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IEA
Advanced Motor Fuels

Annual Report 2009

Contents

These electronic attachments and other updated information on IEA/AMF is found on

a) www.iea-amf.vtt.fi **b) www.iea.org/impag**

February 2010

To IEA

IEA Advanced Motor Fuels

Annual Report 2009

The IEA Committee for Research and Development (CERT) has recommended that an Annual Report shall be submitted by each of the IEA Agreements on Research, Development and Demonstration Co-operation.

This document contains the Annual Report 2009 of the Executive Committee of the IEA Advanced Motor Fuels Agreement.

The contributions from the Operating Agents to this report are gratefully acknowledged.

On behalf of the Executive Committee

Nils-Olof Nylund
Chairman

Claës Pilo
Secretary

Preface

The period 2008 – 2009 has been a good one for the IEA Implementing Agreement on Advanced Motor Fuels (AMF). In 2008, the AMF attracted three new member countries, Austria, People's Republic of China and Thailand. The good drive continued in 2009 when Australia and Germany joined. Participation is now 16 countries from all over the world.

The past period (2005 – 2009) of AMF expired 31st of August 2009. Work to prepare a new strategic plan for 2009 – 2014 and summarizing the 2005 – 2008 activities began in early 2008. In December 2008, the draft Strategic Plan was approved by AMF's Executive Committee. After some minor adjustments it was submitted to the IEA in early 2009. The End-of-Term Report and the new Strategic Plan were presented to the End-Use Working Party (EUWP) on the 31st of March 2009 and to the Committee on Energy Research and Technology (CERT) on the 9th of June 2009. At its June meeting CERT approved the extension of AMF for the period from the 1st of September 2009 to 31st of August 2014. Dr. Ralph McGill was highly instrumental in producing documentation required for the process.

For the new term, the vision of AMF has been formulated as follows:

To contribute to sustainable solutions through our system view of the entire fuel chain from resource development to end-use. Our cooperative research in the field of transport fuels helps to facilitate the widespread use of sustainable fuels of high quality.

The mission statement is:

AMF is one of the key players in the promotion of international collaboration in R&D, deployment and dissemination of clean, energy-efficient and sustainable fuels and related vehicle technology. It will continue to provide a fuel neutral platform for co-operative R&D, deployment and dissemination, make use of the multifaceted expertise of its partners and networks, and provide a respected clearinghouse for information facilitating the wide spread deployment of technologies for sustainable transport. We foresee increased need for cooperation and collaboration with other transport-related Implementing Agreements, such as Bioenergy, HEV, and Combustion. Together with new AMF member countries we are able to address a more diverse set of challenges in technology and local conditions. We also work actively for energy conservation in transport.

We have defined three main objectives:

Objective 1 (Information, Dissemination and Membership): To gather, evaluate and disseminate information on advanced motor fuels and to act as a clearing-house on related information. Provide an easy-access platform for interested parties to become member of AMF.

Objective 2 (Cooperative R&D): To create, maintain and make use of networks among partners involved in research, development, and demonstration related to advanced motor fuels

Objective 3 (Markets and Deployment): To encourage large-scale market deployment of advanced motor fuels by contributing to the identification of technical and economic barriers and by providing solid data to decision makers.

The objectives reflect the need to represent the interests of all of our members in our activities, recognizing the varying needs between the different regions of the world represented in the AMF. We are delighted to have counties such as the People's Republic of China and Thailand aboard our Agreement.

Six running Annexes were carried over to the new phase. In 2009, as a part of the constant renewing process of the Agreement, two new Annexes, "Environmental Impact of Biodiesel Vehicles" and "Enhanced Emission Performance and Fuel Efficiency for HD Methane Engines", were started. Two ExCo meetings were held in 2009, one in Helsinki, Finland in May 2009 and one in Bangkok, Thailand in November 2009. Technical tours to energy and fuel related targets were included.

Renewable energy in transport received much attention in 2009. Hope is put in biofuels as well as in electric vehicles. Biofuels can be implemented for the existing vehicle fleet, whereas for electricity one has to renew the vehicle fleet with fundamentally different vehicles.

In 2008, crude oil peaked at some $150 per barrel. In the beginning of 2009, as a result of the economic recession, the crude price was at around $40 per barrel, but rose steadily through the year ending at some $80 per barrel. Large fluctuations in the oil price make life hard for those who are considering investments in alternative fuels. On the world level, the total share of alternative fuels in road transport is some 5 %. Half of that is from fossil sources (mainly natural gas and LPG) and the other half is biofuels, very much dominated by ethanol.

In Europe, the Directive on the promotion of the use of energy from renewable sources (2009/28/EC) was finally approved in April 2009. The Directive calls for a 10 % share (mandatory) of renewable energy in transport in 2020. This renewable energy can be either biofuels or renewable green electricity. The Directive also defines sustainability criteria for biofuels, although it is obvious that more work is needed in this field. Indirect land use changes, among other things, are a hot topic.

The Directive on renewable energy was accompanied by an update (2009/30/EC) of the fuels quality Directive. Now the blending of 10 % (vol.) of ethanol into gasoline and 7 % (vol.) of

conventional biodiesel (FAME) into diesel is allowed. The fuels quality Directive specifically states that the 7 % limit does not apply to other biofuel components for diesel, such as pure diesel-like hydrocarbons made from biomass using the Fischer-Tropsch process or hydro-treated vegetable oil, thus, in a way, calling for the development of advanced biofuels.

In the U.S., the new administration in putting more emphasis on energy and climate related issues. Relevant for AMF are, e.g., targets for energy savings, greenhouse gas emission reductions and enhanced energy security. The new policy also gives more emphasis on basic research, thus enabling research of next generation biomass-derived transportation fuels and fuels for advanced combustion regimes.

We sincerely believe that AMF has a role to play in shifting transport towards sustainability. Our vehicle, AMF, is in good shape and running well. We foresee increased cooperation with IEA's other transport related Implementing Agreements, and we hope that our AMF Agreement continues to attract new member countries.

Mr. Jean-Francois Gagné and Mr. Kazunori Nagai are due thanks for their able assistance as vice-chairmen. Thanks are due also to Dr. Claës Pilo for his diligent work as secretary for the committee.

Dr. Nils-Olof Nylund

Chairman of the Executive Committee
Implementing Agreement on Advanced Motor Fuels

1. International Situation – National Reports

1.1 Country Report Austria

(Prepared by A3PS)

Regarding the Austrian transport and energy sector, two important initiatives were launched in 2009: the Energiestrategie Österreich (Austrian Energy Strategy) and the Nationaler Einführungsplan Elektromobilität (National introduction plan for electromobility).

Energiestrategie

This is a joint initiative from the Federal Ministry of Economy, Family and Youth and the Federal Ministry of Agriculture, Forestry, Environment and Water Management. The goal is to prepare within specific working groups that involve relevant stakeholders from the government (national and local), industry and companies active in the energy sector, NGOs and social partners a series of measures in order to reach the goals set by the European Union. The process should be finalised by the end of 2009 and the target sectors are: mobility, households (this sector does not include heating services), services, agricultural activities, energy-intensive industries such as steel and chemical companies and buildings (heating and cooling services).

A working group included in the mobility sector addressed the topic of alternative fuels and propulsion systems. The target foreseen is a reduction of energy consumption for transport of 5% to the level of 2005 by 2020 from 385 to 366 PJ (source: http://www.energiestrategie.at).

Enführungsplan Elektromobilität

The introduction plan for electromobility is being prepared in a first instance by the Ministry for Transport, Innovation and Technology by three working groups: technology, infrastructure/transport planning and logistics. In a following phase, stakeholders from industry, research and local governments will join the process.

New RD&D programmes

The Lighthouse Projects Initiative was launched at the beginning of 2009; this funding programme for demonstration of new technologies for transport will cover the following areas in 2010:

- battery electric vehicles
- hybrid vehicles
    - plug-in hybrid vehicles
    - hybrid vehicles with optimised ICE or other range extenders such as fuel cells
    - fuels from renewable sources

The possibility of joint projects with international partners was also included for calls within this programme.

A new call within "Neue Energien 2020" programme funded by the Climate and Energy Fund was introduced in 2009; this call covers among other areas, R&D projects for optimisation of ICEs and production of biogenous fuels (source: www.e2050.at).

The increase of funding budget for RD&D for the transport sector of up to 50 % (from 40 to 60 million €) for 2009 and 2010 is another important development in 2009.

Status of different transport fuels in 2008– distribution between transport modes

The transport sector has the highest share of final energy consumption; the corresponding distribution for 2008 was 33,7 % for transport followed by industry (28,6%), private households (25%) and public and private services (10,4%).

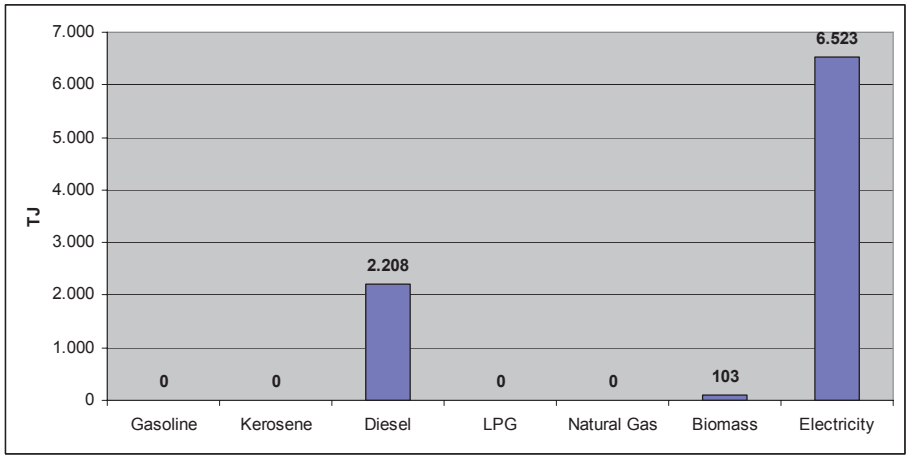


Fig. 1: energy consumption in TJ for different fuels from a total of 8.841 TJ – **railways** (source: Statistik Austria)

