosion to occur, the two following conditions must co-exist: a flammable gas or vapour mixed with air in the proportions required to produce gas-air mixture, and a means of ignition related to electrical apparatus. It is possible to assess to which extent an area is hazardous. It depends on: the quantity of material released, or the rate of release; the conditions of the release (namely temperature and properties of the product, local ambient temperatures and ventilation rate); the rate of evaporation; the nature of release i.e. liquid or vapour.

  Using those criteria, hazardous areas can be differentiated into one extreme, in which an explosive gas-air mixture can be present either continuously in an enclosed space. In this case, a source of ignition must be completely avoided; and a non-hazardous zone where a source of ignition is permissible because an explosive gas-air mixture is not expected to be present (because of a good ventilation of the space for example).

  In general, buildings where methanol and biodiesel are stored and handled should be unheated. If heating is required, it should be provided by means not constituting a source of ignition.

  Materials used in production and storage facilities should be fire-resistant and materials for the construction of equipment should be non-combustible. Floors may be tiled, paved of concrete, but where drums are filled and loaded, steel and other oil and wear resistant impervious flooring is recommended.
- Consideration should be given to the containing and cleaning of spills. Spills of biodiesel should be prevented from entering drains or watercourses. For example, earth can be used to block the flow of spills, and sand or commercial absorbents to soak them up. A spill kit and absorbent materials should be kept easily accessible where oil is stored. A hose should never be spilt down, and detergents should never or use detergents to disperse a spill of product. In general, pollution incident response procedure should be developed on site.

  Security measures for biodiesel also apply to methanol, especially regarding the risks of fire and explosion.

  Note: The full H&S booklet can be downloaded from BioNETT Project website http://www.bio-nett.org/ or can be obtained by contacting NELEEAC:

  http://www.lessenergy.co.uk/NELEEAC_business.htm

Upgrading Biogas into Biomethane

Biogas from anaerobic treatment of wastewater sludge, organic solids and manure is a valuable sustainable energy source. However, for using biogas as a vehicle fuel is necessary to clean raw biogas into upgraded biogas, more specifically biomethane.The upgraded biogas meets the same specifications as for natural gas and thus it can be used likewise, for use as vehicle fuel or in the natural gas grid. The main stages of a biogas cleaning process are the followings:

- H_2S Removal
- CO_2 Removal
- Compression and Drying
- Odourisation

Useful technical information about how to upgrade raw biogas into biomethane can be found the in following web-site: http://www.lackebywater.se/inc/pdf/en_purac_cooab.pdf

Usually the different sections of a gas refining (upgrading) plant are fabricated separately and then put together on site. Malmberg Water AB has developed a compact prefabricated plant for upgrading, assembled directly in a specially manufactured, insulated, ventilated sheet steel building. It has three separate rooms for processing, pumping and power supply. Filling stations are built in line with the compact concept. This means that they are delivered in prefabricated buildings or are integrated into the gas purification plant.

Filling is offered by dispenser as well as slow filling via ramp and also distribution via mobile gas stores.

For more info visit the following sites: www.malmberg.se and http://www.malmberg.se/module/file/file.asp?XModuleId=6793&FileId=12379

Three successful case studies, from Sweden, on biogas upgrading to biomethane and biomethane use as vehicle fuel are described below:

Gas Refinement plant for Biogas in Henriksdal WWTP, Sweden

Stockholm Water Ltd has used the sludge digestion gas from Henriksdal's Wastewater Treatment Plant for vehicle fuel. The installation is illustrated in the attached photo. The capacity is 800 Nm^3/h and the high pressure compression process where the refined biogas is compressed to 350 bar.

A scrubber process based on circulating water is used.

Stockholm Vatten can now produce approximately 7,7 million Nm^3 vehicle fuel per year, which corresponds to around 8 million litres of petrol. The vehicle fuel is used, at first hand, as fuel for the city buses to improve the environment in the city of Stockholm.

This turn-key plant built is one of the largest gas refinement plants in Sweden and puts Stockholm in a leading position when it comes to investing in non-polluting vehicle fuels.

For more information visit the following website:

http://www.malmberg.se/module/file/file.asp?XModuleId=6793&FileId=8719

Gas Refinery for Biogas in Jönköping, Sweden

Jönköping Municipality in Sweden uses the sludge digestion gas from Simsholmen Wastewater Treatment Plant for vehicle fuel. The refinery is placed in the wastewater treatment plant connected to high pressure compression and filling station.

The gas refinery includes the following:

- Gas refinement plant
- High pressure compression
- Filling station
- Automatic control system
- Electrical installation

The plant can produce around 850.000 Nm^3 of refined gas per year. This corresponds to around 850.000 litres of petrol.

Performance

Refining capacity: 150 Nm^3/h

Final gas quality: > 97% methane

Dew point: -30°C at 250 bar

High pressure storage: 10 m^3, pressure 250 bar

Filling equipment: Double dispenser

For more information please visit: http://www.malmberg.se/module/file/file.asp?XModuleId=6793&FileId=3660

Gas Refinery and Filling Station Kristianstad, Sweden

To meet the great demand for biogas as vehicle fuel, Kristianstad Municipality has, in 2006, invested in a new gas refinement plant with a capacity of 600 Nm^3/h. The capacity is corresponding to amount of around 10.000 litres of petrol every twenty-four hours. The new enlargement increases the total capacity in Kristianstad from 200 to 800 Nm^3/h. The plant is one of Sweden's largest gas refinement plants.

Performance

Process: Absorption process with circulating water

Capacity: 600 Nm^3/h (raw gas)

Approximately 400 Nm^3/h refined gas

Final gas quality: > 97% methane

Dew point: - 80° C at 4 bar

For more information please visit the following website: http://www.malmberg.se/module/file/file.asp?XModuleId=6793&FileId=8718

By-products Utilisation

The use of by-products obtained through the biofuel production process is a key issue for the economic sustainability of biofuel production chain. Often the additional value of by-products and their potential to produce extra income are not taken into account or are underestimated.

Thus, in the following paragraphs useful information is given on the potential uses of the two main by-products of biodiesel production, seed-cake and glycerol (glycerine).

Press Cake

The press (seed) cake is a by-product of seeds pressing process. The raw, oil-rich pressed cake is a valuable protein fodder, and is used widely in agriculture. Its greatest value lies in its suitability as animal fodder. The press cake obtained by cold pressing contains more residual oil and has therefore a higher value for animal food purposes than the one which is obtained by warm pressing or oil production by normal extraction.

The press cake is also suitable as solid fuel for chaff furnaces, for the production of biogas and as a compost-fertilizer. Small amounts can also be used as baking additive and in the production of cosmetics. The highest value, however, can be obtained in using the press cake as animal fodder.

Source: Schöne, F.	*Animal Food*	*Compost Preparation*	*Burning*	*Fermentation*
Purpose	Source of nutrients and energy	Source of nutrients for useful plants	CO_2-neutral generation of energy	CO_2-neutral generation of energy
Products	Single portions of forage, Concentrated fodder	Fertilizer	Heat, Ash with nutrients (P, K)	Electricity, Heat, Residues for fertilizing (N, P, K)
Ingredients	High	Low	Medium	Low
Suitable Oil Seeds	Rape, Flax, Sunflower, Safflower	Non feed-able oil seeds,(eg. crambe, abyssinica, camelina sativa)		

Source: Karl Strähle GmbH & Co. KG. Strähle Plant Oil Presses-Energy for life (Information leaflet), Retrieved by http://www.straehle-maschinenbau.de/English/PDF/Prospekt%20englisch.pdf

The utilization of seed-pressing by-products can be a step towards self supply, self control and additional income. "Kilkenny Cereals Ltd" in Ireland and "Astra Bioplant Ltd" in Bulgaria are two companies that have realized the additional value of their by-products and making profit of them.

Cereals Ltd

Kilkenny Cereals was incorporated in December 2003 as a private limited company in Kilkenny, Ireland.

It uses as raw material rapeseeds and produces rapeseed oil through a cold pressing process. Main by-product of this process is a press cake in pellet form. The seed cake is a valuable part of the production process as is sold as fodder, contributing in the economic sustainability of the system.

More information at the attached link:

http://kilkennycereals.killure.ie/cake.htm

Astra Bioplant Ltd

"Astra Bioplant Ltd" is located in the Municipality of Slivo Pole, in Rousse Region in Bulgaria. It started its operation on July 2008 using as raw material sunflower and rape seeds. It has a processing capacity of 500 tonnes of raw material per day and a production capacity of 200 tonnes of vegetable oil per day.

Astra Bioplant Ltd uses its seed processing by-products for animal feeding and steam production purposes. More specific:

- The groats, by-product of sunflower and rapes seed processing, are sold as fodder for agricultural animals.
- The hull, by-product of sunflower, is used directly as fuel in the steam-boilers.

Utilization of by-products contributes in more sustainable close-loop processes of production and in higher profitability of biodiesel production.

Glycerine

Glycerol (glycerine) is a by-product of biodiesel transesterification process. It is usually used as raw material in cosmetics and pharmaceutical industry. An alternative use of Glycerol (Glycerine) is for energy production either through direct combustion or through production of Biogas. Some reference materials for the use of Glycerine for energy production are given below:

Biogas Production Using Glycerol, the Biodiesel by-Product, as the Carbon Source

With the increasing popularity of biodiesel, there has been an increase in production of crude glycerol as a by-product. This increase has flooded the market and has driven the price of glycerol down. Over the past 3 year(s), the price of glycerol has fallen from $0,95/lb in 2003 to $0,49/lb in 2005. New uses of glycerol need to be identified. An option being investigated at Mississippi State University is the anaerobic digestion of glycerol to produce biogas. By using mesophilic microorganisms to consume the glycerol by-product, gases

such as carbon dioxide and methane can be produced. Instead of flaring the biogas, as is typically done in a wastewater treatment plant, the biogas could serve as a source of recovered energy. This energy could then be used to provide heating and electrical power for biodiesel plants. This project has examined the effect of four different added nutrient concentrations. Preliminary results indicate that samples with a lower concentration of added nutrients produce methane at a greater rate (1/10 and ½ of the recommended nutrients produced at rates of 0,000125 and 0,000168 moles of CH_4 per day) than those with samples with greater concentrations of nutrients (2X the concentration of the recommended nutrients produced at a rate of 0,0000486 moles of CH_4 per day). This indicates that the methanagens responsible for consuming the glycerol may prefer oligotrophic conditions. This project also provides a comparison between pure glycerol and crude glycerol as a carbon substrate source for the microorganisms. Changes in pH and chemical oxygen demand (COD) were monitored throughout the duration of the project.

Source: Benjamin P. Hartenbower, Dr. William T. French, Rafael Hernandez, Dr. Margarita Licha, and Tracy J. Benson. (2006). Biogas Production Using Glycerol, the Biodiesel by-Product, as the Carbon Source. Mississippi State University, Chemical Engineering Department. Starkville, MS 39759. Retrieved from:

http://aiche.confex.com/aiche/2006/techprogram/P64103.HTM

Useful information on glycerine uses

Useful information on glycerine potential uses can be found at the attached web-site:

http://journeytoforever.org/biodiesel_glycerin.html

Export of Biogas Technology

An interesting presentation of Jörgen Ejlertsson, Research and Development Manager of Scandinavian Biogas Fuels AB, dealing with the use of Glycerine for biogas, downloadable from:

http://www.businessregiongoteborg.com/download/18.1f0060a0112d6e27725800035/Scandinavian+biogas+J%C3%B6rgen+Ejlertsson+21+May+London.pdf

Conversion from conventional fuels to biofuels

To shift from conventional fuels to biofuels, engine modification and adjustments are required to avoid potential engine compatibility problems.

Conversion from Diesel to Biodiesel

Given that a large proportion of conventional diesel is already a 5% biodiesel blend (B5), many drivers will have already used biodiesel without being aware of the fact.

However, practical issues concerning the use of biodiesel fuels have emerged. As most biodiesel blends as low as B20 are more viscous than mineral diesel, the fuel can 'gel' in cold weather conditions so leading to starting problems. Poor quality pure and modified waste vegetable oils can also clog fuel lines and fuel filters, or form an emulsion in the return fuel line from the fuel injectors to the tank. A more serious potential drawback is biodiesel's incompatibility with certain types of elastomers and natural rubber compounds. It should also be noted that biodiesel generally has slightly lower volumetric energy density than fossil diesel which results in biodiesel vehicles requiring more fuel per kilometre (by up to 10%).

Due to the potential engine compatibility issues listed above, most light-duty diesel vehicle warranties are still only valid for use with biodiesel blends of up to 5%. To manage the potential problems from use of higher biodiesel blends some useful recommendations are given below.

Recommendatory for effective use of biodiesel

1. Use of B5, B20 and B35 blends don't require replacement of elastometers compounds. However use of pure biodiesel (B100) requires replacing them with Teflon or nylon alternatives.
2. For engines, which are not modified to run with biodiesel, only B5 should be used.
3. In order to blend biodiesel with conventional diesel in the combustion chamber, pour first the diesel and after the biodiesel, as diesel has a lower specific weight.
4. A decrease in engine power, compared to diesel, is observed at the first period of using biodiesel. However, after a while the decrease is getting lower, as biodiesel being a mild solvent can clean combustion chamber from impurities.
5. To avoid decrease in engine power, it is recommended to start with B20 or B35 blends and later on to shift to B100.
6. It's possible to reduce exhaust gases using an oxidation catalyst (which is not allowed for conventional diesel). This way, nitric oxides emissions can be reduced at normal levels.
7. At the first period of shifting to B100 a frequent change of fuel filters is required, due to the impurities washed out from the power unit.

   Experienced drivers usually keep the old filters during the first days of B100 use and when the impurities have been washed out from the fuel system they replace the old filter with a new one.
8. It takes almost two times longer to start-up the engine. Hence, it is necessary to use adequate additives to lower air temperature.
9. Condensation of crankcase oil is another problem. As biodiesel isn't vaporized in the engine's crankcase, it is increasing the level of oil. Excess oil can't be pumped so it is necessary to be replaced.

In cars used for long trips, no problems of condensation are observed. But, if there is a routine of “stop-n-go”, it's better to avoid using pure biodiesel as fuel.

Conversion from Gasoline to Bioethanol

Low percentage bioethanol blends (e.g. 5% known as E5) can be used by most conventional petrol engines and may even slightly improve their performance. To convert a conventional spark-ignition engine vehicle to pure bioethanol requires the adjustment of the timing and electronic control systems, and the fitting of a larger fuel tank due to the fuel's low energy density. As bioethanol can corrode certain elastomers and metals, some engine components may also need to be replaced.

Bioethanol is also difficult to vaporise at low temperatures; E95 & E100 vehicles can therefore be difficult to start in cold weather. For this reason, bioethanol is usually blended with petrol to improve ignition (E85 is a common high percentage blend).

One of the most significant recent advances is the development of Flexible Fuel Vehicles (FFVs) that are able to operate on a range of percentage petrol-bioethanol blends up to E85. The engine management system automatically detects which fuel is being used and adjusts the timing accordingly.

It is possible to convert a conventional petrol car into a FFV that

may be run on ethanol, in a reasonable cost. For instance, the PPC Tuning System®, developed by BSR Svenska AB, can be used for several types of vehicles, where BSR's flexifuel software is simply loaded into the vehicle's ECU (some vehicles also require a change of fuel injectors). BSR has also developed a sophisticated control system, MFV, (Mixed Fuel Vehicle System) required for some types of vehicles.

BSR is developing approved conversion kits for a number of cars makes, mainly for vehicles manufactured in year 2000 or newer. The kits are exactly adapted for each type of engine.