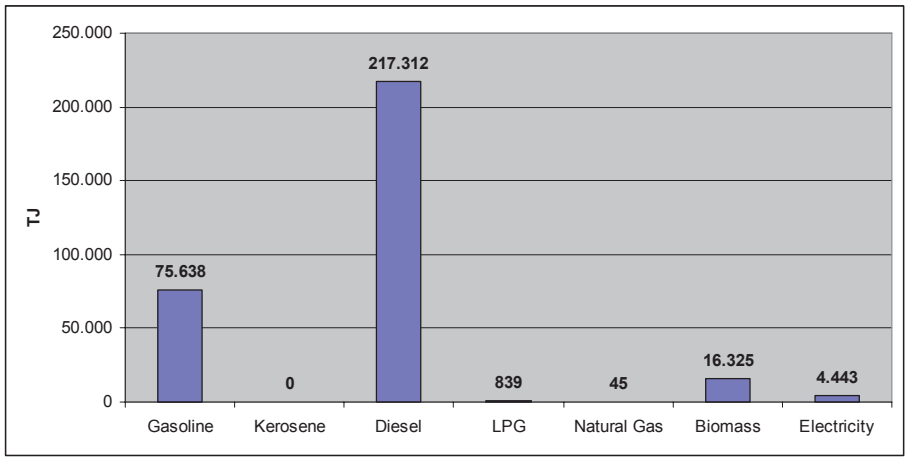


Fig. 2: energy consumption in TJ for different fuels from a total of 314.602 TJ – **other surface means of transportation** (source: Statistik Austria)

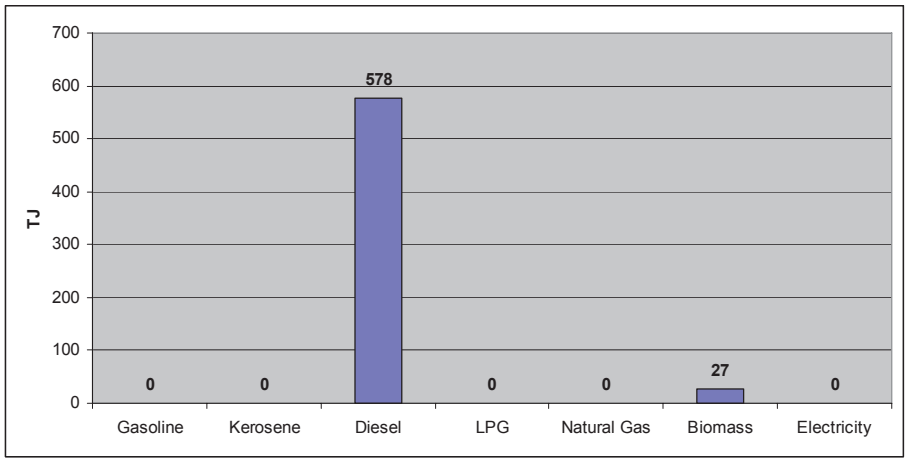


Fig. 3: energy consumption in TJ for different fuels from a total of 605 TJ – **inland waterways** (source: Statistik Austria)

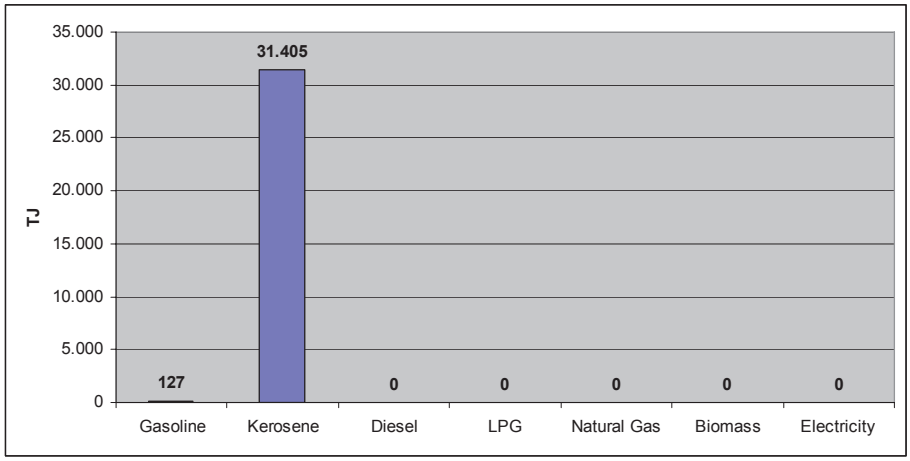


Fig. 4: energy consumption in TJ for different fuels from a total of 605 TJ – **air traffic** (source: Statistik Austria)

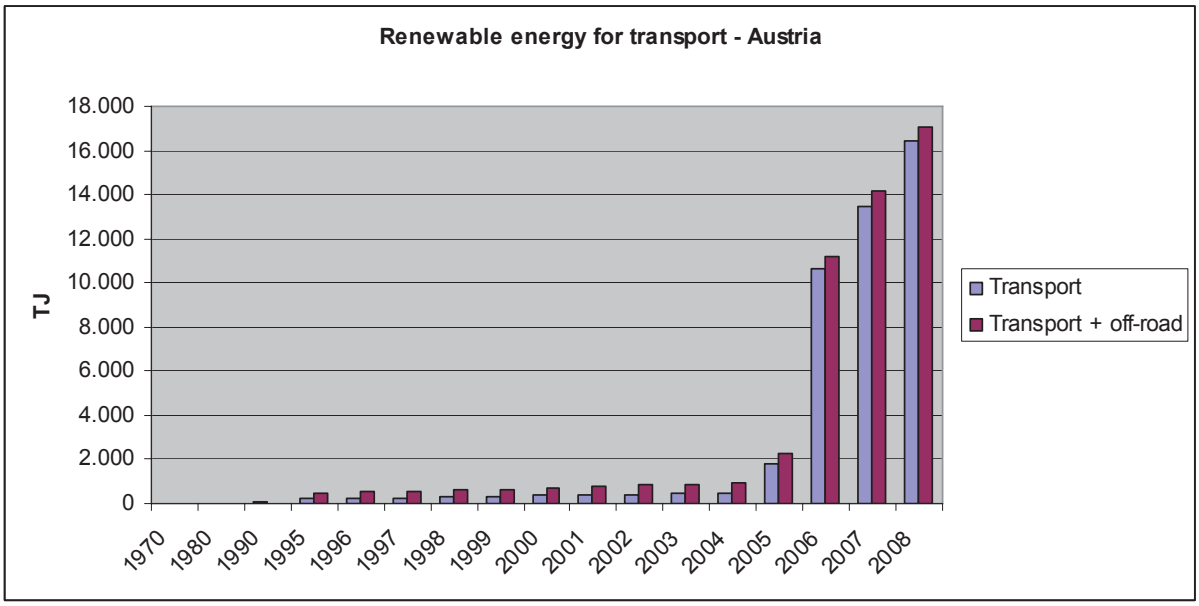


Fig. 5: 1970 – 2008 consumption of renewable energy for transport in TJ (source: Statistik Austria)

Table 1: LDVs fleet data - status November 2009 (source: Statistik Austria)

Fuel/drive	Total LDVs 2008	New LDVs registrations 2009
Gasoline	1.957.751	162.197
Diesel	2.323.016	136.267
Electric	146	33
LPG	1	-
CNG	846	265
Bivalent Gasoline/LPG	32	3
Bivalent Gasoline/CNG	535	219
Hybrid Gasoline/Electric	2.592	997
Total	**4.284.919**	**299.981**

Table 2: filling stations for alternative fuels

Fuel	Filling stations
CNG	160
Biogas	1
E85 (SuperEthanol)	22
Vegetable Oil	20

Status biofuels

Since October 2008, 5,75% of total energy consumption for transport in Austria should be supplied by biofuels (biodiesel, bioethanol, vegetable oil a.o.) following the EU Biofuels Directive. To reach this share, oil companies increased the share of biodiesel from 5% to 7% (B7) starting from February 2009 on. This measure should bring a reduction of 1,5 million tons of CO_2 per year (source: Wirtschaftskammer Österreich) and it does not require adaptations in the vehicles.

Bioethanol is mixed nationwide in a concentration of 4,7% (volumetric) in super and normal gasoline. A further increase of concentration to 10% as introduced in Germany is not yet planned.

Biofuels in pure form and E85 are currently exempted from fuel taxes.

Table 3: status GHG emissions from transport sector (in 1000 ton CO_2 equivalent)

	2007	**% change 1990-2007**	**Share of total GHG emissions (%)**
Road transport	23.456	+ 73	26,7
Commercial vehicles (light and heavy duty)	10.106	+ 138	11,5
Passenger vehicles (including buses and motorcycles)	13.350	+ 44	15,2
Other ways of transportation including waterways and railways	739	+ 48	0,8
National air traffic	75	+ 131	0,1

The transport sector in Austria shows the highest gap over the goals for emissions of the European Climate Strategy (5,4 million tons over the target value in 2007). A critical factor for this development is the export of fuels (share of fuels sold within Austria and consumed abroad) which contributed to 7,2 million tons out of a total of 24,3 million tons in 2007. This is determined among other factors by the price difference of fuels with the neighbour countries, the condition of Austria as an interior transit country and an economy with a high share of exports. Relevant measures are therefore necessary to reduce the share of fuels exports.

Modification of NoVA (Normverbrauchsabgabe)

Starting from July 2008, a new bonus-malus system was introduced for the taxation on the acquisition of new vehicles (NoVA). A reduction of 300 € is applied for vehicles with CO_2 emissions lower that 120 g/km. For vehicles with CO_2 emissions higher than 180 g/km, the increase in the taxation is determined as 25 € per g/km over this limit in the period from 1st of July 2008 to 31st of December 2009. Starting from January 2010, the limit is reduced to 160 g CO_2/km.

Regarding NOx emissions, gasoline vehicles with a maximum of 60 mg/km as well as diesel vehicles with a maximum of 80 mg/km and particle emissions not higher that 0,005 g/km, receive a tax reduction of maximum 200 €.

Vehicles running on alternative fuels such as E 85, CNG and LPG among others or hybrid vehicles, obtain a reduction of maximum 500 €. This measure is planned until the end of August 2012.

The impact of this measure is not expected to be high; a reduction of GHG emissions of 0,01 million tons CO_2 equivalent/year is estimated (source: http://www.parlament .gv.at/PG/PR/JAHR_2008/PK0056/PK0056.shtml).

Further information on status of ethanol: see specific country report (status June 2009).

Further information for CNG, Biogas and Bio-SNG:

- www.erdgasautos.at
- http://www.gaswaerme.at/
- http://www.virtuellesbiogas.at/
- http://www.get.ac.at/Home.html (Güssing Energy Technologies - second generation biofuels)
- http://www.raiffeisen-leasing.at/tankstellen.html?&L=rzxpekllwpubntec (filling stations for alternative fuels)
- www.methapur.com (Biogas filling stations)

1.2 Country Report Canada

(Prepared by Natural Resources Canada's CanmetENERGY)

The convergence of several somewhat independent factors is introducing a complexity to the nature of transportation-related emissions that is unprecedented.

It is well documented that transportation is a major contributor to emissions of greenhouse gases (GHGs), criteria air contaminants (CACs) and other non-regulated emissions in Canada. The 2007 national emissions inventory (the latest available) indicates that transportation emissions account for the majority of CO (75% excluding natural sources) and NOX (53% excluding natural sources) emissions. They also contribute a significant portion of volatile organic compounds (VOC) and fine particulate matter (PM2.5) emissions. These emissions have very real costs to the Canadian economy in terms of environmental and health impacts. Health risk due to ingestion of airborne nanoparticles is seen as one of the most important issues facing Canadians. As a result, the federal government has identified improving air quality as a top priority.

This is also true for GHG emissions, where the transportation sector ranks second to industrial processes (including electrical power generation). According to Environment Canada's (EC's) 2007 Greenhouse Gas Inventory, the transportation sector is responsible for about 27% of the total. In the transportation sector, on-road vehicles (trucks and light-duty vehicles) constitute 68% of the total; while off-road vehicles produce 16%, and air, rail and marine combine for 10% of emissions with pipelines contributing 5%.

Meanwhile, there has been the influence of regulatory requirements, for example the decrease in sulphur content of on-road diesel fuels from 500ppm to 15ppm in 2006, and continued reduction in the limits of regulated emissions. At the same time, we have seen the introduction into the marketplace of ethanol blends of gasoline, increasing consumer interest in biodiesel blends, introduction of numerous vehicles with efficient gasoline direct injection engines, along with growing acceptance of gasoline-electric hybrid powertrains. These market and regulatory driven changes have resulted in a vastly more complex array of fuels and technologies being used in the transportation sector.

Canada along with many other developed and developing countries recognize that biofuels have potential economic and environmental benefits by increasing demand for commodities, creating alternatives to fossil fuels, creating new markets for agricultural products, and contributing to income generation for primary agricultural producers and rural areas more broadly. Although transportation is the largest single source of greenhouse gas emissions in Canada, the use of alternative fuels and new stricter regulations on existing fuels are helping Canadians achieve a more energy efficient and environmentally friendly future.

The Canadian Government has a four-pronged biofuels strategy to:

- Increasing the retail availability of renewable fuels through regulation
- Supporting the expansion of Canadian production of renewable fuels
- Assisting farmers to seize new opportunities in this sector; and
- Accelerating the commercialization of new technologies.

The Government of Canada's comprehensive strategy for renewable fuels includes provisions to increase the retail availability of renewable fuels through regulations that will require 5% renewable content based on the gasoline pool by 2010 and 2% renewable content in diesel and heating oil by 2012, upon successful demonstration of renewable diesel fuel use under the range of Canadian conditions. These new regulations will require enough renewable fuel to reduce greenhouse gas (GHG) emissions by about 4 megatonnes per year, the GHG equivalent of taking almost one million vehicles from the road. Some provinces have also set mandates and targets for renewable content in their gasoline and diesel pools.

Canada's biofuels strategy will provide economic and environmental benefits by supporting the production and use of alternatives to petroleum-based fuels. Canadian grain and oilseed farmers benefit from increased biofuels production in two ways. First, the general increase in grains and oilseed prices will clearly help the bottom line of Canada's grains and oilseeds producers. Additionally, there exists the opportunity to invest in biofuels facilities being built in their communities. These new plants will be a source of new employment and economic growth.

The Government of Canada recently announced an initiative to invest up to $1.5 billion over 9 years to boost domestic production of renewable fuels such as ethanol and biodiesel. A $200 million four-year program is ending on March 31, 2011 that provides repayable contributions of up to $25 million per project to help farmers overcome the challenges of raising the capital necessary for the construction or expansion of biofuel production facilities. Canada also allocated $500 million, available over eight years to invest with the private sector in establishing first-of-kind, large-scale facilities for the production of next-generation renewable fuels. Next-generation renewable fuels, produced from non-food feedstocks such as wheat straw, corn stover, wood residue and switchgrass, have the potential to generate even greater environmental benefits than traditional renewable fuels.

In addition to the market pull and as a result of the regulatory push there exists a complicated offering of engine designs and aftertreatment approaches that are either near or already in the early stages of commercial deployment in the Canadian market. In most cases, these new designs have been spawned by a challenge to reduce GHGs and regulated emissions, but very little is known about how these designs and systems will change the overall physical and chemical characteristics of vehicle emissions. This poses a significant unknown, particularly when Canadian climatological conditions might play a role in these systems failing or performing in unexpected ways. The resulting risks to humans and the environment are essentially not known***. It is essential that these uncertainties be reduced through the careful study of advanced technologies and their potential impacts on emissions and ultimately on the well-being of Canadians and the environment.***

One of Canada’s strategic R&D priorities centers around Clean Transportation Energy, to foster the development and use of cleaner sustainable transportation fuels and systems in order to improve the environment, reduce GHG and CAC emissions, and increase economic activity through development of domestic and export markets. This is accomplished through Clean Transportation Systems R&D to develop, implement, maintain and reinforce the research, development and demonstration activities for advanced vehicle technologies, including hydrogen fuel cells, plug-in hybrid electric vehicles, emission reduction technologies, advanced fuels and materials. Of specific relevance to AMF is the work on advanced fuels and technologies for emissions reduction, which aims at conducting R&D to develop knowledge and technology relating to advanced transportation fuels transportation fuels, engine designs, aftertreatment technologies, and human health effects in order to reduce

emissions of GHGs and pollutants harmful to human health and the environment from the transportation sector, though four overarching research themes:

- the impact of advanced fuels on emissions and on combustion and control technologies
- the influence of engine designs in the production of pollutant emissions
- the effects of engine hardware and aftertreatment technologies in reducing pollutant emissions
- the human health and environmental impacts of transportation-related fuels and emissions

These themes can be captured in the following four questions, which serve to guide individual research projects:

1. How can advanced fuels influence emissions and engine design?
2. How can internal combustion engine designs affect emissions?
3. How can emissions be reduced through the use of engine hardware including aftertreatment devices?
4. What are the health and environmental risks associated with transportation-related fuels and emissions?

Priority research areas include:

- investigation of the impact of fuel composition, particularly biodiesel blends and oil sands derived fuels, on fuel efficiency and emissions
- investigation of the impact of advanced combustion technologies on fuel efficiency and emissions and on potential advanced powertrain applications, particularly highly efficient clean combustion (HECC)
- investigation of the impact of engine hardware and aftertreatment devices on fuel efficiency and emissions, particularly closed loop control sensors, diesel particulate filters (DPFs) and selective catalytic reduction (SCR) devices
- investigation of the human health impacts, particularly the toxicity and mutagenicity, of advanced transportation fuels and emissions products

1.3 Country Report Finland

(Prepared by VTT)

General

As a member of the European Union, Finland has to follow the regulations and targets for energy and emissions set by the EU. For Finland, the new Directive 2009/28/EC on the promotion of the use of energy from renewable sources sets a national overall target of 38 % energy from renewable sources in gross final consumption of energy in 2020. This is the second highest target for renewable energy, only surpassed by the target of 49 % for Sweden. In Finland, the share of renewable energy was 28.5 % in 2005. The share of renewable energy is high because the pulp and paper industry uses process side streams for power and heat generation. Thus biorefineries integrated into the pulp and paper industry are of particular interest in Finland.

In 2009, two briefings on energy and climate change have been presented. The Ministry of Transport and Communications presented its 2020 climate policy for the transport sector in March 2009. It assumes that biofuels will yield a 10 % reduction in greenhouse gas emissions by 2020, and states that the most efficient measure to cut GHG emissions is the renewal of the passenger car fleet with fuel-efficient vehicles. The Government presented its long term (2050) energy and climate policy in October 2009. Not surprisingly, this calls for energy efficiency, biofuels and electrification of transport. A numeral target for the average CO_2-emissions of the passenger is presented, 20-30 g/km in 2050.

Biofuels

Unlike several other countries within the EU, Finland has not implemented extensive tax incentives to promote biofuels for transport. Since 2007, there is a national law requiring fuel distributors to provide biofuels. The obligation is flexible (for regions, season, concentrations etc.), and the fuel distributors can decide how they best fulfill the targets. Distributors may transfer all or part of their obligation to another company. The original targets were 2 % in 2008, 4 % in 2009 and 5.75 % in 2010 (the latter target in congruence with the Biofuels Directive). A mandate was deemed more cost effective than a system based on incentives.

Now a proposal to freeze the target to 4 % in 2010 has been passed by the Government to the Parliament. The rational for this is that the European standard for petrol EN228 has not yet been modified to accommodate 10 % ethanol, the national legislation is not ready for E10 and the sustainability criteria for biofuels have not been fully set on the EU level. Biofuel levels for the years 2011 – 2020 will be decided upon in 2010.

However, the Finnish government is committed to the implementation of biofuels, and has publicly stated that it wants to achieve the mandatory EU target of 10 % renewable energy in transport by 2020 in advance. The statement is that Finland is targeting 10 % renewable energy in transport already in 2015 and 20 % by 2020. This would require the use of waste and residue based biofuels, eligible for “double counting” as defined in Directive 2009/28/EC.

As a means of stimulating next generation biofuels, special funds have been made available to stimulate research and demonstration of next generation biofuels. Biofuels are also part of the

national research programme BioRefine, financed by the Tekes, the Finnish Funding Agency for Technology and Innovation. Within this framework, the pulp and paper company Stora Enso, the national oil company Neste Oil and VTT Technical Research are cooperating to develop wood based BTL fuels. There are also other consortia on BTL fuels.

Neste Oil is producing renewable diesel (hydrotreated vegetable oil NExBTL) in two units at its Porvoo refinery close to Helsinki. Capacity is 170,000 + 170,000 t/a, which is close to 20 % of the current use of diesel fuel in Finland.

The energy company St1 is focusing on de-centralised production of fuel ethanol. Currently five decentralized ethanol units are up and running. The production capacity is 750-2000 t/a per unit, and the total production in 2009 is some 5000 t. Start-up has been with side streams from the food industry, and the company is aiming to broaden the feedstock to separately collected biowaste, municipal solid waste and later on also with straw. The target for 2014 is to produce 300 000 m^3 ethanol per annum. St1 also has invested in a dehydration facility with a capacity of 88 000 m^3/a. While building up local production of ethanol, St1 is importing hydrous ethanol and dehydrate it for blending into petrol.

Since the spring of 2009 St1 is selling a modified a high concentration ethanol fuel under the brandname Refuel RE85 at six refueling stations in the greater Helsinki area. The hydrocarbon part of the RE85 is not regular petrol, but a mix of special hydrocarbons and oxygenates, targeted at delivering good performance also at low ambient temperature.