The Conversion kits available according to the type of vehicle with E85 tuning are listed in the following website: http://en.bsr.se/e85/kits/

For more information about this system visit the following websites: http://en.bsr.se/e85/ , www.bsr.se

Conversion from Diesel to Pure Plant Oil (PPO)

To run a diesel vehicle on PPO a vehicle conversion kit must be fitted. Below examples of two conversions kits developed by the Elsbett GmbH Company and the Global Oil GmbH Company are described.

Useful information on how to convert a vehicle to run on pure vegetable oil is giving in the "The Vegetable Oil Motoring" website http://www.vegoilmotoring.com/eng/. The site covers all important aspects of converting a vehicle including the legal issues such as duty and minimum safety standards, the vegetable oil vs bio-diesel debate and, of most relevence, a section on how to switch to PPO.

SVO conversion kit, Elsbett GmbH

The SVO conversion kit in simple terms heats the oil and thins it down to the same thickness/viscosity as diesel. This allows it to pass through the fuel delivery system in the same way as diesel and burn cleanly in the engine, enabling the vehicle to run in the same way as normal diesel vehicle.

Conversion kits which enable vehicles to run solely on PPO are known as "one tank" kits. Not all vehicles can run on 'one tank' systems vehicles with rotary pumps or common rail direct injection, for instance, will need a "two tank" system as they require start up on diesel. The Elsbett site http://www.elsbett.de/forms/ekit allows the user to search for a particular vehicle and engine size/type, model, year etc, to check its suitability and , if available, purchase the conversion kit directly.

The converted vehicle can run on multifuels. Hence, in case that PPO is unavailable, can use diesel or blends of the two fuels.

"One tank" conversion kits cost around £1.200 including installation.

Plant Oil Transformer, Global Oil GmbH

Global Oil is a manufacturer of Plant Oil Transformers (POT) for diesel engines. POT is an additional transformer and enables the existing diesel engine in the vehicle to use biofuels such as Pure Plant Oil. POT contains of two parts:

1. An electronic control system.
2. A mechanical system which modifies the pure oil as to be used by the engine without changing its chemical structure.

The POT is posted between the fuel filter and the pump without touching any part of the engine and is installed in no more than 1,5h. It is suitable to different plant oils and has the possibility to shift to diesel if no plant oil is available.

Further information about this system at the attached website: www.global-oil.eu

Use of LCA in biofuels strategies

Strategies of use of biofuels in transport require analysis of environmental impact of fuels and biofuels over the whole life cycle of a transport fuel in order to compare environmental aspects of using different fossil fuels and biofuels. The life cycle analysis (LCA) applied to transport emission is named Well-to-Wheels (WTW) analysis and is divided in two stages:

- The Well-to-Tank (WTT) analysis takes into account the first part of the pathway from the origin of a fuel to a tank in a vehicle in terms of energy and GHG emissions.
- The Tank-to-Wheels (TTW) analysis takes into account actual emission from vehicle use (exhaust or tail-pipe emission).

The WTW analysis is a complex study and requires input data from all stages of acquiring, processing, conversion, transportation and end-use of fuels. For each stage and process product and energy flows are balanced and resulting emission calculated.

For traditional fuels major stages of fuel processing include crude oil extraction, transport, and refining, and diesel/petrol transportation.

Analyses for biofuels are more complex and depend on type of plant and specific conditions for crops and method of processing. For example for biodiesel produced from rape seed plants the pathway include rape seed agriculture, transport and crushing, rape seed oil transport, biodiesel production and transportation.(see respective Figure in page 70)

Production of bioethanol from wheat require performing analyses of corn agriculture, transport, distillation, raw alcohol transport, bioethanol production and transportation.(see respective figure in page 70)

There have been several studies and reports giving results of life cycle analysis of fuels and biofuels for different crops, pathways and technologies.

List of results of LCA analyses delivered as best practice tools shall serve as an example for assessing environmental impact and GHG emission abatement as the result of conversion from traditional fuels to biofuels.

Results of two studies for biodiesel and bioethanol are given in the reports of CIEMAT(Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas). The reports show the advantages of using bioethanol and biodiesel from used oil.

Results of study by EUCAR, CONCAWE and JRC on the Well-to-Wheels energy use and greenhouse gas (GHG) emissions for a wide range of potential future fuels and power-trains options are given as the next best practice tool.

Simplified training tool on has been developed within BioNETT to demonstrate reduction of GHG emissions when converting public fleets to biofuels. The spreadsheet model allows for presenting reduction of GHG emission for different fuels and vehicles, based on available LCA studies. It has been seen that decision-makers at local level in communes and municipalities require presenting them environmental consequences of switching their fleets to biofuels. Sample results of the tool are attached at page 72.

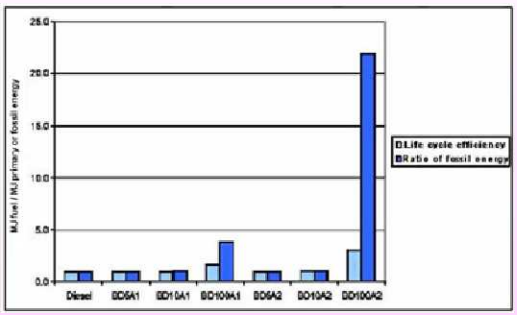
A methodology for the calculation of greenhouse gas emissions from the production and use of transport fuels, biofuels and other bioliquids, is envisaged in the proposal for a new Directive "on the promotion of the use of energy from renewable sources" published by European Commission, on January 2008 (COM (2008) 19 final). The proposal set as requirement a minimum 35% greenhouse gas emission saving from the use of biofuels and set the rules for calculating their greenhouse gas impact (Annex VII of Directive).

Summaries of the above mentioned LCA studies are given below:

Life Cycle Analysis of biodiesel in Spain

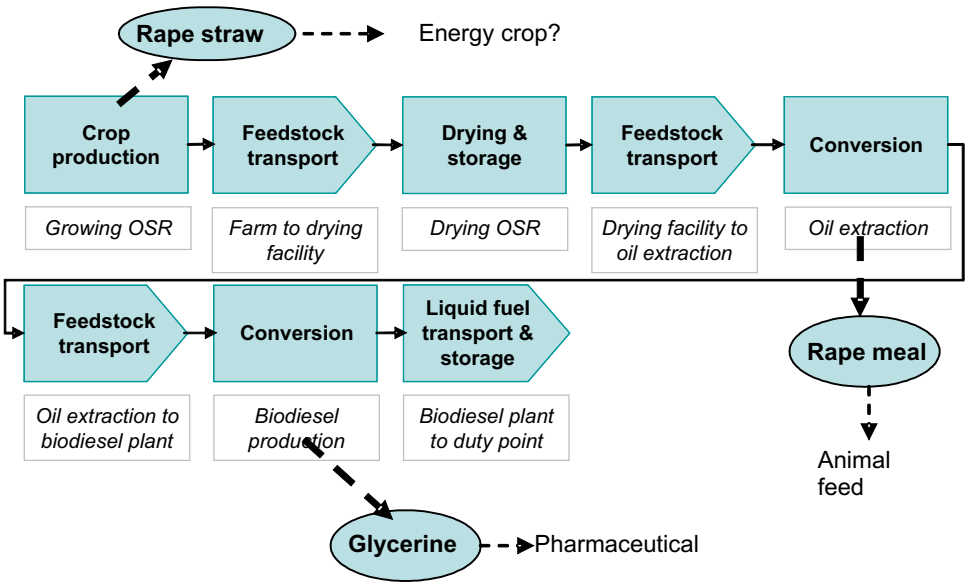
A study on LCA GHG emissions of biodiesel utilisation versus conventional diesel utilisation, has been conducted by the CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas), on behalf of the Spanish Ministry of the Environment. The study considered input data from all major stages of fuels pathway: agriculture, transport and crushing of seeds, transport of vegetable oil, biodiesel production, used cooking oil collection and treatment, transport of used cooking oils, fossil oil extraction and transport, conventional diesel production, distribution of biodiesel-diesel blends, final use in vehicles. The results of the study are illustrated at the attached Chart.

The study concluded that utilisation of Used Cooking Oils as raw material, is the most profitable and efficient means of biodiesel production.

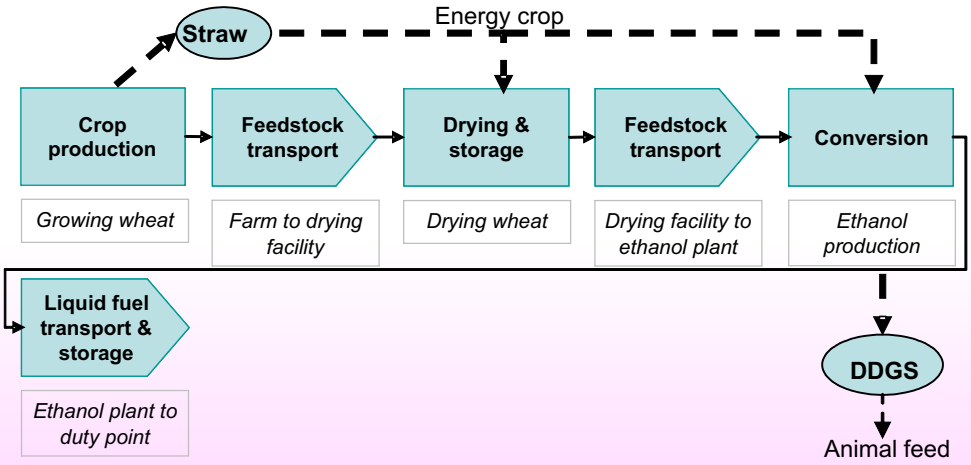


Source: Lechón, Y., Cabal, H., de la Rúa, C ,Lago, C., Izquierdo, L., Sáez, R. Ma, Montserrat F.S.M.(2006).Life Cycle Analysis of alternative fuels for transport-Phase II. Comparative Life Cycle Analysis of Bioediesel and Diesel Energy and Climate Change. Centre of Publications of General Technical Secretariat of Ministry of Environment. (In Spanish)

LCA - Biodiesel from Oilseed Rape



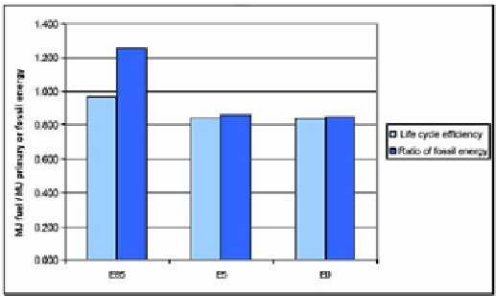
LCA - Wheat to Ethanol



Life Cycle Analysis of bioethanol in Spain

A study on LCA GHG emissions of bioethanol utilisation versus conventional gasoline utilisation, has been also conducted by the CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas), on behalf of the Spanish Ministry of the Environment. The study considered input data from all major stages of fuels pathway: agriculture, bioethanol production, fossil oil extraction and transportation, gasoline production from fossil oil, bioethanol gasoline blends distribution, final use in vehicles. The results of the study are illustrated at the attached Chart.

The study concluded that the benefits of bioethanol use in



vehicles are less important comparing to the benefits of biodiesel use.

Source: Lechón, Y., Cabal, H.,Lago, C., de la Rúa, C., Sáez, R. Ma, Fernández.(2005).Life Cycle Analysis of alternative fuels for transport-Phase I. Comparative Life Cycle Analysis of Bioethanol from cereals and Gasoline Energy and Climate Change. Centre of Publications of General Technical Secretariat of Ministry of Environment. (In Spanish)

Evaluation of the Well-to-Wheels energy use and GHG emissions

EUCAR, CONCAWE and JRC have performed a joint evaluation of the Well-to-Wheels energy use and greenhouse gas (GHG) emissions for a wide range of potential future fuels and power-trains options. The documents available at http://ies.jrc.ec.europa.eu/wtw.html present the results of the study (May 2006).

There are 10 documents available for download, offering various levels of detail:

- A slide pack summarizes the main results and messages.
- The Well-to-Wheels (WTW) report provides and integrated analysis of the complete pathways in terms of energy, GHG emissions, costs and potential availability of alternative fuels.
- The Well-to-Tank (WTT) report details the WTT portion of the pathways, including cost and availability estimates.
- The Tank-to-Wheels (TTW) report describes the vehicle configurations and performance. The appendix gives details on vehicles retail price estimation.

Specific figures provided in the documents allow for calculations of GHG emissions along fuel chain for specific cases.

Documents give results of life cycle analysis of fuels and biofuels. Potential of biomass residues and of conventional bio-fuels is estimated. Availability scenarios for advanced bio-fuels are presented.

GHG emissions Calculation Methodology

Source: Commission of the European Communities. (2008). *Proposal for a Directive of the European Parliament and of the Council, on the promotion of the use of energy from renewable sources.* Brussels

E = eec + el + ep + etd + eu eccs - eccr eee,

where

E = total emissions from the use of the fuel

eec = emissions from the extraction or cultivation of raw materials

el = annualised emissions from carbon stock changes caused by land use change

ep = emissions from processing

etd = emissions from transport and distribution

eu = emissions from the fuel in use

eccs = emission savings from carbon capture and sequestration

eccr = emission savings from carbon capture and replacement and

eee = emission savings from excess electricity from cogeneration.

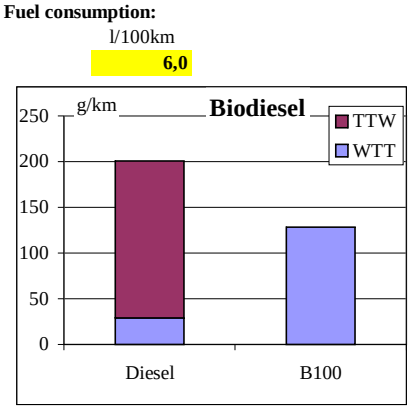
Emissions from the manufacture of machinery and equipment shall not be taken into account.

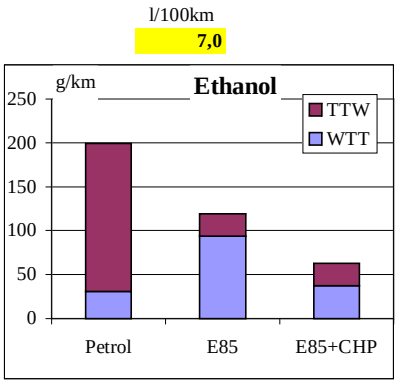
The rules for application of this methodology are given in Annex VII of the above Directive proposal.

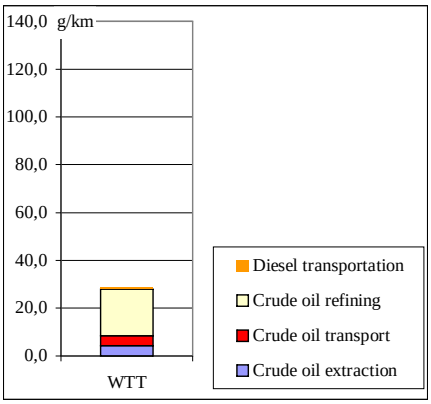
BioNETT Simplified LCA

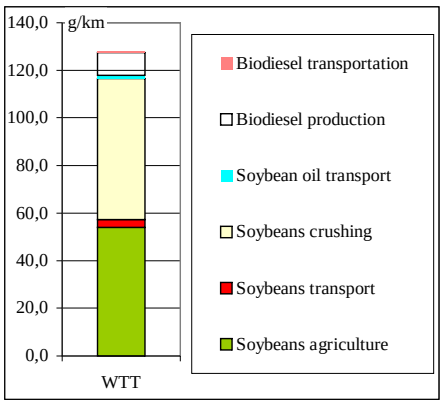
A simplified training tool on biofuels LCA has been developed within BioNETT to demonstrate reduction of GHG emissions when converting public fleets to biofuels. Sample results of the tool are given below.

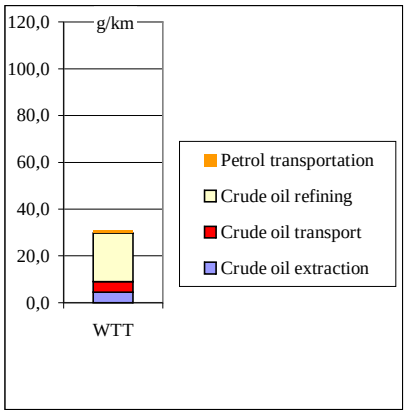
Fuel consumption:

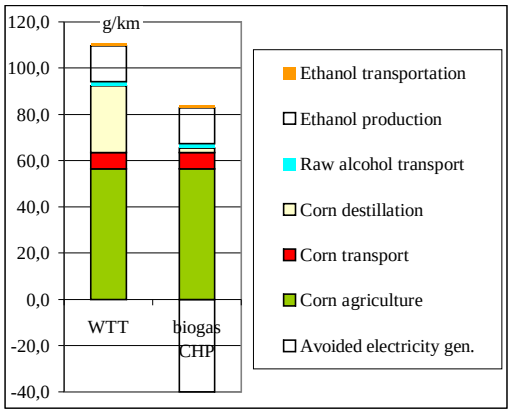












Sustainability Standards for Bioenergy

Several working and research reports have been elaborated dealing with the shortcomings from extensive use of land, water and other resources to produce biomass for production of liquid transport fuels. Although biomass is widely reported as a renewable energy source, the sustainability of its production pathways in the long term and the necessary measures to be taken to maintain its sustainability, especially in case of imported biomass/biofuels from extra EU countries, is still under question.

An interesting report on this subject has been produced by EcoFYS - http://www.ecofys.com/ in April 2007. The report is entitled "Sourcing palm oil from sustainable sources".

A remarkable work on the same issue is IEA Bioenergy - TASK 40 that could be retrieved by www.ieabioenergy.com.

Useful information on biofuels sustainability can be also found in Biofuels Technology Platform website:

http://www.biofuelstp.eu/sustainability.html

The content of this website is summarized below:

Biofuels and sustainability

This part of the Platform presents the views of various organizations and research activities concerning the extensive use of land, water and other resources to produce biomass for production of liquid transport fuels. Although biomass is widely reported as a renewable energy source, the questions remains as to what systems are sustainable in the long term and what actions need to be taken to maintain their sustainability.

Environmental impact

Some intensive modern farm methods used for food production have a range of negative effects on the environment, such as soil erosion, water shortage, pollution from pesticides and problems with overuse of fertilizers (including eutrophication). The eutrophication is only one threat for the biodiversity, which is also endangered by the replacement of natural ecosystems by monocultures, whether annual crops like rapeseed, sugar beet or cereals, or large areas of coppice or short rotation forestry.

Land availability

Millions of tonnes of biomass are required to replace a significant proportion of fossil fuel used in transport. Hence, biomass yield is a very critical point. Higher yields correspond to production of a higher amount of biofuels using less land. Land use efficiency may also be improved by selecting crops or plantations with a higher biomass production capacity. For instance most oils seed crops have an annual production capacity of few tonnes per hectare; sugar and starch crops may generate 5 to 10 tonnes, while significantly greater yields come from woody plants or from conventional crops such as cereals in case that straw is used. Greater utilisation of such materials depends on the development of second generation biofuels. Even if these higher yielding methods come to market, land availability still sets limits to what may be produced. Suggestions have been made for the movement of biomass or biomass derived fuels from the more agriculturally productive regions to the more industrialised countries.

Food versus fuel

The global population continues to grow in alarming rates. This means that production of food should be increased, while more energy will be consumed to ensure a good standard of living to all these people. This raises a debate on 'Food versus Fuel'; how much land and natural resources are available, how should they be used and which are the priorities?

Another interesting report on Sustainable Bioenergy has been produced by WWF Germany and is entitled "Sustainability Standards for Bioenergy". This report could be downloaded from the Biofuels Technology Platform website:

http://www.biofuelstp.eu/downloads/WWF_Sustainable_Bioenergy_final_version.pdf

An abstract of this report is given below. It should be noted that the material in this report is copyright of WWF Germany, Frankfurt am Main.

Source: Fritsche, U.R., Hünecke, K., Hermann, A., Schulze, F., Wiegmann, K. (2006). Sustainability Standards for Bioenergy. WWF Germany. Frankfurt am Main

with contributions from Michel Adolphe, Öko-Institut e.V., Darmstadt.

Sustainability standards for bioenergy are a key issue from an environmental and nature-protection point of view. The World Wide Fund for Nature (WWF) Germany is promoting activities in this direction. To further the ongoing discussion and offer a concrete proposal for standards, WWF Germany commissioned a brief study from the Öko-Institut (Institute for Applied Ecology). The study provides an overview of key ecological and social impacts of bioenergy and develops a core set of standards which could ensure the sustainability of future bioenergy supplies.

This report begins in Section 1 with an introduction to key bioenergy issues, summarizing "drivers", global potential, the key issues of sustainable biomass and standards.

Section 2 gives a brief description of key potential problems

and conflict areas arising from increased bioenergy supply, and derives core sustainability standards for each problem area. The standards were determined on the basis of a broad review of existing labelling and certification schemes for bio-based products and previous work carried out by the authors. A distinction is made between the use of biogenic residues/wastes and the dedicated cultivation of bioenergy crops. The study focuses on the latter.

Section 3 discusses the legal background to implementing sustainability standards with special focus on international rules, EU legal settings and certain German laws. Legal instruments are also briefly described.

Approaches to implementing sustainability standards for biomass is introduced in Section 4, which also draws conclusions from the previous sections and gives recommendations, above all on the need to begin introducing sustainability standards for bioenergy. Furthermore, some open questions are addressed.

The report closes with a reference section, a list of acronyms and annexes offering additional thoughts on environmental assessment methods and synopses with details on sustainability standards for biomass.

Technology ranges and implementation

Biodiesel Taxi Fleet in Graz

Background

The capital city Graz lies in the southeast of Austria and is the largest city in the Styria region. Graz is situated on the Mur River in a low-lying valley surrounded on three sides by hills, and is predisposed to poor air quality, especially in winter the reduction of vehicle pollution is therefore an important local issue. The city's 240.000 inhabitants are well served by an extensive public transportation network including a comprehensive bus and tram service.

Graz has extensive experience of using biodiesel manufactured from recycled vegetable oils for fuel public service vehicles and, since 2003 has operated its entire fleet of 140 buses on biodiesel fuels. The 'waste' vegetable oils are collected from many of the city's restaurants and private households and locally processed to provide the Fatty Acid Methyl Ester (FAME) biofuel.

Given this existing experience and established fuel supply infrastructure, Taxi 878, the city's largest taxi company have also opted to switch from using mineral (fossil) diesel to biodiesel (FAME) and are in the process of converting all of their 225 car fleet. The company have procured vehicles capable of running with 100% FAME and have opened a public-access biodiesel filling station at their central depot. In Austria, Taxi 878 are the first major taxi fleet to switch to pure biodiesel operation.

The biodiesel fuel

Until 2005, Taxi 878 sourced its biodiesel from SEEG, the same company that supplies the city's bus fleet with waste oil derived biodiesel, and one of the first companies in the world to produce recycled FAME on an industrial scale. Waste oil from over 250 restaurants and many private households within Graz is collected and stored in a solar-heated 10.000 litre tank, before being transported to SEEG's processing facility in Mureck, about 50 km from Graz. Here the used oil undergoes transesterification to remove the glycerol component of the oil using a process that was originally developed by the University of Graz together with the Austrian company Biodiesel International (BDI). Each year around 10.000 tonnes of used cooking oil is processed, each tonne producing around 850 litres FAME biodiesel fuel.

However, since 2005, FAME biodiesel has been sourced from an alternative supplier and now uses crop biodiesel feedstocks such as rapeseed to produce RME (Rape Methyl Ester), one of the most common type of FAME used across the EU. The change in supplier was not instigated by any difference in fuel quality, but was a decision based on normal business considerations. In winter, when temperatures are at their lowest, the RME fuel is also blended with 30% fossil diesel to reduce the risk of fuel lines becoming blocked. In order to increase the impact of the project, and to benefit the wider community, a refuelling station for biodiesel was established at Taxi 878 headquarters. The filling station is also open to the public, thus encouraging other companies as well as private motorists to use biodiesel. In parallel with the use within the vehicle fleet, biodiesel is also used to fuel the company's backup generator.

Taxi 878's biodiesel taxi fleet

Taxi 878 is one of the largest private taxi fleets within Graz with around 225 cars. The annual distance travelled by each car is in the region of 70.000-80.000 kilometres. As of 2006, around 33% of the fleet has switched to using biodiesel and the aim is that eventually at least 50%-70% will convert to using 100% biodiesel. Originally, the main car models used within the fleet were manufactured by Mercedes. However, since 2005, the fleet has switched to using Skoda Superb automatics as these have proven to perform well on 100% FAME fuels; the Skoda cars in service have already passed 130.000 km without any problems.

Initially the taxi fleet of (mainly) Mercedes cars experienced technical problems that delayed the adoption of biodiesel within the fleet, but highlighted important technical and regulatory issues that needed to be addressed. The technical problem was initially thought to be either the direct blocking of fuel filters by the FAME fuel, or that sediment left by the fossil diesel was being dissolved by biodiesel and then clogging the filters, both common problems associated with using biodiesel. If either of these problems had been the case, it would be impossible for cars within the fleet to change between biodiesel and fossil diesel and would have therefore restricted use of FAME within the fleet. However, analyses showed that fuel filter clogging was not the issue. In the end it was found that there was a design error in the test vehicle itself. It took

the input of two experts from the local University to finally identify and solve the problem before the conversion to biodiesel could progress. Since this was rectified, there have been no further problems.

There were also problems with vehicle warranties that normally limit the percentage of biodiesel that can be used to 5%. Volkswagen Group advise that for the Skoda Superb manufactured from 2002 to 2006, *"Vehicles built before week 32 (w/c 07/08/2006) RME biodiesel conforming to EN14214 can be mixed in any desired ratio with diesel conforming to the standard EN590 as stated in the relevant Owners Handbook"*. However, Superbs built after this date, and those models that are fitted with a diesel particulate trap (DPF), such as the Superb 2.0 litre TDi from 2005 onwards, are not approved for use with biodiesel. (RME can also be used in the Skoda Octavia A4 1997-2006 and Skoda Fabia 2000-2006 models built before week commencing 26/06/2006.)

Interestingly, the majority of taxi drivers at Taxi 878 are not employees but franchisers, making the switch to biodiesel more of a challenge. In essence, the whole community of drivers needed to be persuaded to use the new fuel voluntarily in their own vehicles and take on any risks involved. This was achieved in part through the use of an information campaign that addressed fuel issues including quality of the biofuel, vehicle compatibility and using the fuel on cold winter days. All drivers were introduced to environmental issues as a part of a one-day training programme for the entire company. This approach was deemed to have been necessary to convince drivers that the risks were minimal. In the event, the technical problems that were encountered did lead to vehicle downtime and loss of income. However, the company succeeded in keeping the drivers 'on-board' as problems were being addressed.

Taxi 878's drivers have also been trained to provide biodiesel information to passengers, and are therefore important 'lay-disseminators'. This capitalises on the fact that passengers are often curious about taxis that are driven on renewable fuels. The objective is that this will encourage the adoption of biodiesel by private motorists who may be unaware of its local availability and wider environmental benefits.

Environmental benefits

Official published vehicle emission data for cars running on 100% FAME is not readily available as vehicles using biodiesel in the EU are type approved using mineral diesel. However, generic vehicle comparisons suggest that compared to fossil diesel, tailpipe emissions of carbon monoxide, hydrocarbons and particulates are reduced by 15%-20%. However, emissions of nitrogen oxides are increased by around 5%-10%. Most significantly, despite using around 10% more fuel per kilometre (by volume), life cycle greenhouse gas emissions of cars using 100% RME are around half of those using conventional diesel.

The original project targets included a reduction in use of fossil diesel use of 1.080 tonnes per year, and a reduction of 2.900 tonnes carbon dioxide and 3,4 tonnes carbon monoxide emissions per year. As of the end of 2006, these have yet to be achieved but are expected to be realised within the near future.

Other advantages of using biodiesel include the fact that the fuel biodegrades more quickly than fossil sourced diesel and removes the environmental risks associated with oil extraction and transport (e.g. Alaskan pipeline and Exxon Valdez spills). However, this has to be balanced by the environmental impacts associated with the feedstock crop production and processing that usually involves synthetic fertilizer, pesticide and herbicide use (organic production is possible but rare).

Cost information

As of 2006, RME biodiesel sourced by Taxi 878 retails at around €0,88-€0,91 and fossil diesel costs in the range €0,94-€0,95 thus RME is typically €0,05-€0,08 less than fossil diesel. This slight cost advantage is a direct result of the fact that, in Austria, biodiesel (meeting minimum fuel specifications) is exempt from fuel tax (as is the case in many other EU Member States).

The project has proved invaluable in confirming the operational costs (fuel costs, maintenance, etc) associated with biodiesel use as compared to mineral diesel. To date the project concludes that, taken overall, and assuming engine failures are avoided through the sourcing of high quality fuels and biodiesel compatible engines, there are no significant economical differences between biodiesel and mineral fuel operation. The wider benefits are, therefore, positive and include the reduction of the impact on the local, regional and global environment.

While biodiesel taxis do not receive any additional benefits,

since 2004, drivers of low polluting vehicles in Graz can receive a €0,40/hour discount on the parking fee (the ordinary tariff is €1,20/hour) low-polluting vehicles are defined as vehicles emitting less than 140g (130g for diesel vehicles) CO_2 per driven km. By inserting a special token in the parking machine the driver receives the lower tariff. To obtain this so-called "Umwelt-jeton", drivers have to register their vehicles at the city council and eligible vehicles must display special sticker on the windscreen.

Lessons learnt

Taxi 878 has been instrumental in demonstrating that private taxi (as opposed to public bus) fleets can operate effectively and reliably on biodiesel fuels with no loss of service or vehicle performance, and without an increase in operating costs. This has been achieved through the overcoming of apparent technical problems that required expert input, and which turned out not to be a significant barrier to the adoption of biodiesel by a large proportion of the taxi fleet.

The experience of Taxi 878 within Europe is unique and could be used by other EU fleets who wish to switch to biodiesel for environmental and/or fuel supply reasons. One important lesson offered by the project is that, although vehicle warranties usually only allow up to 5% biodiesel blends, it is possible to source vehicles (with care) that are able to use high percentage blends or pure biodiesel fuels. Co-operation with vehicle manufacturers and suppliers is also advised.

Taxi 878 has also shown that it is necessary to bring users 'on-board' in this case this was achieved through driver education and training, both of which required significant time and cost investment by the company. Not only did this increase the chances of the project succeeding, but it has led to taxi drivers acting as information 'multipliers' and advocates drivers are trained to provide passengers with information about the benefits and practicalities of used biodiesel. This has succeeded in building a wider support base for biodiesel within the city of Graz.

While the city of Graz has had a long experience in using biodiesel in public transport, this project has demonstrated that different barriers to the adoption of biofuels exist for private fleets. Whereas the public transport operator may have more capacities for research, private fleets have to buy in expert advice when required and are more sensitive to the economic penalties associated with some cleaner fuels. These potential barriers were exacerbated in the case of Taxi 878, as the fleet is not centrally owned (all drivers are franchisees). However, even in this regard the project has succeeded in convincing fleet drivers that the benefits of using biodiesel are worth the investment in overcoming initial problems in implementation.

References

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Well-To-Wheels Analysis Of Future Automotive Fuels And Powertrains In The European Context. Well-to-Wheels Report. Concawe, Eurcar, EU Joint Research Centre, 2006.