Vehicle numbers and fuel volumes

At the end of 2008 the vehicle population in Finland was as follows:

- passenger cars 2 682 831
- vans 315 275
- trucks 105 106
- buses 12 230
- speciality vehicles (heavy) 13 030

In 2008, in total 139 647 passenger cars were registered. The division by fuel was as follows:

- petrol 70 300
- diesel 69 298
- natural gas 26
- other 23

This means that diesel passenger cars have made a break-through also in Finland (see taxation), and that other technologies (other than petrol and diesel) are practically non-existent. The natural gas vehicle fleet in Finland consists of some 100 buses in the Helsinki region, less than 10 heavy CNG trucks and some 300 passenger cars and vans. Natural gas and biogas are exempted from other fuel taxes except a low basic tax on natural gas as of 1.1.2004.

In 2008, 1.76 Mt of petrol and 2.25 Mt of diesel fuel were used. The public statistics do not account for biofuels or natural gas in transport. According to Gasum, the national natural gas company, some 5.5 million Nm^3 (~ 4600 toe) of natural gas was used in vehicles in 2008.

With the 4 % obligation for biofuels, the amount of biofuels for 2009 will be some 160,000 toe. As ethanol currently is the cheapest biocomponent, the distributors try to maximize the ethanol concentration in petrol, up to 5 % (vol.) according to the current EN228 specification. However, this accounts for a maximum contribution of some 60,000 toe, meaning that some 100,000 toe biocomponents for diesel is needed.

Neste Oil is taking advantage with its high-quality hydrotreated renewable diesel, which can meet the European EN590 diesel fuel standard in concentrations up to around 30 % (vol.). For fulfilling its biofuels obligation, Neste Oil is marketing diesel with 10-20 % NexBTL under the name Green Diesel in southern Finland, thus optimizing the logistics for biocomponent dispensing. Some other competitors are blending in conventional esterified biodiesel (FAME).

Together with Helsinki City Transport, Helsinki Metropolitan Area Council and Proventia (a manufacturer of exhaust after-treatment equipment) Neste Oil is demonstrating the use of NExBTL in the bus fleet in greater Helsinki area. The field test now covers some 300 buses at four different bus operators. Test fuels are a 30 % blend of NExBTL and neat (100 %) NExBTL. Especially in the latter case, significant reductions of both regulated and unregulated exhaust emissions have been demonstrated. Paraffinic diesel fuel, including hydrotreated vegetable oil, is now covered by a pre-standard, a so-called Workshop Agreement (CWA 15940), by CEN, the European organization for standardization. This document is specifically drafted to enable the use of clean-burning paraffinic diesel fuel in dedicated diesel vehicle fleets such as city buses.

High concentration ethanol and FFV cars were introduced to the Finnish market in the spring 2009, at the same time when St1 launched their RE85 ethanol fuel on the market. Vehicle importers like Ford, GM (Saab) and Volvo are now actively promoting FFVs. The vehicle registration system does not account for FFVs, but the number of FFVs at the end of 2009 should be in the range of 500 – 1000 units.

Taxation

The taxation system is being reworked. The purchase tax for passenger cars is linked to CO_2-emissions as of 1.1.2008. Minimum tax is 12.2 % (60 g CO_2/km or less) and maximum 48.8 % (360 g CO_2/km or more). Starting 2011 also the annual vehicle tax will be linked to CO_2-emisions, the range being 20-600 €/a (CO_2 66-400 g/km).

The CO_2-based purchase tax has been an effective instrument in reducing the CO_2-emission of new passenger cars. Figure 1 shows the average CO_2-emissions of new passenger cars. Due to the change in taxation, the average value dropped from some 180 g/km in 2007 to 163 g/km in 2008. The reform also has meant a boom for diesel cars, as fuel-efficient diesels benefit from the new system.

A reform of fuel taxes is also under way. The current system is based in fixed volumetric taxes, 0,63 €/l for petrol and ethanol and 0,36 €/l for diesel and biodiesel. The system is unfair for biofuels, and especially for ethanol with its low volumetric heating value. A clear distinction between an energy component and a carbon component is proposed. The energy component will be linked to the heating value of the fuel. Biofuels will be partially or wholly exempted from the carbon component tax, depending on their ability to reduce well-to-wheel greenhouse gas emissions. A bonus for low local emissions is proposed for paraffinic diesel fuel and methane. The new taxation scheme for fuels is scheduled to be commissioned in

2011. In the fuel tax reform, VTT Technical Research Centre of Finland is providing technical assistance to the Ministry of Finance.

Although Finland has not implemented large-scale tax intensives to promote biofuels, tax exemptions have been granted for demonstration projects. This is the case for the bus fleet demonstration with NExBTL as well as for the first stage of introducing high concentration ethanol for FFVs.

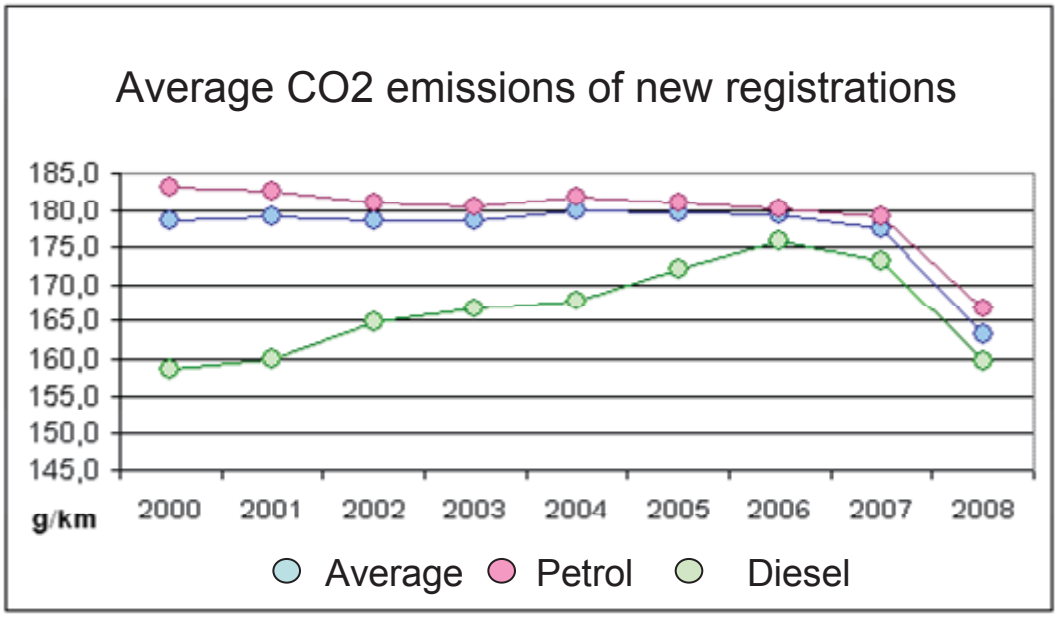


Figure 1. Development of average C

1.4 Country Report France

(Prepared by ADEME)

France, like the rest of the world, faces the twin challenges of climate change and excessive dependence on fossil fuels. Confronted with the necessity of reducing greenhouse gas emissions while also diversifying energy sources, biomass is a renewable energy resource that is particularly suitable for the production of liquid fuels on which the vast majority of passenger and goods transport vehicles are dependent, on land, on sea and in the air. Transport is responsible for close to one quarter of greenhouse gas emissions in France and in Europe. From 1990 to 2007 the transport sector registered the largest increase in GHG emissions. It is therefore vital to find ways to reduce these emissions.

In order to define the key points of public policy to reduce these emissions, the French government instigated the "Grenelle Environment Round Table". For the transportation sector, the "Grenelle Environment Round Table" is very ambitious with an objective to reduce average CO2 emissions per km from 170g to 130g in 2020 from total vehicle park .

Governmental incentives

The French government is therefore strongly engaged at reducing CO2 emissions from transportation. One of the most effective measures to reach this goal was the instigation of the bonus-malus. The bonus-malus consist of a financial reward (bonus) for purchasers of environmentally friendly new cars and a financial penalty (malus) for those buying cars emitting high levels of CO2. By setting-up the bonus/malus incentive, new vehicles average CO2 emissions per km reached 134 g mid-2009. More than half (55%) of new vehicles sold in the first semester of 2009 could benefit from this incentive (Only vehicles emitting less than 130 g of CO2 per km are eligible). This proportion has to be compared with the 44% reached at the same period in 2008. The sale of vehicles being taxed by the malus (vehicles emitting more than 160g of CO2 per km) felled below the 10% of the total vehicles sold. In 2009, the bonus-malus incentive is composed by:

- A bonus of
  - 5000 Euro for vehicles emitting less than 60g CO2/km
  - 1000 Euro for vehicles emitting less than 100g CO2/km
  - 700 Euro for vehicles emitting between 101 and 120g CO2/km
  - 200 Euro for vehicles emitting between 121 and 130g CO2/km
- A malus of
  - 200 Euro for vehicles emitting between 161 and 165g CO2/km
  - 750 Euro for vehicles emitting between 166 and 200g CO2/km
  - 1600 Euro for vehicles emitting between 201 and 250g CO2/km
  - 2600 Euro for vehicles emitting more than 250g CO2/km

Since the 1st January of 2009, the vehicles using E85 benefit from a 40% rebate on CO2 emissions to calculate the bonus-malus incentive.

LPG

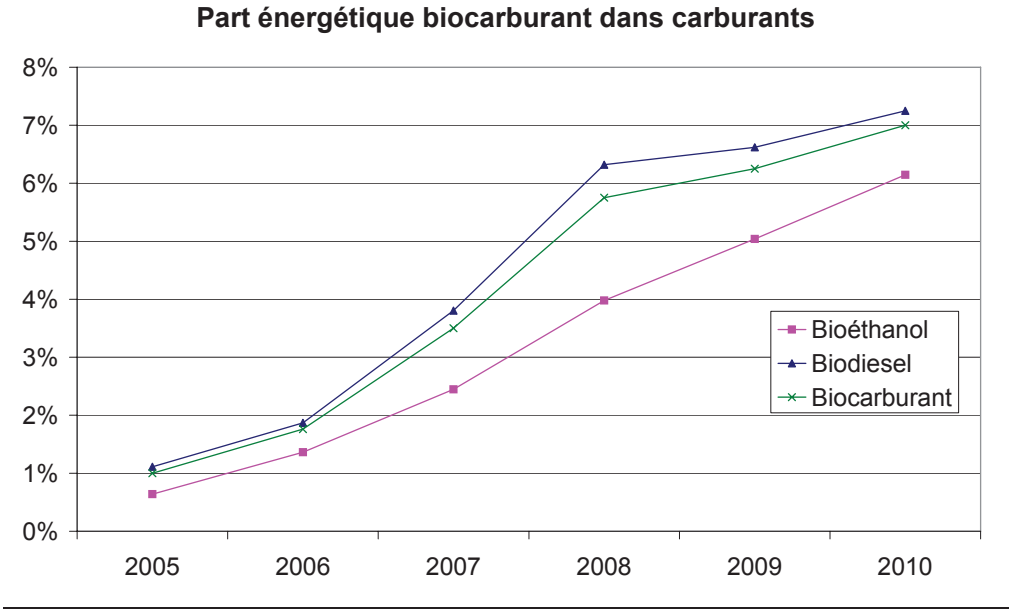
The environmental impact of LPG is known to be advantageous with a 10 to 15% CO2 emissions reduction compared to gasoline and equivalent HC but higher NOx and CO emissions. When compared to diesel, CO2 emissions from LPG are equivalent but there is a significant reduction in NOx and PM (when compared with diesel without a particulate filter) despite more CO and HC. In France, in 2009, the situation remains stable for the use of LPG.