Civitas Trendsetter website: www.civitas-initiative.org

SUGRE Sustainable Green Fleets website: www.sugre.info

European Local Transport Information Service website: www.eltis.org

Acknowledgment is given to Taxi 878 and SkodaAuto, a division of the Volkswagen Group UK, for their cooperation and assistance in constructing this case study.

Stockholm's Municipal Fleet of Bioethanol FFVs

Background

Stockholm, located on Sweden's east coast, is the largest municipality in Sweden and has a population of over 765.000 inhabitants. The capital has a reputation for being an environmentally clean city. This has been strongly supported by national policy in 2006, Sweden set itself the goal of achieving total independence from oil by 2020 in response to security of supply issues, the rising cost of crude oil and climate change. Although a number of transport biofuels are being developed for large-scale use, the production of bioethanol is of particular interest given the significant renewable forest biomass resources within the country. As part of its ongoing environmental programmes, the City of Stockholm initiated the Clean Vehicles project in the mid 1990's, with the objective to procure environmentally friendly cars for the municipality. These initially included biofuel and electric vehicles, and now also include hybrid cars and small city-cars. The focus of the municipal fleet project was a strategic decision to use its procurement power to stimulate a market for cleaner fuels and associated infrastructure.

This project has successfully led to the significant improvement in the supply of clean vehicles and the development of a city-wide biofuels infrastructure. As of 2006, there are 600 clean vehicles in operation, which represents 60% of the municipal fleet, the majority of which are bioethanol Flexible Fuel Vehicles (FFVs). The impact of the procurement programme has been to stimulate the wider market (almost 25.000 clean vehicles are now in use in Stockholm). In the light of this success, the city has decided that all of the municipal fleet should be 'clean vehicles' where possible, and that all flexible fuel cars should use biofuel for at least 80% of the time.

The bioethanol fuel

Svensk Etanolkemi AB (SEKAB) is the main supplier in Sweden of fuel bioethanol for FFVs and bioethanol-adapted buses. Until recently, most of the vehicle ethanol was manufactured using upgraded 'wine ethanol' produced from the EU wine surplus, with a smaller fraction being produced at a sulphite pulp processing plant located close to SEKAB's main facility. However, in 2006, SEKAB began importing sugarcane bioethanol (mainly from Brazil) this now comprises the main source for bioethanol for FFVs in Sweden.

SEKAB provides two types of fuel ethanol to the vehicle sector: ETAMAX D for adapted diesel engines the fuel consists of bioethanol and 5% water, plus smaller amounts of ignition improver, corrosion inhibitor, MTBE and isobutanol; and ETAMAX B 'E85' for FFVs the fuel consists of a mix of petrol (Swedish environmental class 1, MK 1), anhydrous bioethanol (86% by volume), MTBE and isobutanol. Other suppliers of vehicle anhydrous bioethanol include Agroetanol AB however, this bioethanol is not used for FFVs but is used for blending with petrol for Stockholm and the Southeast of Sweden (up to 5% bioethanol according to the EU directive).

Around 300'000 m^3 of bioethanol is used for vehicle use (for FFVs and blending), of which around 15% is produced domestically. Future Swedish bioethanol production is likely to sourced from cellulose biomass sources. In 1983, the Foundation for Swedish Development of Ethanol (now the Bio Alcohol Fuel Foundation or 'BAFF') was founded with the goal to develop the production and use of biomass-based bioethanol

in the transport sector. This led, in 2004, to the construction of a small cellulosic ethanol pilot production plant that produced its first bioethanol in 2005.

The bioethanol refuelling infrastructure has grown in parallel with supply. Since 1994, when the first Swedish E85 filling station was opened in Örnsköldsvik, well over 200 E85 refuelling points have been installed across the country. In Stockholm, there are currently around 50 E85 stations (representing 60% of all fuel stations), with a further 30 in the region. Although the installation of new E85 stations is being driven by commercial considerations, recent Swedish legislation states that all but the smallest fuel stations must offer at least one cleaner fuel (including E85).

Stockholm's Municipal FFV Fleet

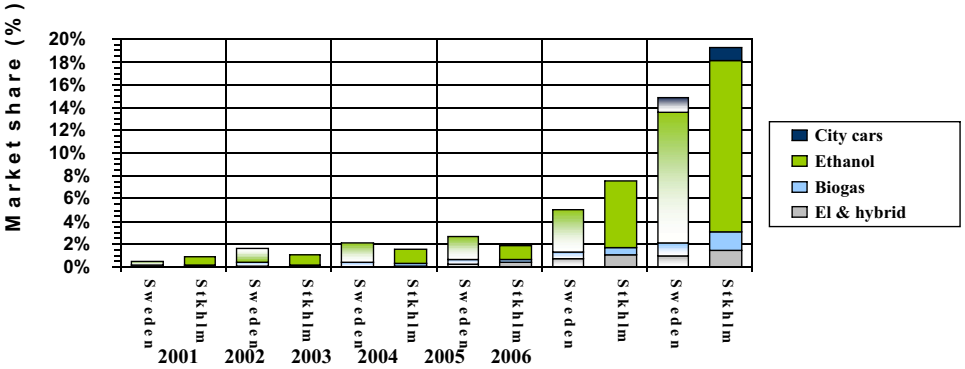
In early 1990's, only one bioethanol FFV was available in Sweden; the 'Flex-Fuel' Ford Taurus. Around 200 of these cars were imported from the US and leased for company and government use. Given the limited vehicle supply and choice, in 1997, the municipality of Stockholm and the Environmental Technology Delegation initiated a project to stimulate the FFV market. This resulted in the establishment of the Swedish FFV Buyers Consortium, which included the Auto Emission Consultant KEE AB, OK (fuel company), The Swedish Road Administration, and KFB (Swedish Transport & Communications Research Board). The aims of the Consortium were to set up a joint procurement programme, and identify initial customers in order to stimulate demand for FFVs and encourage manufacturers to increase the number of FFVs models at a reasonable price.

By 2000, when the number of Consortium members (i.e. potential customers) had reached 3.000, Ford decided that this was sufficient market size to start production of the Ford Focus FFV (with a 1,6 litre engine). This was initially offered to fleet customers in 2001, and to private users in 2002. The price that Ford finally asked for the FFV Ford Focus was approximately €500 below the price of an equivalent petrol Ford Focus vehicle. In 2005, two other manufacturers followed Ford' s lead; SAAB Motor Company introduced a FFV version of its model SAAB 9-5 (BioPower), and Volvo introduced FFV versions of the Volvo S40 and Volvo V50. Renault, Peugeot and Citroën have since announced that they will launch FFV models in 2007.

As shown by the attached chart, the number of cleaner vehicles and FFVs in Stockholm has increased dramatically over the past 5 years, with the number in 2005 exceeding the original target that 4% of the city's new cars should be flex-fuel, biogas, electric or hybrid. In 2006, the increase has continued with 19,5% of all new car sales being 'clean', three-quarters of which (15% of total) are FFVs. This increase has been primarily driven by the municipality, whose 600 clean vehicles now represent 60% of the municipal fleet, again exceeding initial set targets.

Interestingly, between 2000 and 2005, the percentage of clean vehicles within the municipal fleet actually fell slightly. This was largely due to a reorganisation within the council. Whereas vehicle procurement had been conducted centrally, the process was decentralised to separate departments within the council. The result was a loss of expert input and a lowering of the priority to purchase clean vehicles. Several actions were taken to counteract this trend. First, each department received a letter from the City Director reminding them of the clean vehicle policy, and second, seminars were held to inform departments about the benefits of clean vehicles, the models available, followed-up by individual purchasing schemes for each fleet manager.

To date, around 25.000 FFVs are now operated in Stockholm, the models including the Saab 9-5 BioPower, the Volvo V50 and the Ford Focus (over 80% of all the Focus cars sold in Sweden are FFVs). Whereas in 2001 FFVs were only available to public and private sector fleets, now retail customers buy more than 60% of flex-fuel vehicles sold. BAFF estimate that, by 2009, Sweden will have around 300.000 FFVs (representing 7% of the total light-duty fleet in Sweden) and 450.000 by 2011 (10% of the total light-duty fleet). Following existing trends, it is likely that the highest concentration of FFVs will be within the Stockholm region.



Environmental benefits

Official published vehicle emission data for FFVs running on E85 are not readily available as bioethanol cars in the EU are type approved using petrol. However, manufacturers have made emission data available to Stockholm municipality, who have confirmed this data by conducting their own measurements. Figures for a range of FFV models suggest that, compared to petrol, tailpipe emissions of nitrogen oxides are reduced by 50% and carbon monoxide is reduced by 15%-20%. Although tailpipe hydrocarbons are largely unchanged, between 63% and 91% of these are ethanol and are therefore not an issue. Most significantly, despite using around 40% more fuel per kilometre (by volume), on a life cycle basis, FFVs using E85 reduce CO_2 emissions by around 75%; this assumes that the bioethanol component of the fuel is imported sugarcane ethanol from Brazil (or other similar tropical region), which is increasingly the case in Sweden.

Other advantages of using bioethanol include the fact that the fuel biodegrades more quickly than fossil sourced petrol and removes the environmental risks associated with oil extraction and transport (e.g. Alaskan pipeline and Exxon Valley spills). However, this has to be balanced by the environmental impacts associated with the feedstock crop production and processing that usually involves synthetic fertilizer, pesticide and herbicide use (organic production is possible but rare).

Cost information

Due to the fact that bioethanol FFVs can be produced from standard petrol models with relatively minor modifications (the replacing of some materials that are degraded by ethanol, the addition of a larger fuel tank, and the modification of engine management systems), FFVs are similarly priced to their petrol counterparts. This has been assisted in Stockholm by the buying power of the purchasing Consortium, which it is estimated, has reduced any additional costs by up to 15%.

Although fuel production costs for bioethanol remain higher than for petrol, in Sweden, biofuels are zero-rated for fuel taxes (VAT is still charged). The result is that E85 can compete commercially against conventional fuels as of 2006, petrol costs around €1,17 per litre (10,6 Krona), and E85's retail price is €0,95-€1,00 per litre. However, bioethanol's lower energy content (by volume) means that E85's petrol equivalent price is €1,33-1,41. (The relatively high bioethanol price is due in part to an extra toll of €0,22 (approx. 2,0 Krona), applied from July 2006.)

Given that fuel costs can be 15%-20% higher for FFVs running on E85 as compared to petrol, other financial incentives have proved important in supporting the relatively new FFV market. In Stockholm, these incentives include zero fuel tax, free parking for FFVs and designated parking spaces, and exemption from the city's Congestion Charging. Added to these benefits is the permission to use bus lanes and to access restricted urban areas; although not financial incentives as such, they do represent a monetary advantage for many users (eg time is money). A national Local Investment Program (LIP) for sustainable municipal investment also provides capital funding for new refuelling infrastructure (of up to 30% of additional costs) where required. However, in practice, for E85, this has proved not to be an important driver of fuel infrastructure expansion given the increasing strength of consumer demand.

Lessons learnt

The Swedish Buyers Consortium, set up by the municipality of Stockholm with other partners, has proved to be crucial in the catalysing of the Swedish FFV market. Although incentives for bioethanol existed before the Consortium existed, it was only through the collective procurement power that manufacturers such as Ford made the necessary investment in new FFV models that gave the market a choice of vehicles (a factor found to be important for the introduction of all fuel types). The Consortium's activities essentially reduced the investment risk for manufacturers, who realised that a market for FFVs did exist and that this would be supported by municipal and national Government.

Stockholm's strategy was that the initial Consortium would stimulate the wider market for FFVs and other clean vehicles. This has indeed occurred the introduction of clean vehicles into the municipal fleet has supported the adoption of cleaner cars by local companies approximately 50% of all major companies now have at least one clean vehicle in their fleet. The awareness of clean vehicles among the business community and general public has also increased it is estimated that all private companies with more than 250 employees and an environmental manager, and 53% of Stockholm's inhabitants, are aware of clean vehicles. 15% of the city's population now state that they intend to buy a clean vehicle in the near future.

Bio-methane in Lille

Background

Lille Metrople is a large metropolitan area in the North East of France. It comprises of 85 communes with a population of some 1,2 million inhabitants and covers an area of about 600km^2. The metropolitan authority is responsible for the services and amenities in the urban area including waste and water treatment and public transport services. The public transport network in the area is extensive and is run by the Syndicate Mixte Des Transport, the local public transport authority.

In 1990 Lille Metrople saw the opportunity to gain environmental benefit from linking two aspects of the services it provides in the area excess biogas from the local sewage works at Marquette and the operation of the bus fleet. At the time sewage gas from Marquette was being used to provide heat and power for the sewage plant with any excess being flared off. A pilot project was set up to upgrade this gas to 95% methane (bio-methane) and use in 8 buses in the bus fleet. The first buses came into operation in 1994.

The law on 'Air and rational use of energy' came into force in France in 1996 and required all municipal areas with a population of greater than 100.000 to have an urban mobility plan. Lille Metropole developed a plan that included an objective to reduce the pollutant emissions from public and private transport. This became a key driver for the authority in further developing the gas bus fleet using both bio-methane and fossil methane. Today the authority has over 100 gas buses and a new biogas treatment facility producing gas specifically for the public transport fleet.

The bio-methane fuel

The idea of using bio-methane was developed in the early 1990's as a way of using excess sewage gas and to reduce emissions from the bus fleet. Initially there was some 3.000 Nm^3 of gas available that was upgraded to 95% methane using a water absorption system. The gas was produced and upgraded at the Marquette sewage treatment plant.

This initial scheme was run as a pilot, starting up in 1994-1995 with a limited number of buses. The fuel was dispensed from

pumps at the sewage treatment works and so the buses had to refuel away from their normal depot, which did add to the operational mileage of the vehicles.

The success of these initial trials promoted the expansion of the fleet to well over 100 buses using a mixture of bio-methane and fossil methane. Initially the bio-methane was from the trial plant at Marquette, but this is being expanded to a capacity 1 million Nm^3 and ultimately to 4Nm^3 of gas with the introduction of a new biogas processing facility. The new biogas facility will take a mixture of organic wastes from municipal waste collection, restaurants and the food industry. This new facility is due to be in place in 2006-2007 and will provide enough bio-methane to fuel 100 buses.

Alongside the bio-methane, fossil methane or compressed natural gas (CNG) has been used. The CNG is being used to allow expansion of the gas bus fleet prior to the new bio-methane production facilities being in place and to manage fluctuations in bio-methane production capacity. The refuelling sites are dual sites using both bio-methane and CNG through the same systems.

In a future expansion of the biogas system in the city they are looking to inject the bio-methane directly into the mains gas grid so that it can be used from wider range of locations.

Fleet operation

The main focus of the bio-methane fleet operations is on public transport buses. To date the bus company has approaching 200 CNG buses running on both bio-methane and CNG. A purpose built gas refuelling station that can take 150 busses, and the original pilot fuelling station fuels these buses. This

represents about 50% of the total bus fleet in Lille, and the aim is to have a 100% gas fleet by 2015. Bio-methane will be used in about 100 of these buses when the latest biogas plant is in full operation.

In Lille the experience with the gas buses has been very positive. There were a few initial problems with the pilot buses, but these were ironed out. Now with large scale introduction the vehicles are seen as a mainstream technology and a major part of the public transport service in the city. Both the transport operator and the passengers feel the buses operate as well as diesel vehicles in terms of providing a service. Building on the success with the bio-methane buses Lille Metropole are now looking to implement bio-methane in 10 municipal waste vehicles and about 30 light vans used by municipal staff.

Environmental benefits

Biogas performs as a vehicle fuel in the same way as CNG and produces a noticeably cleaner and quieter vehicle than its diesel counter part. This was backed up by a customer survey in Lille where the passengers identified that the gas vehicles were much quieter and the emissions were less odorous.

Exhaust emissions results for CNG vs diesel buses are shown at the table above. The table shows that the CNG buses in Lille and those tested recently in Finland by VTT produce very low PM and NOx emissions which meet Euro 5 standards. This makes them ideal for urban situations where there are commonly air quality problems associated with NOx and PM. However, the methane buses do produce slightly higher CO and HC emissions. With regards the HC emissions most of these are methane emissions in the form of un-burnt fuel.

In terms of CO_2 emissions the direct emissions from the vehicles was reported to be similar between both diesel and gas buses. However, when the gas buses are operated on bio-methane they produce significantly lower life-cycle green house gas emissions. Based on the recent life-cycle study of vehicle fuels by Concawe (2005), CO_2 equivalent emissions can be reduced by between 75% and 200% when using bio-methane when compared to diesel.

An additional environmental benefit reported by the work in Lille was a 60% reduction in noise levels of the gas buses when compared to the diesel buses.

Cost information

Lille has spend over €2 million investing in the bio-methane system of the city, mainly on the new buses and the refuelling infrastructure, with the initial biogas plants already being in place. They have been supported in meeting these costs with European, national and regional grants. In particular they have been successful with the European CIVITAS demonstration programme TRENDSETTER and most recently the European biofuel cities project BiogasMax. Not only have these programmes given Lille financial support, but also technical and political support by working with other European cities who have also been progressing bio-methane as a transport fuel.

The current biogas plants in Lille are estimated to be producing bio-methane for transport use at a cost of €0,75/litre (diesel equivalent) which is similar to that of diesel. However, other studies have estimate the price at only €0,47/litre to €0,56/litre, considerably cheaper than diesel. In terms of vehicle costs no specific data was publicly available for the Lille situation, but other work has suggested that the additional cost of the gas vehicles will be in the region of €35.000 - €50.000. Since Lille have purchased a significant number of vehicles it would be expected for the price to be at the bottom end of this scale. It was these additional vehicle costs that the grant money was used to fund.

Exhaust emissions from CNG and diesel buses

	Emissions in g/km				
	CO	NMHC	THC	NOx	PM
CNG *	3.26	0.37	4.47	1.59	0.042
CNG TWC **	2.5	0.03	1.5	2	0.005
Diesel Euro 2 ***	4	1.1	1.1	7	0.15
Diesel Euro 3 ***	2	0.6	0.6	4	0.1
Diesel Euro 3+ CRT **	0.2	0.05	0.05	9	0.02
Diesel Euro 4 ***	1.5	0.46	0.46	3.5	0.02
Diesel Euro 5 ***	1.5	0.46	0.46	2	0.02

* emissions results from Renault CNG bus operated in Lille
** emissions results from vehicles tested by VTT in Finland in 2004.
*** emissions limits for heavy duty vehicles

Lessons learnt

The use of bio-methane for the buses in Lille has been driven by two issues:

- A need for the treatment of organic wastes and to use the excess biogas.
- A drive to reduce the pollutant emissions from the public transport system.

The scheme has been very successful in meeting both these goals and has been well received by both the bus operator and

the public. An important lesson was the use of an existing biogas plant, which was already used to produce heat and electricity, to gave a platform on which to build the bio-methane scheme. With the existing biogas plant in place, built to provide a waste treatment process for the city's organic waste, the marginal cost to use the resulting biogas as a vehicle fuel is then just the upgrading plant, the refuelling infrastructure and the new vehicles.

However, even with an existing biogas plant it was recognised that the scheme would not have been economically viable without grant support, due to the high capital costs of the vehicles and refuelling infrastructure. However, now that the system is being developed on a larger scale the economics are improving, with vehicles and infrastructure becoming more readily available. Also having the right conditions in terms of tax and political policies will help the success of the scheme and allow it to expand to a wider vehicle market.

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Pilot biofuels in use projects

A plan for the penetration of Biofuels in the Region of Central Macedonia

Project summary

The "Plan for penetration of biofuels in the Region of Central Macedonia (RCM) aims to reach the target of 5,57% share of biofuels for transport use in Central Macedonia, by its own grown crops by the year 2010.The current cultivations of agricultural crops in RCM are investigated and three different scenarios for their replacement with energy crops are developed.

Introduction

The Region of Central Macedonia consists of seven (7) Prefectures: Thessaloniki, Serres, Kilkis, Halkidiki, Pieria, Pella and Imathia. It has 731.645 ha of fertile land out of which 29.053 ha are set-side land.

At the beginning of BioNETT Project, in 2006, the biofuels sector was initiated in Greece. The development of a plan for the penetration of biofuels in the Region of Central Macedonia was considered essential to promote and further development of biofuels sector.

The work was conducted by REACM-ANATOLIKI S.A. at the framework of BioNETT Project. Farmers Organisations and Regional Authorities assisted in the elaboration of the plan through the networking activities held in the framework of Bio-NETT project at the second semester of 2006.

Short Description of the Pilot Project

The plan focuses on the current cultivations of agricultural crops in the Region of Central Macedonia, proposing three scenarios for the replacement of non-energy traditional kind of crops together with the use of set-aside land for energy crops (specifically soya, sunflower, cotton and rape).

Moreover, the annual potential of these crops for the production of biodiesel is calculated, taking into account that in Central Macedonia there are 731.645 ha of fertile land out of which 29.053 ha are set-side land. The three cases considered are:

- 1% use of the available land above for the cultivation of each of the four above suggested energy crops (low penetration scenario).
- 2% use of the land for the cultivation of each of the four suggested crops(scenario of medium range).
- 4% use of the available land for the cultivation of each of the four suggested crops (high case scenario).

The implementation of the penetration scenarios will contribute 10.506 klit, 21.011 klit and 42.022 klit of biodiesel respectively, which correspond to 7,08%, 14,16% and 28,32% of the 5,75% national target for the year 2010.

Technical Data

Total agricultural land in the Region of Central Macedonia in 2005: 731.645 ha

Suitable Energy Crops: Sunflower, Rape, Soybean and Cotton

1st Scenario-Low penetration

Cultivated area: 29.266 ha

Fuel: 10.506 klit biodiesel

7,08% of the target of 5,75% biodiesel necessary to meet in 2010

2nd Scenario- Medium range penetration

Cultivated area: 58.532 ha

Fuel: 21.011 klit biodiesel

14,16 % of the target of 5,75% biodiesel necessary to meet in 2010

3rd Scenario-High case scenario

Cultivated area: 117.064 ha

Fuel: 42.022 klit biodiesel

28,32% of the target of 5,75% biodiesel necessary to meet in 2010

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The project was facilitated by **REACM-ANATOLIKI S.A.**, in the framework of BioNETT

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1000 ha of biodiesel

Project summary

The Pilot Project"1000 ha of biodiesel" aims to define and develop an integrated biodiesel chain, from field to tailpipe, in Northern Italy. The main stakeholders, Lombardy Region and other regional public and private actors, coordinated by Navigli Lombardi Scarl, take the challenge to develop a biodiesel supply chain and test its sustainability in the context of the Italian Biofuels Scenario for 2008.

Introduction

The aim is to grow biofuel crops (soy and rapeseed) on about 1000 hectares of agricultural land in Lombardy Region, in the North of Italy. Approximately 1000 tonnes of biodiesel should be produced for fuelling public and private fleets. Initially the project focused only on boats for the inland navigation in the Navigli di Leonardo da Vinci, a channels grid within Milan municipality, but today the goal is to extend the use of biodiesel to other vehicles fleets.

Based on a rough estimation, the total amount of biodiesel produced could be used, as B100, by approximately 1.000 cars. The use of blends with lower biodiesel content should proportionally increase the number of cars using this mixture.

Coordinator of the Project is Navigli Lombardi Scar, a private organisation administrated by a Board of Directors mainly consisted of representatives of Public Authorities (Region Lombardy, Province of Milano and several other Municipalities). It was established in line with the regional laws and it could be considered a public body.

Besides Navigli Scarl that coordinates the project, other important actors are:

- Lombardy Region, as main sponsor and stakeholder. Lombardy Region is one of the most important regions of Northern Italy, always active in the promotion of biofuels and biomass.
- Consorzio Agricolo di Milano e Lodi Agricultural Union of Milano and Lodi, for the management of the agricultural part of the chain.
- CTI Italian Thermotechnical Committee as technical advisor and Bio-NETT partner.
- Assocostieri Unione Produttori Biodiesel National Association of Biodiesel Producers.
- Local associations of farmers.

Short Description of the Pilot Project

Objective of this pilot project has been the development and implementation of an integrated biodiesel supply chain, from field to tailpipe, for both public and private fleets.

Technical Data

Available land: about 1000 ha

Fuel Crops: soy and rapeseed

Fuel: about 1000 t/year of Biodiesel to be used pure or blended. 1.000 tonnes of B100 is suitable for fuelling approximately 1000 cars/year.

Final users: public and private fleets and boats in Navigli Channels.

Main actors:

- Lombardy Region Main sponsor and stakeholder
- Navigli Lombardi Scarl - Coordinator
- Consorzio agricolo di Milano e Lodi
- Comitato Termotecnico Italiano
- Assocostieri Unione produttori biodiesel
- Associazioni agricole: Cia, Confagricoltura, Codiretti

Estimated cost: €310.000 for the first year of activities. The project is funded by the Lombardy Region and the other actors involved.

Current status:

Under the coordination of Navigli Lombardi Scarl, and with the technical support of CTI, a feasibility study is being carried out taking into account the unsteady conditions of Italian market. In the meanwhile the coordinator and CTI are trying to identify fleets interested to potential use biodiesel.

The Consorzio Agricolo is planning the next agricultural activity in order to produce the requested amount of seeds to be crushed for the oil production.

Assocostieri will provide technical support for the conversion of pure oil into Biodiesel.

The cultivation of the first fuel crops is expected to start in 2008.

The project was facilitated by **CTI**, in the framework of BioNETT

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Agro-Energy Kilkis

Project summary

Pilot Project "Agro-Energy Kilkis" envisages the development of a short biodiesel supply and use chain in the Prefecture of Kilkis (one of the seven territories-prefectures which comprise the region of Central Macedonia in Northern Greece).The plan was elaborated in the framework of the Innovative Development Plan of the Prefecture of Kilkis and was facilitated by BioNETT Project.

Introduction

In 2006, the Prefecture of Kilkis, elaborated an Innovative Development Plan. The Plan envisages the development of new agricultural activities. It examines the farming of energy and aromatic crops, the processing, production and commercialization of biofuels as well as other oils and the development of agro-tourism in the area. The time frame is suggested from September 2007 to December 2012.

The biofuels development and commercialization section was accomplished through the networking activities held in the framework of Bio-NETT project at the second semester of 2006.

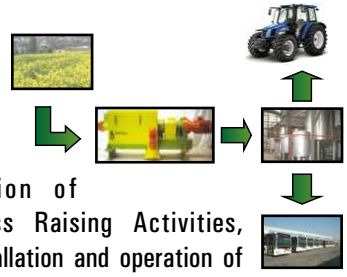
Short Description of the Pilot Project

Aim of the project is to develop a short local biodiesel chain in Municipality of Axioupoli, with Farmers' Association of Axioupoli being not only producer of raw material but entrepreneurs and users as well. The project envisages cultivation of 1.000 ha with rape, in the Municipality of Axioupoli, in the Prefecture of Kilkis.

The seeds produced will be further processed to rapeseed oil at the local seed-pressing plant run by Farmers Association, while rape crop residues will be collected and further utilised in a local pilot-plant. The rapeseed oil will be supplied to the biodiesel plants, already existed in the area. Approximately 825 tonnes of biodiesel (650 toe) will be produced and they will be used for fuelling of tractors and public transport fleets. Vehicles will be fuelled, through the two biodiesel pumps stations to be established in the Municipality of Axioupoli.

The project will be coordinated by the Prefecture Authority of Kilkis, while local and regional stakeholders from the agriculture, research and development sector will play important roles:

- REACM ANATOLIKI S.A.: Consultancy and technical services, Dissemination, Pilot plant for utilisation of biomass residues, Best Practices.
- Farmers Association of Kilkis: Pilot rapessed cultivations, Awareness raising activities.



- Farmers Association of Axioupoli: Awareness Raising Activities, Storage-facilities, Installation and operation of Rapeseed-oil production plant, Training of plant personnel, Biodiesel pumps.
- Aristotle University: Farmers training, Research, Scientific consulting.

Technical Data

Available land: 1.000 ha
Pilot-Energy Crops: rapes
Fuel: about 650 toe/year of Biodiesel
Final users: tractors and local public buses
Other investments: 1 seed pressing plant, seeds storehouses, 2 biodiesel pumps, 1 pilot-plant for utilisation of rape residues
Main actors:

- Prefecture Authority of Kilki, Division of Agricultural Development
- REACM-ANATOLIKI S.A. Regional Energy Agency of Central Macedonia of Local Development Agency of Eastern Thessaloniki (ANATOLIKI SA)
- Farmers Association of Kilkis
- Farmers Association of Axioupoli
- Aristotle University of Thessaloniki,Laboratory of Agricultural Economic Research

Estimated cost: €5.100.000 for the core investment (energy crops, storehouses plants and pumps), and additional €1.120.000 for training of farmers and plants' personnel, consultancy and technical services, consulting services, research, awareness raising and dissemination activities.

Current status

Delays in approval and funding of the Project combined with the crisis in Greek biodiesel sector in 2007 (high purchase prices of cereals and vegetable oils) hindered its implementation. It is expected that availability of European Structural and Regional Funds for the period "2007-2013" will encourage its implementation.

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Pure Plant Oil (PPO) as fuel in public and private fleets

PPO for Mid Western Regional Authority vehicle fleets

Project summary

After the TEA presented the BioNETT project to the Mid Western Regional Authority (MWRA) Renewable Energy Committee a biofuels subcommittee was set up to look at the potential of biofuels in local authority fleets. At the initiation of this project in 2006 Pure Plant Oil (PPO) was the only biofuel available locally to this region. A study was then carried out to look at the feasibility of running vehicles on PPO and what was involved in converting diesel engines to run on PPO. Vehicles were identified that were suitable to run on PPO and a tender was launched in May 2007 to solicit suppliers for the conversion kits and PPO. The response from to the tender was then passed onto each local authority in the MWRA and Limerick City Council proceeded to convert 2 Citroen Berlingo Vans to run on PPO. The other local authorities are in the MWRA are planning to convert vehicles to PPO in 2008.

Introduction

The MWRA is made up of 4 local authorities: North Tipperary County Council, Limerick County Council, Limerick City Council and Clare County Council. TEA participates on a Renewable Energy Committee run by the MWRA which includes representation form each of the local authorities in the region. Local Authorities have been identified as key drivers in government initiatives to reduce energy consumption and to increase the use of renewable energy in carrying out their activities. A presentation was given on BioNETT to this committee in April 2006. Following on from this, it was agreed that further research should be carried out on biofuels and a biofuels subcommittee was formed to steer this initiative. TEA who participated in this biofuels subcommittee then undertook a project as part of BioNETT to carry out a feasibility study to look at the potential for each of the local authorities to use biofuels in their vehicle fleets.

Description of Pilot Project

TEA working with the BioNETT Local network carried out a feasibility study to examine each local authority's vehicle in the MWRA and to identify what biofuel alternatives there were. As all local authorities used almost 100% mineral diesel to fuel their fleets the biofuel options identified were PPO or biodiesel. As PPO was more widely available than biodiesel it was decided to concentrate on this fuel.