Natural Gas

In France, there is an interest to use Natural Gas in buses and dump trucks applications for the noise reduction potential but the environmental well-to-wheel analysis is slightly in favour of Diesel. Despite an objective of increasing the number of stations to 300, only 1 additional station delivering natural gas has appeared in 2009.

Biofuels

First-and second-generation biofuels constitute a way to simultaneously reduce the sector's dependence on petroleum products and to reduce GHG emissions in the short and medium term, provided that these biofuels are sustainably produced. European directive 2003/30/EC sets the target of 5.75% biofuels in the motor fuels market by 2010 for European Union countries. The French transposition of this European directive, introduced by Prime Minister Jean-Pierre Raffarin and accelerated a few months later by Prime Minister Dominique de Villepin, sets target levels at 5.75% in 2008, 7% in 2010 and 10% in 2015, placing France among the leaders in Europe for biofuel use.
The graph below shows the proportion of biofuels (bioethanol and biodiesel).



Ethanol: In France, the mix ethanol-gasoline reached 75 to 85% of ethanol E85 in summer and 65 to 75% in winter due to cold start. There are more than 300 point of sales. Production capacity reaches 1.3M of cubic meter available for a consumption estimated at 865 000 cubic meter. However, the sale of flex-fuel vehicles in June 2009 cumulated 1209 (a 33% decrease compared to 2008).

Biodiesel: In France, the market of biodiesel for commercial vehicles is increasing. More and more commercial vehicles can accept up to 30% of Biodiesel.

R&D

Priority research demonstrators for new energy technologies have been identified in the French national energy research strategy and in the work of the operational committee for research under the "Grenelle de l'Environnement" summit. The most significant policy decided at the Grenelle summit is undoubtedly the Research Demonstrators Fund. This fund will provide support for testing technologies that are still in development, prior to the pre-industrial phase. The funding amounts to €400 million for the period 2009-2012. The first three Calls for Expressions of Interest under this mechanism target low-greenhouse-gas vehicles, 2nd-generation biofuels, and the geological capture, transport and storage of CO2.

2nd-generation biofuels

At present all biofuels are produced using so-called first-generation processes that exploit only plant storage organs. These processes limit the range of resources that can be exploited for biofuels, interfere with certain food supply chains, and have energy and environmental balances that could be considerably improved. With second-generation processes this feed would have to be obtained elsewhere, taking up other agricultural land. Accordingly research and development work has been started to pave the way for a progressive and sensible transition to so-called second-generation processes that use whole-plant resources to produce biofuels, thus ensuring greater complementarity rather than competition between the different uses of biomass, in particular in relation to the food supply chain, while reducing pressure on the environment. Two major projects funded under the ADEME research demonstrators funds can illustrate this effort:

- BioTfueL aiming at developping a complete industrial chain of processes to convert the lignocellulosic biomass thermochimically
- GAYA aiming at demonstrating at an industrial scale the technical, economical, environmental and societal viability of gaseous biofuels thermochemically produced

Low-greenhouse-gas vehicles

A very important plan for low-greenhouse-gas vehicles has been launched by the government to develop electric and hybrid vehicles. A number of research projects involving demonstrators (small urban vehicles, hybrids) has been funded in 2009, pertaining not only to passenger cars but also to light utility vehicles, which represent a significant share of the market, and therefore of fossil fuel consumption, CO2 emissions and negative impacts in cities, in developed countries as well as in emerging economies.

Globally about 1 Billion of euros should be mobilized up to 2012 for R&D actions including "Energy and engines for the future". In this respect, ADEME has been credited with a special fund (400 Millions of euros for 4 year period) in order to support projects of demonstration in the field of New Technology for Energy (NTE): Renewable energy, Buildings, Biofuels, Intelligent Networks, CCS, Sustainable transport vehicle...were eligible to this fund in 2009.

Other programs related to Biofuels

Other programs have also been initiated:

- Methodology for a better assessment of Environmental performances of biofuel financed and driven by ADEME/IFP/Public Authorities
- Research project financial support : this is the third very active pillow of the French Policy towards Alternative Fuels with three principal instruments :
    - ADEME through historical programme like AGRICE created in the 80's to finance Biofuel projects or its new system for research, demonstration and innovation supports (about 50 millions of euros per year).
    - "les pôles de compétitivité", regional structure.
    - ANR or National Research Agency: a public institution for the management of administrative issues created on January 01, 2007, and is a funding agency for research projects. The principal thematic for **Alternative fuel is the "Sustainable Energy & Environment"** which includes: Program PAN-H - National Action Plan on Hydrogen and Fuel Cells, program BIOENERGIES 2008, Program VTT or Road Transport Vehicle.

1.5 Country Report Japan

Prepared by the New Energy and Industrial Technology Development Organization (NEDO)
and the Organization for the Promotion of Low Emission Vehicles (LEVO)

This is the overview of the trend of alternative fuels for vehicles that are being promoted in Japan.

1. Natural Gas Vehicles

Natural Gas Vehicles (NGVs) have been defined as one of the clean energy vehicles in Japan. Total 37,117 NGVs have been practically used in end of May 2009. The breakdown is 15,507 passenger cars and light duty trucks, 20,155 medium duty trucks and garbage trucks, and 14,55 buses. In addition, Total 344 NGV stations have been operated.

2. Bio ethanol

The Petroleum Association of Japan aims to introduce the crude oil equivalent of 210,000 kL Ethyl-Tertiary–Butyl-Ether (ETBE) derived from bio-ethanol in FY2010. The Petroleum Association of Japan launched distribution demonstration projects for ETBE blended gasoline at 100 gas stations in 2008.

For the introduction of bio-ethanol, it is necessary to promote measures with due consideration to its effects and impacts by, for example, developing ethanol-production technologies using cellulosic raw materials, which do not compete with food production, in view of the effects of reducing emissions of lifecycle carbon dioxide, competition with food, and industrial competitiveness (development of ethanol-production technology). Furthermore, in order to ensure sustainable use of bio-ethanol as fuel, an economical production is vital. In a medium and long run, the cost of ethanol production must be reduced to level at which it can compete with gasoline. In order to proceed with developing innovative technologies toward the economically efficiently production and large amounts of bio-fuels from cellulosic biomass, Biomass Nippon Strategy promotion Council has promoted to formulate the Bio-fuel Technology innovation Plan. A production cost is 100 yen/L (about 1.1 USD/L) for an immediate target and 40 yen/L (about 0.44 USD/L) for a target with innovative technologies.

3. Bio-diesel

Bio-fuels other than bio-ethanol include bio-diesel fuel (fatty acid methyl ester) and Bio Hydrofined Diesel (BHD). The former, which is produced by waste cooking oil, is blended with diesel oil. The latter is obtained by hydrogenating vegetable oil to produce hydrocarbon oil similar to regular diesel oil, as the quality of bio-diesel fuel is unstable. BHD is called the “second-generation bio-fuel” just like cellulose-based ethanol. To solve the quality problems caused by blending bio-fuel with diesel fuel, the joint program between major petroleum companies and automotive companies has already started for developing BHD in Japan.

1.6 Country Report Spain

(Prepared by IDAE)

Alternative Vehicles and Fuel Stations

In the frame of the Action Plans 2005-2007 and 2008-2012 of the Spanish Energy Efficiency and Saving Strategy, IDAE is currently supporting in collaboration with Regional Governments, the acquisition of alternative vehicles (hybrid, electric, LPG, natural gas, hydrogen and fuel cell) and the implementation of charging points/fuel stations for each technology.

The financial support covers up to 15% of the market price of these vehicles and the 30% of the implementation costs of the charging points/fuel stations.

In this frame, there are established supporting lines for the acquisition of motorbikes, cars, and vans and also for trucks, buses and other fleet transport vehicles.

Current situation (December, 2009):

Alternative fuel	Current amount of Vehicles	Number of fuel stations
LPG Financial support (up to 2.000€ for cars and 12.000€ for trucks and buses) to the acquisition and transformation of industrial vehicles and cars/vans with a maximum CO2 emission of 160gCO2/km in 2009 and under 150gCO2/km in 2010.	Amount of vehicles: **3.500** (market of 40-50 new cars per month). Agreements has been signed between REPSOL and Town Councils of Madrid, Alicante and Málaga in order to acquire LGP vehicles for town fleets and for setting up LPG charging stations. Madrid will include benefits for LPG vehicles in case of new regulations (in study) related to access of vehicles to city centre.	CURRENT NUMBER OF FUEL STATIONS: 44 REPSOL: Commitment of 80 charging stations in Spain for 2010.
Natural Gas Financial support (up to 2.000€ for cars and 12.000€ for trucks and buses) to the acquisition of industrial vehicles and cars/vans with a maximum CO2 emission of 160g/km	**1.863** vehicles of the following models. Most of them are industrial vehicles. Cars available: -Fiat Multipla MY 1.6 16v Dynamic 68 CV Metano BiPower -Volkswagen CADDY, TOURAN and PASSAT Transport Comsortium of Madrid will be in 2010 the greatest fleeet in GN urban buses: signed a new contract with Gas Natural for increasing its fleet of GN buses up to 700 units. Transport Consortium of Málaga has acquired 100 GN buses (a third part of its total fleet) and the Urban Waste fleet of Murcia will run all their vehicles with GN.	CURRENT NUMBER OF FUEL STATIONS: 42 (fuel stations on NG are mainly located in fleet sites).
Hybrid Financial support (up to 2.300€) to the acquisition of cars/vans with a maximum CO2 emission of 130g/km. Financial support for industrial vehicles came to a maximum of 50.000€.	-Honda Civic Hybrid and Insight: 1.694. -Toyota Prius: 8.121 total units sold in Spain at the end of November 2009. -Lexus: 4.141 units aprox. -Mercedes Benz S 400h : 9 vehicles **Total cars: 13.965** Urban buses: in the frame of the "Electrobus project" will be acquired a number of **192 hybrid urban buses** (included also transformations from convenctional into	——