A full vehicle survey was carried out with each local authority to get information on vehicle types, annual distance travelled, fuel consumption and the type of activity the vehicle was engaged in. Research was carried out in to using PPO and assistance on this research was provided by University of Limerick where Final Year Mechanical Engineering carried out research in to converting mineral diesel engines to run on PPO. The MWRA biofuels subcommittee did a study tour of Cork City Council to evaluate their experience with PPO in October 2006, as they were running 15 vehicles on PPO at that time. From the surveys carried out and the research gathered a number of vehicles from each local authority were identified as being suitable to convert to PPO. From this list each local authority identified approximately 3 vehicles to convert to PPO.

A tender was issued in June 2007 to procure interest form suppliers if conversion kits and suppliers of PPO. 2 companies tendered to supply conversion kits and 2 companies tendered to supply PPO. A full evaluation was carried out of the tenders received and was presented to the MWRA biofuels subcommittee in October 2007. It was agreed that each local authority would convert their vehicles to PPO. Limerick City Council converted 2 Citroen Berlingo Vans to run on PPO in December 2007. It is anticipated that the other North Tipperary and Limerick will convert vehicles to run on PPO in 2008. Clare County Council have decided not to pursue with PPO due to issues with supply due to the distances involved from the companies that tendered to supply PPO.

Short Description of Pilot Project

The object of this pilot project is to evaluate the suitability of using PPO for the local authorities of the MWRA and to look at running a sample of vehicles form each local authority on PPO.

Technical Data

Number of vehicles identified 12(average 3 per local authority)

Estimated Annual Fuel consumption: 30.000 litres

Fuel: Pure Plant Oil (PPO) DIN 51605

Fuel Price in September 2007: €0,94/lit inc VAT with full excise relief

Conversion Kit: Average €1.900/vehicle

The project was facilitated by **TEA**, in the framework of BioNETT

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PPO in Iecavnieks' fleet

Project Summary

The pilot Project "Iecavnieks" deals with introduction and increase of rapeseed oil (PPO) use as a fuel for tractors and trucks, owned by the private company "Iecavnieks", as well as individual farmers, cooperating with the company.

Introduction

Starting the work at development of pilot projects in 2006, Riga Managers School has to encounter the regional reform of municipalities currently under way. All the municipalities have been focused in activities connected with preparation of their enlargement. Discussion and adoption of the law on regional reform lasted for 3 years from 2006 till 2008.

Moreover, the legislative framework was unfavourable to introduction of biofuels due to the unsteady political situation (frequent changes in the Government).

Therefore Riga Managers School decided to support projects for biofuels use in private fleets, in which the economic sustainability of the project is the main criterion. Managers of two companies expressed their interest to use biofuels, one of which was "Iecavnieks".

Description of Pilot Project

The "Iecavnieks" company was created by reorganising a collective farm of Soviet times and due to a correctly selected strategy manage to maintain its position on Latvian and international market.

Profile of the company: grain storage and primary processing, oil production, transport services to other companies and farmers, agricultural consultancy services.

Producing rapeseed oil both for food and for biofuel production, the company encountered difficulties in selling it as a fuel to local consumers.

In 2006 the company started to use rapeseed oil for fuelling its own fleet of vehicles. In close cooperation with the Latvian team of BioNETT, explanatory seminars have been carried out for Iecavnieks' personnel and for its collaborators from agricultural sector (farmers).

Use of vegetable oil as a fuel was stimulated by the fast increase in conventional fuel prices. "Iecavnieks" using the knowledge delivered by BioNETT Project and supported by Latvian Technical Experts developed a technology for truck modification in order to use rapeseed oil as fuel.

In the framework of local workshops, trucks DAF, MAZ and MAN, a Nissan Serena minibus, a John Deere 7800 tractor and two combine harvesters (JD1170 and JD1188) were modified. This work is done on each new truck purchased (The company buys 5-10 years old used cars).

Selecting between biodiesel and PPO, the Company has implicitly stayed on PPO for economic reasons. The cost of the vegetable oil, produced by the company itself is € 0,41/lit.

Short Description of the Pilot Project

Modification of one vehicle to run with PPO costs €700-850.

In the existing exploitation load this money may pay off in 2-3 months.

At present the company uses 12 modified vehicles, run using PPO.

Stimulated by "Iecavnieks" example, farmers selling rapeseeds to the company for processing, use as well PPO in combine harvesters and tractors.

The project was facilitated by **RMS**, in the framework of BioNETT

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PPO in South Tipperary County Council

Project summary

South Tipperary County Council (STCC) participated in a project 'Biofuels for Transport' run over 2007. Under this project grants were available to cover 75% of the costs to convert diesel engines to run on PPO. STCC were successful in their application to obtain this grant to convert 2 haulage trucks to run on PPO. The trucks were converted to run on PPO in July and September 2007 and to date there have been no issues with the performance of either truck.

Introduction

South Tipperary County Council (STCC) who are key participants in the BioNETT local network and who built up an awareness of biofuels through the BioNETT project applied to participate in the 'Biofuels for Transport' project funded by the Department of transport and administered by the German Irish Chamber. The project which ran over 2007 was a national initiative to promote and evaluate the performance of PPO in a variety of vehicles throughout Ireland. There are 3 workshops organised over the course of the project to disseminate the findings of the project and STCC participated in providing feedback on their experiences at the last work shop in November 2007.

Description of Pilot Project

STCC had participated in the BioNETT network and were interested in looking at using biofuels in their vehicle fleet. In the summer of 2006 TEA carried out a vehicle survey for STCC and identified a number of vehicles that were suitable to convert to PPO. STCC were interested in pursuing looking at converting some of their vehicle to run on PPO and applied to participate in the 'Biofuels for Transport' programme which was offering a grant of 75% to cover the costs of converting vehicles to run on PPO.

STCC had their first vehicle a Mercedes Actros gravel haulage truck converted by Greencar in July 2007 to run on PPO. A Dual Tank Kit was fitted to the truck. The dual tank system has two tanks the main tank which contains PPO and a secondary tank that contains diesel. Due to the high viscosity of PPO it provides problems for engine when starting cold particularly first thing in the morning. In a dual tank system the truck is started on diesel and then when the PPO reaches the correct temperature the fuel line automatically switches over to run on PPO. Towards the end of the day before the driver completes the final journey they must remember to switchback on the diesel on tank to flush out the PPO so that the truck will start on diesel the following morning.

STCC converted their second truck a Volvo FM 9 to run on PPO in September. They have had no major issues running the trucks. The main issue encountered has been to change filters more frequently due to a faster build up of particulate in the filters. As a result of this the time between servicing has been halved. The PPO is supplied by a local company Kilkenny Cereals in 1000 litre in intermediate bulk containers (IBC).

Short Description of Pilot Project

The object of this pilot project is to practically evaluate the performance of vehicles running on PPO in working conditions.

Technical Data

Number of vehicles: 2
Estimated Annual Fuel consumption: 50.000 litres PPO
Estimated Annual Mileage: 160.000 km
Fuel: Pure Plant Oil (PPO) DIN 51605
Fuel Price in September 2007: €0,94/lit, including VAT, with full excise relief
Conversion Kit: €5000/truck, 75% grant (cost with grant €1.250)

The project was facilitated by **TEA**, in the framework of BioNETT

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Biodiesel in Slivo Pole

Project summary

"Astra Bioplant Ltd" is located in the municipality of Slivo Pole, in Rousse Region in Bulgaria on an area of 5ha. The plant has a biodiesel production capacity of 60.000 tonnes per year and use as raw material sunflower, soybean and rape seeds.

Introduction

In 2006, the biofuels sector in Bulgaria was initiated. MEA in the framework of BioNETT Project provided consultancy services and support to potential investors in biofuels production. It implemented market searches and energy analyses for biofuels, developed networks connecting major actors of biofuels chain and organized several activities (round tables, workshops, conferences, etc.) to increase knowledge on biofuels production and use. Several investments in Rousse Region have been stimulated and facilitated by MEA, but only one was finally implemented and started its operation in July 2008. That is the biodiesel production plant of "AstraBioplant Ltd" in Slivo Pole. However, establishment of new high capacity biodiesel plants is expected for the near future.

The "Astra Bioplant Ltd" plant is located in the municipality of Slivo Pole, in Bulgaria, 20 km east of Rousse and 9 km away from the port terminal of Bulmarket DM Ltd. The Rousse Region has strong agricultural character and tradition on cultivation of seed crops.

The idea for the implementation of the plant was born at the beginning of 2006. The activities carried out in the framework of BioNETT , helped to bring this idea to a more mature stage. Thus, in the middle of 2007 started the planning and in October 2007 the construction work. In July, 2008 the first quantities of biodiesel were produced.

The plant aims to use as raw material seeds from sunflower and rape crops in the Municipality of Slivo Pole and the Region of Russe. The biodiesel produced will be used for transport purposes in Bulgaria.

To achieve these objectives a strategy should be developed that will involve all major local actors. Moreover, the biodiesel produced will be distributed to potential buyers on the basis of contract agreements that foresee the mandatory use of produced biodiesel in Bulgaria (in compliance with the new "Law for stimulating use of RES, AES and bio-fuels").

Short Description of Pilot Project

In the following paragraphs the most important sections of "Astra Bioplant Ltd" are described.

Oil Production

"Astra Bioplant Ltd" uses modern technological equipment for vegetable oils production. The installation is designed to operate with rape, soy-bean and sunflower seeds. It has a processing capacity of 500 tonnes of raw material per day and a production capacity of 200 tonnes of vegetable oil per day.

Oil Refining and Biodiesel Production

Up to date automatic equipment is used in these two installations that are continuously in operation. The biodiesel is produced through a transesterification process. Vegetable oil reacts with methanol producing biodiesel and glycerine as by-product.

Laboratory

A modern laboratory operates in the plant, for testing of seeds, unrefined and refined oil, biodiesel and glycerine samples.

Storage

Silos for raw material, 20 units x10 m^3

Tanks for biodiesel, 2 units x1000 m^3

Subsidiary Sections

- Steam-boiler station, producing 12 t/h, by using by-products(oil-cake or glycerine)
- Waste water treatment plant
- Water pump station to supply water to industrial processes
- Condensation station
- Power substation 3 MW

Additional Information:

Personnel: 120 persons

Current investment cost: €14 millions

Cost price - biodiesel July 2008: €0,81/ lit

Mixing: 5% biodiesel - 95% diesel

Presence of registered excise storage: Yes

End User: Local Market

The project was facilitated by **MEA,** in the framework of BioNETT

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Biofuels in Gloucestershire County Council

Gloucestershire County Council has appointed a corporate sustainability manager with a remit to consider biofuels. Two bio fuels pilots have been implemented in fleets contracted to the Council with a third at the planning stage. Gloucestershire County Council has received some help and support at an early stage from the BioNETT program - SWEA provided information on the sustainability and performance issues around using Pure Plant Oil (PPO) as a fuel, in addition to information on vehicle conversions and the tax implications of PPO.

Gloucestershire Fire & Rescue

Gloucestershire Fire & Rescue services have sourced B5 for the bunkered fuel for their fleet vehicles. The fuel is using in 4 of their stations with 35 vehicles regularly using the fuel. Through put is around 71.000 litres of fuel per year at 5% blend.

Gloucester Park and Ride

After the success of the Fire and Rescue pilot Bennets Coaches the Gloucester based coach company contracted to run the Gloucester Park and Ride scheme have also switched to B5 blend in their bunkered fuel.

The firm began to pilot the fuel in their 29 vehicles in January 2007 and ran the scheme up until August 2007. The vehicles used 275.000 litres of diesel fuel during this period with 13.750 litres of biofuel.

Gloucestershire Highways

Gloucestershire Highways have also put in place plans to trial pure plant oil in 5 vehicles at their Forest of Dean Depot. The pilot has been on hold until new vehicles had been purchased these are now in place and the trial is expected to start in late 2008. The vehicles that will be taking part in the trial are 2 x 3,5 tonne tippers and 3 x 7,5 tonne tippers. The vehicles are expected to use over 25.000 litres of fuel per annum.

Lessons Learnt

The bio-fuel turned out to be 1,8p per litre more expensive than conventional diesel and the engines did require more frequent filter changes. Other issues raised by the users were the land use implications of biofuels and some complaints as to the smoke emissions from the fuel however this was eventually put down to faulty engines rather that the fuel.

The Fire and Rescue pilot is still running but the Park and Ride pilot is now on hold but it is hoped that it can be re-instated before the end of the year.

The project was facilitated by **SWEA,** in the framework of BioNETT

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Gloucestershire County Council & Atkins

Biodiesel for Gniewino public fleets

Project summary

Pilot Project "Biodiesel for Gniewino public fleets" deals with the installation of a fuel station supplying a blend "Biodiesel-Diesel fuel (from B20 to B100)" for vehicles' fleet of the Commune Gniewino (school busses, fire brigade vehicles).

Introduction

Commune Gniewino is a rural commune in the North of Pomeranian Province with about 7.000 inhabitants and an area of 176km^2.

Commune Gniewino has been very active in promoting renewable energy sources and taking care on environment. Modernised school has been supplied from the wood-chip boiler plant. Sewage system is connected to own modern sewage treatment plant. There are two schools where children are transported by own busses from the commune area.

The commune has established a Technical Support Centre in Kostkowo, where fleets of Vehicles Park and are serviced. The Centre is prepared to be equipped with the fuel station, supplying communal vehicles. At first fleets of nine school busses and fire brigade vehicles are expected to be fuelled from the pump.

BAPE has been cooperating with the commune for long time on renewable energy projects. The biofuel project has originated from the BioNETT training and activities. The concept and the technical support have been provided by BAPE within the BioNETT project.

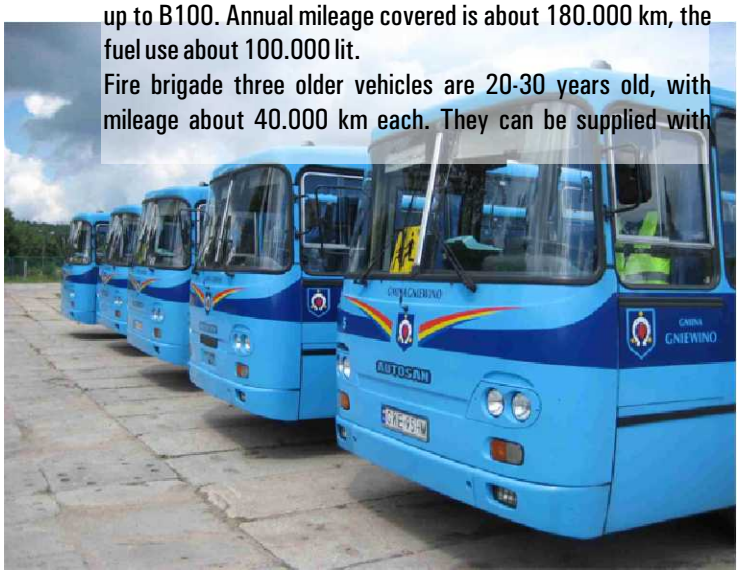
Short Description of Pilot Project

The object of this pilot project is a Fuel Station supplying a blend "Biodiesel-Diesel fuel (from B20 to B100)" for vehicles' fleet of the Commune Gniewino (school busses, fire brigade vehicles, 14 vehicles in total).

Technical Data:

School busses are on average 20 years old, they are after complete overhaul. Their engines can be supplied with biodiesel up to B100. Annual mileage covered is about 180.000 km, the fuel use about 100.000 lit.

Fire brigade three older vehicles are 20-30 years old, with mileage about 40.000 km each. They can be supplied with biofuels.



After successful operation of the biofuel fleets the next vehicles can be supplied with biodiesel and the new purchased vehicles could be already prepared for biodiesel.

The site is suited for location of the fuel station. The solution depends on the supply system.

Presently there are no biofuels on fuels market. The whole production of biodiesel production goes to owners fuels companies for blending. LOTOS Group from Gdansk is presently offering "Lotos Diesel Service" (LDS), with rented fuels station located at a consumer site and supplied with fuel and related services. However in 2008 LDS offer does not include biodiesel.