	hybrid ones).	
Electric and PHEV Financial support to the acquisition of cars (up to 7.000€), motorbikes (up to 750€) and Industrial vehicles (up to 50.000€).	Bus: 20 Buses Gulliver for EMT Madrid Motorbike (Vectrix): around 200 units Cuadricicles (Reva, Mega, Microcar): numbers not available In the frame of the MOVELE project will be acquired a number of **2.000 PHEV and BEV** in Spain between 2009 and 2010. Currently has been acquired a number of 215 vehicles (cars, vans, light vehicles and motorbikes).	(1 EMT Madrid in Carabanchel -6 hr charging for 10 hr range) In the frame of the MOVELE project will be disposed a number of 546 charging stations is Madrid, Barcelona and Seville. Also will be created other charging networks in other Spanish cities in a collaboration programme between IDAE and regional administrations.
Hydrogen/Fuel Cell Financial support to the acquisition of cars (up to 7.000 and Industrial vehicles (up to 50.000€).	Not commercialized today. Pilot (fuel cell) vehicles in different places: Andalucía (Hércules Project- Santana Vehicle) Albacete: 1 cuadricicle and 1 tricicle 3 Buses Gulliver modified in Zaragoza (Expo zone)	TOTAL FUEL STATIONS: 4 2 (CUTE project). Currenly not in operation. 1 Zaragoza (operating until 2016, in the Expo zone) 1 Albacete (Ajusa; will operate since 2009) 1 Andalucía (Hércules Project)

Biofuels

Biofuels production in Spain is incentivized by means of the Law 53/2002, on Tax, Administrative and Social Measures, which modifies the Special Taxes Law 38/1992. This law establishes that until end of year 2012 the rate of the Hydrocarbons Special Tax for biofuels will be of 0€/1000 l.

The Energy Efficiency and Saving Plan 2008-2011 aims to save 44 MBbl (6 Mtoe), that is, 10% of annual crude oil imports by means of 31 measures addressed to energy consumption sectors (transport among them). Some of these 31 actions are related to the biofuels sector:

- Exemplary actions carried out by public administrations: a minimum 20% share of biofuels shall be used in public fleets by 2009.
- Regulatory developments will be carried out in order to reach 5,83% minimum share of commercialization, o the base of energy content, in all the gasoline and diesel used for transportation by 2010. The 7% share should be reached by 2011.

The Law 12/2007, that modifies the Law 34/1998 of the Hydrocarbon Sector, extends the list of products susceptible of being considered as biofuels and sets annual objectives to biofuels and other renewable fuels commercialization for the period 2008-2010: compulsory 3,4% by 2009 and compulsory 5,83% by 2010. This law also entitled the Ministry of Industry, Tourism and Trade to enact the necessary resolutions to regulate a mechanism of promotion of biofuels in order to meet the annual objectives. This mechanism has been established by means of the Ministerial Order ITC/2877/2008. Among other things, the Ministerial Order defines the obliged parties involved in the obligation, sets a flexible mechanism to comply with the compulsory objectives, entitles the National Energy Commission to certify the observance of this law by obliged parties, regulates the mandatory conditions for certification and quantifies compensatory payments in case of failure to comply with the order.

Nowadays, two new initiatives are being undertaken in the field of Renewable Energy in Spain.

The first one is the Energy Efficiency and Renewable Energy Sources Law. This text aims to be the general legislative framework for all regulations to be developed from now on in the field of Renewable Energy. In fact, the new Directive on Renewable Energy Sources transposition will be carried out by means of this law.

The second strategic initiative starting now is the new Spanish Renewable Energy Plan 2011-2020. The REP includes, for all kinds of renewable energy sources: evaluation of the national resources, the situation in Spain (technology, administrative procedures, environmental and economical aspects), objectives by 2020, identification of barriers and proposal of measures to overcome detected barriers.

The CENIT programme (*Consorcios Estratégicos Nacionales de Investigación Técnica* - National Strategic Consortia for Technological Research), is promoted by the Spanish State in the context of its programme to foster stable public/private cooperation on R&D&I. Its intention is to promote and develop great industrial research projects of a strategic nature. The consortia must be made up of a minimum of four companies, two large and two small, as well as at least two research bodies subcontracted by the companies comprising the consortium. At least 25% of the project's total budget must be invested in this development subcontract and the budget must consist of a sum of between 20 and 40 million € for the four-year duration of the project. The project must be led by a company with sufficient significance and technological capacity and is financed by up to 50% through the CDTI (Centre for Industrial Technological Development).

Currently, there are two remarkable CENIT projects related to biofuels development in Spain.

The first one is the IDEA project (Research and Development of Ethanol for Automotive Applications). This project is lead by Abengoa Bioenergía and its objective is to cover the complete bioethanol cycle, from production of raw material (energy crops) and enzymes (biotechnology) to bioethanol production technologies and their application in engines.

The Project on Innovation to Boost Biodiesel in Spain (PIIBE) is lead by Repsol YPF. The PIIBE project aims to increase the availability of local raw materials for the production of biofuel, including seaweed, waste cooking oils and animal fats, and to reduce its production costs, thus facilitating its introduction into the market.

The following table presents a summary of the main figures related to biofuels production and use in Spain in 2008:

Fuel	Installed Capacity (toe)	Production (toe)	Consumption (toe)	Fuel stations
Bioethanol	294.100	176.300	125.000	18
Biodiesel	1.518.900	168.600	519.000	456

1.7 Country Report Sweden

(Prepared by Swedish Road Administration, SRA)

Summary
The proportion of motor biofuels reckoned in energy content was 4.9 % in 2008. Low-admixture ethanol still accounts for the highest proportion of motor biofuels use. The number of passenger cars that can be run on predominantly renewable energy comprises 3,5 % of the total number of registered passenger cars. 45 % of the filling stations in the country sold renewable motor fuel in January 2009.

Overview of Current Situation

1. Policies

Sweden has been one of the leading countries in Europe in terms of introducing biofuels and vehicles dedicated for alternative fuels. The government has stated that the Swedish car fleet 2030 will be independent of fossil fuels. Sweden of course intends to comply with the EU-directive that states that 10 % of the transport energy 2020 will be renewable, i.e. biofuels or electricity. EC Directive 2003/30/EC on the promotion of the use of motor biofuels or other renewable motor fuels gives general guidelines for the introduction of motor biofuels. Indicative targets for the EU of 2% motor biofuels by 2005 and 5.75% by 2010 are expressed. Sweden set a target of 3% for 2005 and 5.75% for 2010. In January 2008, the European Commission presented its proposal for a directive on renewable energy intended to replace Directive 2003/30/EC and others. The Directive includes binding requirements on every country for 10% renewable energy in the transport sector by 2020. Sustainability criteria are also set, which must be met if a motor biofuels is to be regarded towards the target.

2. Use of Renewable Energy in Transport

The Directive from 2003 is aimed at promoting the use of motor biofuels that would replace petrol or diesel fuel for transport applications. The proportion of motor biofuels reckoned as energy content was 4.9% in 2008, corresponding to 4,4 TWh. The renewable motor fuels used to any major extent in Sweden are bio ethanol, FAME and biogas.

The use of motor biofuels in Sweden increased by 20 percent between 2007 and 2008. Low-admixture ethanol accounts for the highest proportion of motor biofuels use. Low admixture FAME has increased substantially during the past years, after it became possible to add 5% FAME to diesel fuel in 2006. During 2008, 76 % of all diesel fuel delivered had low admixture. A total of 1.5 TWh of FAME was used in 2008. 92 % of all petrol had low admixtures of ethanol (5%) in 2008. In 2008, 1.4 TWh of low-admixture ethanol was used.

The use of biofuels in Sweden 2002-2008 (1000 m^3)

Year	2002	2003	2004	2005	2006	2007	2008
Ethanol	76	150	261	285	321	359	422
Biodiesel	5	5	9	11	65	130	165
Biogas	8825	11347	12929	16052	23716	28423	33740

3. Supply of Biofuels

3.1 Domestic production

Wheat based ethanol is produced near city Norrköping and is used in low blend. The capacity of this plant is ca 210 000/y equal to 1.4 TWh .A few other plants are planned but not decided.

3.2 Import

All ethanol used in E-85 is imported from Brazil. (Feedstock, sugar cane). Besides, there is a small net import to feed the 5 % low blend.

3.3 Filling stations

In January 2009, 45 % of the 3250 filling stations in the country had a pump with renewable fuel. The filling stations that increased most rapidly are those for E85 and they account for by far the highest proportion of biofuel filling stations. The total number of filling stations in Sweden continues to decline.

A law on the obligation to make renewable fuels available came into force on 1 April 2006. According to the law, filling stations with a certain sales volume must offer a renewable motor fuel in addition to petrol and diesel fuel. The law initially covers filling stations that have a sales volume in excess of 3000 m3 of petrol or diesel fuel. The requirement will gradually increase to 1000 m3 of petrol or diesel fuel, and it is estimated that this will lead to around 60% of all filling stations being able to supply a motorbiofuel by 2010. Investments are mainly made in ethanol pumps since these are the least expensive pumps to install in order to conform to the law. A grant is now available for pumps other than those for ethanol.

3.4 Vehicles

Means of promoting EEC´s in Sweden

(EEC = environmentally enhanced cars)

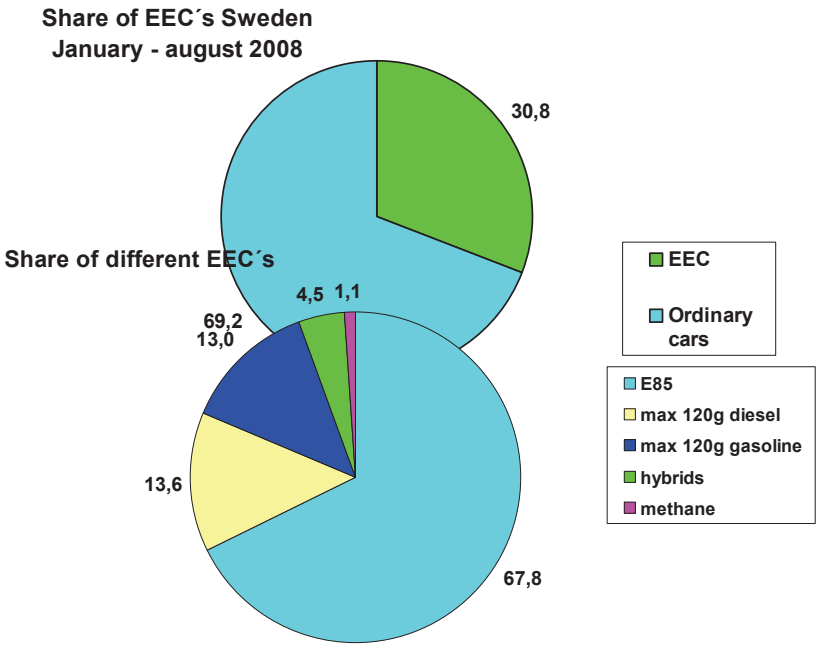
In order to reduce CO2 emissions a lot of incentives have been decided.