The pilot project is ready to be implemented. The possible time schedule is 2009, with own fuel station (costs of investment supported from one of environmental funds) or employing LDS system of biodiesel supply.

The project was facilitated by **BAPE,** in the framework of BioNETT

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Biodiesel in urban buses of Murcia City

Project summary

The Pilot project foresees use of biodiesel in three urban buses in the city of Murcia. These buses belong to line 4, the longest urban line in Murcia covering the main avenues and districts. The trial period started on July 14th and it will last one year: The first semester, buses will use B10 and if the results are positives, B20 will be used for the next semester. During the last semester, the possibility of extending the project to the nine bus lines of the city of Murcia will be investigated and organized.

Introduction

The main actors of the pilot project are:

- ARGEM being, in charge of the management and the technical support of the pilot project.
- The Municipality of Murcia that owns the urban bus lines network (9 lines) of Murcia city.
- LATBUS, the company in charge of the urban bus transportation in Murcia.

Several buses and bus routes were studied to identify the most adequate ones to replace conventional fuel with biodiesel. Finally, it was decided to apply the pilot project in three buses of urban line 4. Line 4 transports about 320.000 passengers/year. The three buses selected run about 135.000 km/year, consuming 60.750 litres of diesel fuel per year. Using B10 and later B20, 24,5 tonnes of carbon dioxide emissions will be avoided during the first year of implementation.

Short Description of Pilot Project

The buses of Line 4 are MAN NM-223-F. The manufacturer company gave its consent to use biodiesel to fuel the buses. Before fueling the buses with biodiesel, their tanks and fuel circuits were cleaned to eliminate presence of impurities, which could cause biodiesel emulsion with particles, causing problems to the fuel injectors. Moreover, the rubber tubes of the buses' engines were checked to certify that they are made from synthetic rubber, as biodiesel is a solvent and it can cause degradation of natural rubber.

The buses are fuelled with biodiesel through a storage tank of 5.000 litres and a fuel pump of 50 lit/min. Tank's capacity is enough to fuel the three buses for approximately one month. The Biodiesel supplier committed to deliver biodiesel in 24 hours after the order. LATBUS purchase B100, which is blended with diesel in the storage tank, to get B10 (10% biodiesel + 90% diesel), during the first sixth months, and B20 (20% biodiesel + 80% diesel), during the following six ones.

A comparative study will be conducted to investigate biodiesel impact on the buses' engines. Motor oil from both the buses of Line 4 fuelled with biodiesel-diesel blends and similar buses of Line 4 fuelled with conventional diesel will be analyzed and compared. By the end of the pilot project, 8 comparative analyses will have been carried out (in total 16 analyses: 8 on biodiesel buses and 8 on conventional diesel buses). The Polytechnic University of Cartagena will carry out the analyses of the first oil samples obtained from the engine's crankcases.

At the back of the three buses an advertisement indicates that they operate using biodiesel, while around 3.000 informative leaflets will be hand round to bus passengers.

The contribution of BioNETT Project in the pilot use of biodiesel in the urban bus fleet of Murcia has been essential. BioNETT provided complete technical support for the development of the project, while LATBUS technicians attended the training sessions carried out at the framework of BioNETT.

The project was facilitated by **ARGEM**, in the framework of BioNETT

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Biodiesel for Planetobus busses

Project summary

Pilot Project "Biodiesel for Planetobus busses" deals with the installation of a fuel station supplying a blend "Biodiesel-Diesel fuel (from B20 to B100)" for Planetobus busses.

Introduction

Planetobus is a private bus company, operation local bus lines at the outskirts of Gdansk.

The company has started its operation in 2002 with four local lines. Since than developed its fleet to over thirty busses and minibuses, operating route lines at the outskirts of Gdansk and offering other bus services. The line operation is based on a contract with Gdansk public transport authorities.

The biofuel project has originated from the BioNETT training and activities. The concept and the technical support have been provided by BAPE within the BioNETT project.

Short Description of Pilot Project

The object of this pilot project is a Fuel Station supplying a blend "Biodiesel-Diesel fuel (from B20 to B100)" for Planetobus busses, (30 vehicles in total).

www.planetobus.gda.pl

Technical Data

Planetobus busses are 20-30 years old, they have been renovated and serviced. Their engines can be supplied with biodiesel up to B100. Annual mileage covered is about 60.000 km per bus, the fuel use about 60.000 lit annually per bus.

After successful operation of the biofuel fleets the new purchased busses and other vehicles could be already prepared for biodiesel.

The site is suited for location of the fuel station. The solution depends on the supply system.

Presently there are no biofuels on fuels market. The whole production of biodiesel production goes to owners fuels companies for blending. LOTOS Group from Gdansk is presently offering "Lotos Diesel Service" (LDS), with rented fuels station located at a consumer site and supplied with fuel and related services. However in 2008 LDS offer does not include biodiesel.

The pilot project is ready to be implemented. The possible time schedule is 2009, with own fuel station (costs of investment supported from one of environmental funds or fund supporting SMS company) or employing LDS system of biodiesel supply.

The project was facilitated by **BAPE,** in the framework of BioNETT

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Biodiesel in Ticino Park

Project summary

Pilot Project "Biodiesel in Ticino Park - Biodiesel nel Parco del Ticino" deals with the installation of a fuel station supplying a "Biodiesel-Diesel fuel (B25)" blend to all the vehicles' fleet (cars, jeeps, heavy vehicles 25-30 vehicles in total) owned by Parco del Ticino. Parco del Ticino is the largest regional park in Italy with about 450.000 inhabitants and an area of 91.000 ha.

Introduction

The Regional Park of Ticino is situated in the north-west area of the Lombardy Region and has an area of 91.600 ha. It is the largest regional park in Italy and it is comprised by 47 municipalities and 3 provinces. It has in total 447.641 inhabitants.

The Park has developed its engagement to environmental sustainability by joining the Aalborg Charter in 2001 and adopting a programme for the promotion and coordination of "Local Agenda 21 in the Park". Although the complete Local Agenda 21 for the Park is not fully operative yet, important preparatory work has been carried out in the field of environmental sustainability. Park's environmental sustainability performance in several fields has been examined in order to identify projects already in operation and to provide support and information to Local Authorities.

The Park's Local Agenda 21 promotes Green Procurement via a "Park Mark" for agricultural products and sustainable inter-municipal mobility. Moreover, it promotes environmental certification, in accordance with ISO 9000, ISO 14000 and/or EMAS Standards, for agricultural enterprises producing goods by applying biological and integrated methods for high-quality products.

It was recognised that the Park could play an important institutional role in promotion and elaboration of a Sustainable Energy Action Plan at local level, to be shared by all the local institutional and social actors. To meet the sustainable objectives already set, the Park coordinated and promoted the WISE PLANS - Co-operation between communities for Energy Action Plans, an IEE project, Action HKA1 Sustainable Energy Communities. This Project should firstly bridge the knowledge and information gap by increasing awareness of local actors, in order to convince them to play a more active role in the application of energy-efficiency measures, introduction of renewable energies in all end-use sectors and promotion of relevant economic activities. Energy should be integrated in the social and institutional agreement to identify specific solutions to be implemented in every area of the Park.

CTI has been involved in the WISE PLANS project, providing technical support to Ticino Park on planning activities. At the framework of this cooperation the idea of a "demonstrative project" on Biodiesel use was born. As far as WISE PLANS is just a "Planning Project", CTI provided technical support for implementation of the Biodiesel Use Project, in the framework of Bio-NETT Project.

Short Description of Pilot Project

The object of this pilot project is a Fuel Station supplying a "Biodiesel-Diesel fuel (B25)" blend to all the vehicles (cars, jeeps, heavy vehicles 25 vehicles in total) of the fleet owned by Parco del Ticino.

Technical Data

Tank: 7000 litres

Fuel: Eco-Diesel B25 (25% Biodiesel/75% Diesel fuel).

Fuel Price in November 2007: €0,945/lit + VAT (20%) = €1,134/lit (when the supply contract was signed the price of diesel fuel was €1,210 /lit).

Investment required: €5.916 for the fuel station and the fleet management software

Park managers are planning to extend the use of Eco-Diesel in the vehicles of the employees of the Ticino Park.

So far, the feedback from final biodiesel users is positive, while both Park-Keepers and Park Managers have expressed their satisfaction with the system.

The project was facilitated by **CTI**, in the framework of BioNETT

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RME in PATA-AB

Project Summary

The pilot project "RME in PATA-AB" deals with the use of various biofuels blends to fuel the fleet of trucks (almost 40 vehicles) owned by the company PATA-AB. PATA-AB is one of the largest companies in Latvia working in timber market.

Introduction

Starting the work at development of pilot projects in 2006, Riga Managers School has to encounter the regional reform of municipalities currently under way. All the municipalities have been focused in activities connected with preparation of their enlargement. Discussion and adoption of the law on regional reform lasted for 3 years from 2006 till 2008.

Moreover, the legislative framework was unfavourable to introduction of biofuels due to the unsteady political situation (frequent changes in the Government).

Therefore Riga Managers School decided to support projects

for biofuels use in private fleets, in which the economic sustainability of the project is the main criterion. Managers of two companies expressed their interest to use biofuel, one of which was PATA-AB.

The main exported goods of Latvia are timber and woodwork. Therefore the companies, working in this field, are of great potential.

The company PATA-AB is owner of forests, producer and supplier of firewood, as well as a transport carrier of both its own products and of the timber produced by other companies.

Working on both the local and international markets the company, already before Latvia joined EU, ensure that its vehicles meet the strict European standards.

The technical management team of the company is open to innovations; since 2006 has been collaborating with the local team of BioNETT in a pilot project aiming to increase biofuels use in the company's fleet. The main problems faced were connected with selection of appropriate vehicles and supply of good quality fuels.

Having participated in the seminars, held in the frameworks of BioNETT, and receiving adequate information on progress done in other countries, the manager of the company decided to increase the monthly use of RME to up to 70-100 tonnes for the period 2006-2008. The amount of used RME depends on the current RME's market price and the availability of fuel .

Short Description of the Pilot Project

PATA-AB uses trucks Scania R-124, R-420, R-480 which do not require any special modification for using biofuel. The trucks are 1-4 years old. The vehicles fleet is regularly renewed with aim not to use vehicles older than 4 years. The company owns up to 40 vehicles.

Fuel: Biodiesel B5, B100, depending on prices and availability of fuel.

The company uses various blends with RME content from 0% up to 100%. Exploitation corresponds to class E3 and since 2007 started to increase the volume of E4.

The marginal value, under which the company shifts from biodiesel to diesel fuel, is when the ratio RMEprice/DIESELprice is 0,9.

Fuel price including VAT in June, 2008:

Diesel €1,10 /lit

RME €0,96 /lit

In 2008, PATA-AB started to use the additive "Adblue" which decreases hazardous emissions. Today, 4 vehicles are run on this fuel.

Due to the well organised service the use of biofuel does not cause any problems. Only financial considerations may hinder use of RME.

The project was facilitated by **RMS**, in the framework of BioNETT

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Biodiesel in Commercial Group fleet

Commercial Group in Cheltenham has a vehicle fleet of 67 vehicles (12 vans and 55 cars) and is piloting the use of biodiesel by running approx 10 of their delivery vans on a 50% blend of biodiesel. The company has installed a 20.000 litre dual tank that holds 10.000 litres biodiesel and 50% standard diesel.

They expect to be using around 250.000 litres of bio-fuels per year once the full roll out to all vehicles is complete.

The system will be fully automated so that each vehicle has a unique code that is inputed at the pump and the correct blend of fuel is delivered to the vehicle. The blend is therefore controlled centrally and integrated into the fuel management system. This particularly important for a diverse fleet that contains cars and light vans from a range of manufacturers.

Commercial Group were awarded runner up in the 2007 Energy Saving Trust 'Fleet Heros' Awards and is a finalist for the Greenfleet Award and Fleet Hero Award in 2008 see http://www.energysavingtrust.org.uk/fleet/fleetheroawards/heroes2007.

The company have agreed to take part in the BioNETT project and hosted a training session and site visit on the 4th June 08.

Lessons Learnt

The bio-diesel project is part of a wider program of environmental action including energy efficiency improvements, renewable energy projects and recycling programs. Combined with delivery consolidation and a dynamic routing system devised in house, the company has already reduced audited carbon emissions of the fleet by 52% in 2007. Commercial work extensively with their customers, including BSkyB, Johnston Press and UCAS, in various environmental initiatives, including promoting the use of high quality sustainable biofuels.

COMMERCIAL GROUP

The project was facilitated by **SWEA,** in the framework of BioNETT

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Collection of UCO for biodiesel production

Project summary

The Region of Murcia Government, in particular the Regional Sustainable Development Ministry, is carrying out a pilot project for the collection of domestic used cooking oil to produce biodiesel. The system of used oils collection from households in the Region of Murcia consists of providing citizens with special funnels to make easier keeping their used oil in a standard plastic bottle and disposal of the filled bottles in a net of special bins. Then, the oil in bins is collected to produce cosmetic products and biodiesel.

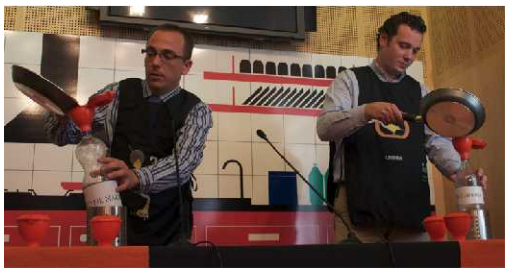
The main objective of this pilot project is to solve the problem of used cooking oils and to promote the development of new technologies of biofuels production.

Introduction

ARGEM, in the framework of BioNETT Project, worked in close collaboration with the Regional Sustainable Development Ministry, in order to elaborate the project. Together, they developed the idea of implementing a small-scale system for collection of used oil in order to be used as raw material, in a local plant, for biodiesel production.

The annual production of domestic used oil is about 4 litres per person. It means that the Region of Murcia citizens dump to their waste pipes 450.000 litres of used oil per year.

The domestic use of vegetable oils, made from olive, sunflower or soybean, produces a very pollutant urban waste which, normally, after oils use, is dumped to drains. The disposal of oils in waste water treatments plants is very difficult, and it causes an increase in the cost of the process. Moreover, in case of lack of total treatment of the oils, it can cause contamination of surface water, environmental degradation and the proliferation of health harmful micro-organisms. Another important inconvenience of dumping used oils in waste pipes, is the missing of opportunity to use it for energetic purposes or other applications in agriculture or industrial sector.



Short Description of Pilot Project

A special funnel has been designed to make easy filling up a bottle with used oil. This funnel has got a screw to adapt it on the top of a standard plastic bottle for drinks, preferably carbonated drink bottles. Thus, we transform a bottle that has finished its useful life, in a wide rim recipient to put the used oil as we produce it. When the bottle is full of oil, we remove the funnel, put the top on and take the bottle to the closest oil bin. Approximately, 140.000 funnels has been distributed, accompanied with leaflets explaining how to use them.

Bins where to put the bottles with oil have been placed in several points in the Region of Murcia. There are more than 500 bins in total, with a capacity of 240 litres each one. Bins are placed in strategic points like supermarkets, neighbourhood associations, town halls, public buildings, schools.

Companies from the Association of Gathering, Treatment and Recycling of Oil (Asociación de Empresarios de Recogida, Tratamiento y Reciclaje de Aceite y Grasa, AERTA) collect the bottles deposited in the bins. Later, these companies give the bottles with oil to a final agent, which insert the bottles in a system that tears up the bottles, extracts oil and, finally, grinds up the plastic to recycling. The oil extracted will be used to produce cosmetic products and biodiesel.

Biodiesel will be obtained through the transesterification of triglycerides (oils). We can produce almost one litre of biodiesel from one litre of used domestic oil.