1. Exemption of energy and CO2-taxation for biofuels
2. Obligation for fuelling stations to provide biofuels to dedicated cars
3. Incentive for EEC´s bought by private car buyers (€ 1000) (ends 1/July 2009 and will be replaced by tax exemptions.
4. Procurement of vehicles purchased by governmental authorities
5. Exemption from congestion tax in Stockholm
6. Free parking in bigger cities
7. Reduced taxation of car benefit
8. Vehicle taxation based on CO2 emissions

Nr 1 makes ethanol in 5 % blend cost competitive. Nr 2 has resulted in that more than 1000 filling stations can provide E-85. Unfortunately E-85 is not always cost competitive. Sometimes the cost of driving 1 km is more expensive on E-85 than in gasoline.

Nr 3-8. Promotes FFV-cars (and methane fuelled cars) and in some cases fossil fuelled car with CO2 emissions below 120 g/km.

At the 2008/2009 turn of the year, there were around 4.3 million passenger cars on the roads in Sweden, of which about 149 000 were passenger cars that could be run on predominantly renewable energy. The numbers of passenger cars that can run on renewables represent 3.5 % of the total number of registered passenger cars. Ethanol (E85) can be used as fuel in cars with so-called flexible fuel engines (also known as flexifuel cars). The engine can run on any mixture of petrol and ethanol. E85 consists of 85 percent ethanol and 15 percent petrol. Petrol is mixed into the ethanol in order to improve the starting characteristics and the cold-start emissions. Ethanol fuelled cars account for almost 90% of passenger cars that can be run predominantly on renewable energy. Trucks and buses fuelled by renewables consist principally of vehicles that can be run on gas. More than one third of buses fuelled with renewables use ethanol in the form of ED95 (95 % ethanol). Several Swedish cities have decided on biogas as the fuel for local buses. During 2007, there were biogas-fuelled buses in operation in 16 cities, and the number of cities is gradually increasing.



Comments: The real bottlenecks in a global perspective are the limited potential of producing biofuels /ethanol. But the Swedish incentives have more focused on the ability of the car to run on Biofuels i.e. E-85.

The incentives are so strong that more than 30 % of the sales (2008) were EEV´s 2/3 of them were FFV /E-85cars. If you count the sales of FFV it is rather a success story but if you count the impact of CO2 emissions the success shrinks a bit. These incentives are furthermore costly especially when the cost relates to mitigate CO2 emissions.

The Swedish Government is considering the possibility of mandating biofuels-quota. I f quota will be mandated some but not all of the other incentives will be removed.

3.5 Research programmes on Ethanol

A research program on ethanol financed partly by the government has been running for about 15 years. The purpose is to make it possible to produce ethanol from wood or preferably wood residues.

The main reasons are potentially large feedstock, Swedish know how from forest industry and security of supply due to domestic production. Besides ethanol fuels today are seen as favourable for Swedish carmakers, which produces FFV car that can run on E-85.

Research on cellulosic ethanol in a Pilot Plant in the city of Örnsköldsvik has been carried out. The feedstock is wood chips. The intention is to use wood residues. The main results from the plant are that it is possible to maintain a continuous process but there are some drawbacks. Forecasts of the cost from a full-scale future plant seem to be unacceptably high if there is a demand for high yield. At moderate yield (at about 20 % in terms of energy) the cost will eventually be competitive to ethanol from wheat if you can allocate the cost to by-products as heat and lignin.

The future seems very uncertain because the managing company SEKAB has closed down all their activities in both business and research.

3.6 Plans or promotion of other second-generation biofuels

There are pilot and demonstration plants in Sweden for the so-called second-generation motor biofuels. These plants are:

- Synthesis gas production from black liquor in Piteå. The next step will be an almost full-scale plant gasification of black liquor and producing DME or Methanol.
- Synthesis gas production from biomass in Värnamo.
- Methanol production from gasification of wood waste in Hagfors.
- Methane production by gasification in Gothenburg.

All these projects are planned but not yet financed or decided.

1.8 Country Report Thailand

Prepared by National Science and Technology Development Agency (NSTDA)
and
Ministry of Science and Technology (MOST)

On the 11th December 2009 , Thailand Prime Minister, H.E. Mr. Abhisit Vejjajiva, gave a Special Talk on the topic "The Way Forward for Thailand's Automotive Industry and Energy Usage". The government's target within the next five or six years is to be among the top ten of the world's automobile industry, manufacturing 2.5 million vehicles per year. At present, 50 percent of 1 million vehicles are exported abroad, increasing by 2 million vehicles per year.

The Alternative Energy Development Plan of Ministry of Energy within the next 15 years will promote the use of alternative energy, proportionally increasing from 6 %to 20 % by 2022. The plan consists of the transportation sector 10.3 % (Biofuel 4.1%, NGV 6.25%) and energy for stationary sector 10% (Heat 7.6 %, Power 2.4%).

Thailand's government policy on alternative energy as a national agenda encourages the production and use of alternative fuels for vehicles, the use of LPG, CNG, bio-fuel such as gasohol (E10, E20 and E85), bio-diesel (B2, B5) to enhance energy security, reducing pollution, greenhouse gases and other pollutants. This is the overview of alternative fuels for vehicles, which are being developed and promoted in Thailand.

NGV/CNG

NGV is one of the alternative fuels that is clean and safe for both humans and emits lower Greenhouse Gas (GHG) emissions. It is also cheaper than other fuels because Thailand has it own domestic resource. The NGV vehicle population in Thailand has risen rapidly, from 23,496 in 2006 to 160,018 in 2009. There are 358 gas stations (161 stations in Bangkok and Perimeter Region, 197 stations in the upcountry). Nowadays, there are 38 NGV air-conditioned buses and approximately 12,000 taxi cars in the Bangkok Metropolitan Region. Thai government actively promotes the use of natural gas in urban mass transit with 4,000 buses in 2012. However, the light-duty sector has not responded with as much enthusiasm to the use of NGV in passenger vehicles. Currently, the only NGV vehicle for sale in Thailand through and OEM is the Chevrolet Optra, Mitsubishi Lancer and Tata Xenon pick-up truck.

NGV Car Statistics (January – November 2009)

NGV Car (units)			Total	Stations
Benzene	Diesel	OEM		
123,444	27,835	8,739	160,018	358

OEM = Original Equipment Manufacturer

LPG

Recent soaring global oil prices have meant that many people have turned to using Liquefied Petroleum Gas (LPG) powered vehicles. About 495,024 LPG hybrids with benzene engine and 5,108 LPG hybrids with diesel engine such as passenger cars, taxis and pickup trucks are running on roads in Thailand at present. There are 374 LPG gas stations (186 stations in Bangkok and 374 stations upcountry), which dispense 8.89 million liters (Jan. '09).

Ethanol

Ethanol blended with gasoline (gasohol E10, E20 octane number 91 & 95) is one alternative fuel with high potential in Thailand. Gasohol consumption increased from 9.3 million liters per day in 2008 to 12 million liters per day in October 2009. At present, there are 17 ethanol plants with average capacity of 2.575 million liters per day. There is an expected increase of 7 ethanol plants by 2009-2010 at production capacity of 2.2 million liters per day. Additionally, in terms of the promotion policy on using the E85 gasohol in FFV (Flexible Fuel Vehicle) at present, the car market company has opened the FFV manufacturing line such as Volvo S80 2.5 FT and Mitsubishi Lancer EX. The energy ministry issued and announcement for the FFV importers and car markets to join in the project since 6th June 2009 and reduce the import duty lf the FFV from 80% to 60%. A study on the FFV auto parts to reduce its imported duty to 0%.

Biodiesel

Biodiesel (B100) use in Thailand has increased from 1.6 million liters per day in 2008 to 1.8 million liters per day in 2009. There are 12 biodiesel (B100) distributions with a capacity of 4.4 million liters, receiving approval from the Department of Energy Business: (DOEB), Ministry of Energy. Presently, biodiesel is used to blend with 2 types of diesel oil, i.e. regular HSD (High Speed Diesel) or B2 and B5 HSD as an alternative for consumers. The present total B5 diesel consumption is at 24 ml per day or 50 percent of total diesel use, increasing from the same period last year that consumed only 11 ml per day or 23 percent of its total consumption. This could count as an achievement at a certain level of the biodiesel use promotion. The Energy Ministry aims to promote B10's creation in 2011-2022.

DOEB issued the Notification regarding a quality improvement of biodiesel for blending in diesel oil at higher quality than international standard that takes effect since the 15thAugust2009.

Trends in Research and Development

Thailand is strongly focusing in terms of both the 2nd generation Bio-fuels as Bio-ethanol from cellulosic biomass and Biomass to Liquid (BTL) syn-diesel fuels.

Beside E85 fuel, via supporting the set-up of E85 automobile manufacturing line, with an initial target at least 2,000 FFV in 2011 and 1,000,000 E85 cars by 2018.

With regard to NGV, the goal is that vehicles using NGV will be better facilitated and the waiting queue will be reduced by one-third, and sufficient supply of NGV will be closely monitored. By the end of this year, engine modification of 20,000 taxis to support NGV will be accelerated, with a target number of 50,000. A target is set to increase the share of NGV use in the transportation sector to 20% within four years.

1.9 Country Report United States

(Prepared by DOE)

Biofuels

The United States government has many active research programs evaluating biofuels from multiple feedstocks. In the near term, the United States government is aggressively pursuing ethanol for displacement of gasoline in the transportation fleet, and to a lesser degree it is pursuing biodiesel for displacement of conventional diesel.

Ethanol

Ethanol is the most common alternative fuel in the United States by a large margin, although the vast majority (>99%) of ethanol currently sold in the United States is in the form of gasoline blends containing up to 10% ethanol (E10). E10 is legal for sale and use in all regions of the United States as a direct replacement for gasoline. The use of ethanol in gasoline blended with 10% ethanol has increased drastically in the past five years, from approximately 3.5 billion gallons in 2004 to an estimated 10.3 billion gallons in 2009 [EIA Annual Energy Outlook, Dec 14, 2009]. Blends containing up to 85% ethanol (E85) are only legal for sale in flex-fuel vehicles (FFVs). On an energy content basis, ethanol currently displaces approximately 5% of the United States gasoline demand.