The project was facilitated by **ARGEM,** in the framework of BioNETT

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Biodiesel from Used Cooking Oil (UCO)

Pure Fuels Ltd - Biodiesel Production from Used Vegetable Oil

Project summary

Pure Fuels produces and supplies a 100% biodiesel, generated from used cooking oil. The company currently supplies six neighbouring companies (courier and haulage mainly), but is looking at extending its clientele (including local authorities).

Introduction

Based in an industrial estate in Enfield (North East London), Pure Fuels was established in 2006 and has started producing biodiesel since February 2007. The company collects used cooking oil (UCO) from restaurants and take away outlets across London and throughout Essex and Hertfordshire. Pure Fuels also buys UCO that has already been collected by fellow suppliers.

The biodiesel is produced using a transesterification process, whereby glycerine is separated from the used cooking oil by mixing alcohol and heating the substance to a high temperature.

Short Description of Pilot Project

Pure Fuels endeavours to be a reliable biodiesel supplier, to ensure a wider use of its fuel, to include businesses, Local Authorities and the public sector.

Generally, the used cooking oil can be any vegetable oil such as soybean, rapeseed , sunflower, peanut, corn, canolat.

The remit of Pure Fuels is to concentrate very much on the environmental impact which can be achieved through the production of biodiesel as opposed to that of mineral diesel. The vehicles which are used to collect the UCO are themselves run from 100% biodiesel generated from UCO which means there is very little environmental impact through transportation. Current UK legislation also states that UCO should not be poured down the drain, which means the collection of waste oil meets this requirement.

Pure Fuels has recently concluded a partnership with the Royal Borough of Kensington and Chelsea. The council has set up a free waste oil collection scheme for businesses. Green Miles Ltd the collection company who operates on behalf of Kensington and Chelsea provides empty barrels to businesses ready for collection. Following collection these are then provided to Pure Fuels for production.

Pure Fuels is encouraging other local authorities to start a similar service. It can benefit local authorities greatly as Pure Fuels is able to provide data on the amount of UCO supplied through the scheme. These figures can then be used by local authorities as part of their reporting process on CO_2 reduction and waste recylcing. Local authorities have the additional benefit of purchasing biodiesel from Pure Fuels at a discount rate as part of the service provided.

There is a fuel pump on site which means that clients can fill up straight from the production facility.

Pure Fuels has received advice and support from the BioNETT project through NELEEAC since the early stages of its creation. Pure Fuels management has received information about quality standard for biodiesel and by-products (glycerol in particular).

BioNETT networking activities such as thematic group meetings and workshops helped discussion with possible end-user (including local authority fleet managers) about the fuel quality concern and issues surrounding vehicle warranties.

Technical Data

Fuel: 100% biodiesel

Fuel Price in June 2008: 121 pence /lit

Quantity of biodiesel sold per week in June 2008: approximately 6.000 litres

The biodiesel can be mixed with a small percentage of mineral diesel by the end- users to avoid any engine problems with older vehicles.

The project was facilitated by **NELEEAC**, in the framework of BioNETT

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Biodiesel in Richmond Council fleet

Project summary

Richmond-upon-Thames Council has run a successful pilot project running 10 vehicles on a 100% biodiesel generated from used cooking oil during three months early in 2008. Convinced by this trial period, the transport fleet manager of the council plans to run the entire council fleet and subcontractors' vehicles, which will represent 300 vehicles in total, on 100% biodiesel generated from used cooking oil by the end of 2008.

Introduction

The London Borough of Richmond-upon-Thames is situated in South West London and covers an area of 5.095 ha. Richmond Council endeavors to be a very environmentally committed council and has already set up a few schemes in favour of sustainable transport (such as vehicles emissions related parking permits which gives residents free parking spaces if they use fuel efficient cars).

The fleet Manager of the Council has decided to make a further commitment to adopt 100% biodiesel for all Council vehicles and is tendering for a biodiesel local producer and supplier. It is expected that the fleet will start running entirely on biodiesel by the end of Summer 2008. Richmond will then become the first Local Authority in the UK to run its entire vehicle fleet on recycled cooking oil.

NELEEAC has established a contact with the fleet manager as part of the BioNETT networking activities, and has discussed biodiesel production technologies and barriers, including vehicle warranties. In the framework of BioNETT, useful information and examples of biofuels application in other project partners' countries were provided to the fleet Manager.

Short Description of Pilot Project

The objective of this pilot project is to run the entire Council fleet on biodiesel generated from used cooking oil. The feedstock collection and the production should be made local to avoid excessive transport from the oil collection points to the generating plant. This is to ensure that there is minimum environmental impact from the collection of biodiesel, thus keeping the benefit of the carbon savings of the initiative. The local collection of oil would also contribute to improve the waste recycling in the boroughs where it would take place (current legislation states that used oil should not be disposed down the drain).

The initial three-month trial with 100% biodiesel from used cooking oil was run from January to March 2008. Ten vehicles of all types and ages were selected for the trial. 8.500 litres of biodiesel was then transported from South Wales as the council had no local supplier certifying the fuel for this trial. The only technical problem encountered during this trial period is the fact that the fuel had become unusable at low temperatures (zero degree Celsius and below). This problem could be overcome by using additives in the fuel. Even though no engine problems were reported during the trial, Richmond council has its own garage facility which allows the fleet staff to repair vehicle damages without having to call on vehicle warranties from the manufacturers.

It is proposed that 300 vehicles in total (Council fleet and subcontractors vehicles such as waste collection trucks) will be run on 100% biodiesel.

In the long-term, Richmond transport fleet manager hopes that this project could set an example and be repeated in other boroughs in the country.

Current status of the project

The Council has tendered for the biodiesel supply.

Technical Data

Fuel: 100% biodiesel generated from vegetable oil

Number of vehicles in the fleet: 300 of various types (cars, vans, waste collection trucks)

Quantity of bio diesel needed per year to run the fleet: 750.000 litres

CO_2 savings estimated per year: 300 tonnes

Current status of the project: the Council has tendered for the biodiesel supply.

The project was facilitated by **NELEEAC**, in the framework of BioNETT

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Biogas in Ljungby town, Sweden

Project summary

The pilot project "Biogas in Ljungby town" deals with the installation of an upgrading system and a gas filling station for cars in the town of Ljungby.

The waste water sewage treatment plant is producing raw biogas which will be upgraded into biomethane for vehicle use.

The present gas production corresponds to 200.000 litres of diesel per year (2 GWh). That is biofuel for 150 cars.

The town of Ljungby with 18.000 inhabitants is located in the western part of Kronoberg County in the south of Sweden.

"Biogas in Ljungby town" has been facilitated by the Energy Agency for Southeast Sweden, in the framework of BioNETT Project.

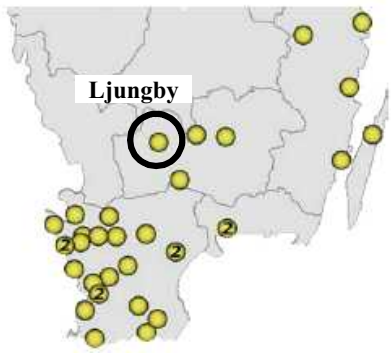
Introduction

The town of Ljungby with 18.000 inhabitants is located in the western part of Kronoberg County in the south of Sweden.

The project started when the Energy Agency for Southeast Sweden contacted the municipality of Ljungby to investigate if there was a potential of producing biofuels for cars. The municipal wastewater sewage treatment plant in Ljungby has been producing biogas for heating for several years. Today there is a surplus of gas that is not used and fired in vain in a torch.

Was there a better way of using the biogas?

Besides, there is a district heating grid in the town supplied by a Combined Heat and Power plant fuelled by waste and woodchips. A change of heating system in the waste water sewage treatment plant from biogas to district heating would release the biogas for automotive use.



Furthermore, an added value in this project will be an increased production of renewable electricity from the Combined Heat and Power plant as the waste water treatment plant will increase the heat load in the CHP.

Thus the Ljungby project has high system efficiency!

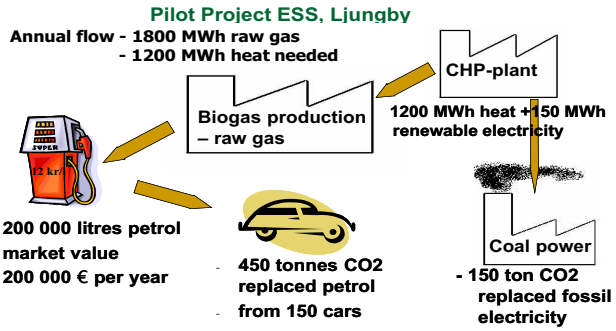


Fig. A schematic view of releasing biogas for automotive biofuel and supplying the waste water treatment plant with district heating in the town of Ljungby.

Description of Pilot Project

In January 2006 the Ljungby Municipality started to count on the gas volumes in the waste water treatment plant and started calculating the economy.

In February 2008 a consultant had finished the pre-study and the conclusion was to continue with a gas upgrading plant in connection with the gas storage and filling station close to the waste water sewage treatment plant. There were more studies needed regarding an increased production of the raw gas and also keeping down nitrogen emissions in the waste water treatment process.

By July in 2008 the consult work was in progress investigating how to increase the raw gas production.

Received budget tenders showed that the most likely solution for the upgrade plant is a performing contract and for the gas filling station total contract.

Investment required for the biogas upgrading plant, storage and gas filling station is estimated to €1,3 M.

The present gas production corresponds to 200 000 litres of diesel per year (2 GWh). That is biofuel for 150 cars.

In a second stage, when the gas station is in place and running, in order to increase the production of biogas even more, there are plans for an investment in a new digest chamber supplied with agriculture substrate from farmers in the neighbourhood.

Energikontor Sydost
Energy Agency for Southeast Sweden
The project was facilitated by **ESS**, in the framework of BioNETT

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Biogas in the city of Kalmar, Sweden

Project summary

The pilot project "Biogas in the city of Kalmar" deals with the installation of an upgrading system and a gas filling station for buses and cars in the city of Kalmar.

Raw biogas from the wastewater sewage treatment plant is sold to Kalmar Biogas Ltd that upgrades it into biomethane for vehicle use. Eon Gas Ltd distributes the biomethane for the vehicles. In August 2008, 15 buses in the local public transport will be supplied with biogas. There is present gas potential for the 15 buses and another 300 cars, which means that the total amount energy in the biogas corresponds to 1.200.000 litres of diesel per year (12 GWh).

The city of Kalmar with 60.000 inhabitants is located by the east coast is the regional centre in the County of Kalmar in the southeast of Sweden.

"Biogas in the city of Kalmar" has been facilitated by the Energy Agency for Southeast Sweden, in the framework of BioNETT Project.

Introduction

The city of Kalmar with 60.000 inhabitants is located by the east coast and is the regional centre in the County of Kalmar in the southeast of Sweden.

The wastewater sewage treatment plant company Kalmar Water Ltd has been producing a lot of biogas for several years, mostly used for heating. There has also been a small production of biomethane for gas cars since some years, not so much used, though.

To secure the investment of a new bigger upgrading plant, Kalmar Water needed a buyer of the gas. Meanwhile, to get a better air quality in the city of Kalmar, increase the use of renewable fuels, reduce their dependency on oil and reduce fossil CO_2 emissions, the public transport company, KLT, wanted to drive their buses on biogas. KLT called for a tender on new buses in which the biogas buses won.

That was the start of the project.

Short Description of Pilot Project

In June 2007 Kalmar Biogas Ltd called for a tender of an upgrading plant. By the end of 2007 the tender was settled and an upgrading plant with a gas cleaning capacity of 200 m^3 per hour was ordered. That is corresponding to 1.200.000 litres diesel per year and biofuel enough for 15 city buses and approximately 300 cars (12 GWh).

In August 2008 the local buses will be supplied from a gas filling station provided by Eon Gas Ltd and meanwhile the present old public filling gas station will be modernized and moved to a more public and available site.

Fuel price in July 2008 is €0,83/lit petrol equivalent + VAT (25%) = €1,04 /lit

(Present petrol price in Sweden in the beginning of July is €1,20/lit)

Investment required for the biogas upgrading plant: €0,9 M.

Energikontor Sydost
Energy Agency for Southeast Sweden

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Biogas in WWTP's fleet, in Murcia

Project summary

EMUASA is the company charged of the waste water treatment in Murcia. The biogas produced from the anaerobic digestors has been used as fuel on Otto engines, to produce electricity locally. Aim of this project has been to prepare this biogas to be used as a fuel in cars. The car used is a flexifuel one, able to run both by using gasoline or this biogas, properly converted into methane. The biogas pilot plant has a biomethane production capacity of 10 m^3/h (50.000 m^3/year), enough to meet the fuel needs of 4 vehicles.

Introduction

EMUASA has developed the AMEB process. With this process one can get fuel for vehicles from the biogas produced in the wastewater treatment plant. The fuel produced is called BioEDAR. The pilot project has been implemented at Murcia-East plant of domestic water treatment, which has a capacity of 100.000 m^3/day.

The use of biogas as vehicle fuel aims to protect the environment, by using energy more efficiently, reducing the consumption of fossil fuels and avoiding pollutant emissions. Moreover, it encourages reduction and recycling of waste water.

People from EMUASA have attended the training sessions organized by ARGEM in the framework of BioNETT Project. Moreover, ARGEM, based on its experience in biofuels sector and the experience of other BioNETT partners, provided assistance and technical support to EMUASA to develop the pilot project.

Short Description of Pilot Project

The AMEB process has four stages:

1st stage: At this stage the concentration of some of biogas compounds is eliminated in order to obtain a pure draught of methane and carbon dioxide. In the following table, the inflow and outflow compound'concentrations are illustrated:

Compound	Concentration at 1st phase inflow	Concentration at 1st phase outflow	Units
Methane(CH_4)	59,60	60	%
Carbon dioxide (CO_2)	39,10	39,8	%
Relative humidity	100	20	%
Hidrogen sulphide (H_2S)	4.500	< 1	ppm
Sulphur compounds	1,82	< 0,1	ppm
Nitrogen compounds	9.000	< 1	ppm
Volatile organic compounds (VOC's)	312	< 1	ppm
Benzene, Toluene, Xylene (BTX)	3,35	< 0,5	ppm
Siloxanes	8,74	< 0,5	mg/m^3

2nd stage: At this stage separation of methane from carbon dioxide takes place. The biogas from phase 1 passes through an absorption system, where the carbon dioxide is retained (absorbed), and the methane draught continues to become BioEDAR.

3rd stage: Carbon dioxide absorbed on stage 2 is recovered to feed the plant's system for fire extinguishing.

4th stage: The biogas treatment plant has a system for compression and storage of BioEDAR. This system is basically a multiple-stages compressor for raising biogas pressure, from 150 mbar to 300 bar. Then the BioEDAR is stored in a 23 bottles pack, of capacity 50 litres per bottle. This quantity is sufficient to fuel daily 4 vehicles, ensuring 420 km of mean autonomy for each.

The pilot plant has a biogas treatment capacity of 10 m^3/h, 6 m^3/h of which are methane. That is 4.320 m^3/month, corresponding to an energetic contribution of about 9.504 kWh/month.

The project was facilitated by **ARGEM,** in the framework of BioNETT

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Legend:

Reference number format: FUEL-YEAR-NUMBER: All-Biofuels, BioD-Biodiesel, BioE-Bioethanol, BioG-Biogas)

Topic: policy, production, vehicle issues, economics, environment, project, all

Number in index: 84

Reference Number	Topic	Title/description/URL	Author and/or organisation	Year
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All-2001-002	Policy	Communication on alternative fuels for road transport and on a set of measures to promote the use of biofuels, EC Communication COM(2001) 547	European Commission	2001
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