The use of ethanol may expand significantly in the following years, although not likely due to expanded E85 use. Due to laws enacted in 2007 requiring the use of 36 billion gallons of renewable fuels by 2022, research and testing programs are being conducted by the United States government and private industry to assess routes to dramatically expanded ethanol use. The largest effort is an evaluation of the impacts of increasing the legal blend limit for non-FFVs from 10% ethanol to something higher, such as 15% or 20% (E15, E20). The ongoing program is focusing on issues including, but not limited to emissions, durability, and infrastructure. The United States Department of Energy (DOE) has committed significant additional resources to this program in 2009 and expects to continue funding it through 2010.

The authority to approve new fuels, such as E15 or E20, for use in the passenger vehicle fleet resides with the United States Environmental Protection Agency. In December 2009, the EPA deferred a ruling on a request to approve E15 for non-FFVs until additional data on the long-term durability of vehicle emissions control systems is available. The EPA did expect to revisit the waiver request again in June 2010, when a larger amount of data from one of the DOE's studies will be available. As such, the DOE and several industry stakeholders have accelerated and expanded a prior test program with the intent of providing a large amount of data on 2005 model year and later vehicles by the end of May 2010.

Although the vast majority of increased ethanol use in the United States has been the expansion of E10, E85 use continues to increase as have the number of available FFVs and fueling stations. There were approximately 7.3 million FFVs in the United States light-duty fleet at the start of 2009, although the number using E85 is significantly smaller. Chrysler, Ford, and General Motors each offered several FFV models in 2009. Mercedes, Nissan, and Toyota each offered one FFV engine package (2 vehicle models for Toyota and Nissan). In total, there were 37 different E85 FFV models for sale in 2009 compared to 19 models in 2004 and just 2 models in 1998. Additionally, there were 1,973 E85 stations as of December 2009 compared to fewer than 200 stations in 2003 [DOE, Alternative Fuels Data Center]. Due to the increasing availability and use of E85, the United States Department of Energy commenced with nationwide E85 quality surveys in 2008 that were still ongoing in 2009. Also, because volumetric fuel consumption increases with ethanol compared to gasoline, the

Department of Energy has an active research and development program aimed at increasing engine efficiency when operating on ethanol. Funded research projects mainly exploit ethanol's octane, which is higher than that of gasoline, to improve engine thermal efficiency.

In an effort to increase the use of ethanol, industry stakeholders have focused considerable attention on blender pumps, which are capable of dispensing any mixture between E0 and E85, by splash blending the two fuels. Such pumps are marketed to consumers who want to use ethanol fuels but seek a greater driving range than can be attained with E85. Unsubstantiated claims of optimal blends for fuel efficiency occasionally accompany the marketing of such pumps, although research by the United States government shows fuel consumption to be directly proportional to the energy content of the fuel, i.e., it increases linearly with increasing ethanol content. Several ethanol trade organizations have announced plans to install up to 5000 blender pumps in the coming years. The estimated number of blender pumps in current operation during 2009 is between 100 and 200 [Renewable Fuels Association, Growth Energy, and DOE Alternative Fuels Data Center]. Such pumps are currently only legal for use in FFV's if the blends exceed 10% ethanol (E10) because of the concern that consumers will intentionally misfuel conventional vehicles if the price of ethanol blends is lower than that of gasoline. Anecdotal evidence strongly suggests that a significant amount of deliberate misfueling of non-FFVs with >10% ethanol is occurring from blending pumps. The United States government doesn't have any active research activities into blender pumps, but there are concerns with fuel quality and volatility characteristics of splash-blended fuels. The United States government does have an active consumer education campaign for ethanol-blended fuels that includes discussion of blender pumps.

Biodiesel

Biodiesel production in the United States is expected to drop from approximately 690 million gallons in 2008 to approximately 590 million gallons in 2009 [EIA Annual Energy Outlook, Dec 14, 2009] due to lower domestic fuel demand and anti-dumping tariffs imposed by the EU in March 2009. Consumption in the United States has increased from approximately 26.9 million gallons per year in 2004 [EIA Short Term Energy Outlook supplement, table 5, April 1, 2009] to an anticipated 325 million gallons in 2009 [EIA Short Term Energy Outlook, table 8, December 8, 2009]. Blends of up to 20% biodiesel (B20) are currently legal for sale in all regions of the United States and 679 B20 fuelling stations were available throughout the United States as of September 2009 [DOE Alternative Fuels Data Center]. Blends containing up to 5% biodiesel can be marketed as regular diesel fuel instead of biodiesel and may use the existing infrastructure. An increasing number of B20 Original Equipment Manufacturer-approved vehicles and engines are becoming available thereby contributing to increased biodiesel use in the coming years. A notable example is the 2011 Ford F-Series pickup truck. Ford has dominated the light-duty diesel marketplace in the United States with nearly 46% of all diesel registrations, making the approval of B20 for the F-Series truck significant.

Algae-derived fuels

A workshop was held in Washington, DC in December 2008 to develop a roadmap for a research path studying algal oils for renewable fuels. One purpose of the workshop was to help guide funding into high value areas. In late 2009, the United States Department of Energy's Biomass Program commissioned a large research program for algae-derived fuels studying cultivation, oil extraction, conversion, and deployment. Uses of by-products from algae fuel production are also being investigated for other applications, such as bio power, to lessen the overall greenhouse gas impact.

Compressed Natural Gas - CNG

CNG (methane) prices have dropped dramatically in the past few years as advanced recovery techniques, such as horizontal drilling combined with hydraulic fracturing, have become widespread. CNG continues to be one of the more common alternative fuels used in the United States, and the use for transportation has become more attractive as prices have dropped. Additionally, the United States government has been actively promoting the use of natural gas in appropriate niche applications such as urban mass transit. Roughly 20% of the transit bus fleet is currently CNG powered. The light-duty sector has not responded with as much enthusiasm to the use of CNG in passenger vehicles. The number of models available for sale from OEMs has dropped from 16 in 2004 to just 1 in 2009. Currently, the only CNG vehicle for sale in the United States through an OEM is the Honda Civic GX (which is sold packaged with a home-based refueling system). Even with the lack of available OEM vehicles, there were approximately 772 fueling stations available in the United States as of September 2009 and an estimated 114,000 CNG vehicles in service as recently as of December 2007 [DOE Alternative Fuels Data Center].

The United States government did not have any active research programs studying CNG in light-duty vehicles in 2009, but related gaseous fuel storage activities are being conducted by the Department of Energy's Hydrogen Fuel Cell and Infrastructure Technologies Program. However, the DOE Vehicle Technologies Program has committed to begin research activities for CNG in medium-duty applications in 2010, although the scope may be limited.

Liquefied Natural Gas – LNG

While LNG does increase the volumetric energy density of methane compared to CNG, it is not commonly used or available in the United States for transportation use. There were only 367 fueling stations in the United States as of December 2009 and fewer than 3 thousand vehicles in use [DOE Alternative Fuels Data Center]. Furthermore, most of the LNG fueling stations aren't publically accessible and 27 were concentrated in the State of California [DOE Alternative Fuels Data Center]. The US considers LNG to be exclusively a fuel for fleets due to safety and complexity related to dispensing and using cryogenic liquid fuel. The United States government did not have any active R&D programs studying LNG as a replacement for petroleum fuels in 2009. The Department of Energy's Vehicle Technologies Program will initiate a heavy-duty LNG engine development and vehicle platform integration project in 2010.

Liquefied Petroleum Gas – LPG

LPG (propane) has the largest refueling infrastructure of the alternative fuels in the United States with 2,468 fueling stations as of September 2009 [DOE Alternative Fuels Data Center],and is one of the more common alternative fuels in use. While there is only one light-duty vehicle offered by the OEMs, a number of companies provide certified conversions for dedicated or bi-fuel use and there were an estimated 158,000 vehicles in use as of 2007 [DOE Alternative Fuels Data Center]. LPG is most commonly used in off-road and non-transportation applications such as hi-lo lift trucks and agricultural equipment. Due to the maturity of the market, the United States government does not have active R&D programs with LPG.

Hydrogen

The United States government has a large research program studying hydrogen for transportation. The work is primarily being done in the Department of Energy's Hydrogen Fuel Cell and Infrastructure Technologies Program. Research funding for hydrogen as a

direct replacement for gasoline in internal combustion engines has been declining in recent years and hydrogen is primarily expected to be used in fuel cells. Some research into the use of hydrogen in internal combustion engines continues, which could become a transition to the use of hydrogen in fuel cells. Hydrogen refueling stations are rare, with only 63 in the United States as of December 2009 [DOE Alternative Fuels Data Center]. Seventeen states have at least one hydrogen refueling facility (although most are not publically accessible), with California having the most with 26 stations [DOE Alternative Fuels Data Center]. At present, hydrogen is still considered a fuel of the future to a greater extent than other alternative fuels.

Other Fuels

Higher alcohols, such as butanol, are receiving more attention and the United States government has several smaller research projects studying them for use as a transportation fuels. The United States government also has several research programs studying Biomass to Liquids (BtL). Methanol is currently not under study by the United States government as a direct replacement for gasoline, but there are still research programs studying it for use in fuel cells. Worth mentioning but not widespread is hydro-treated waste fats for fuel use. While such fuels are eligible for tax credits and are being studied by several private companies, they are not currently being studied by the United States government. Di-methyl Ether (DME) is another notable fuel not being currently studied by the United States government as a replacement for gasoline.

Trends in Research and Development

With the passage of the Energy Independence and Security Act (EISA) in December 2007, the United States has dramatically increased its renewable fuel targets. While EISA does not specifically call for ethanol to be the major renewable fuel to meet a 36 billion gallon per year mandate by 2022, it is being pursued as the most likely choice. EISA also limits the renewable credits available for corn ethanol. This has raised the bar for research into advanced biofuels such as cellulosic ethanol and algae-derived fuel and the United States government has substantially increased funding in those areas in recent years. FAME-type biodiesel use is also mandated by EISA, but biodiesel production capacity in the United States is significantly lower than ethanol capacity and diesel is not expected to significantly replace gasoline as a transportation fuel for passenger vehicles. Another recent trend is that research into the various steps of biofuel production ranging from feedstock cultivation through end usage is becoming more-tightly integrated. Various non-process oriented impacts are also becoming increasingly critical to strategic decisions, such as land usage changes and lifecycle greenhouse gas emissions.

Diesel is expected to remain the fuel of choice for over the road freight transport, and research into the effects of increasing biodiesel levels in the heavy industry fleet is ongoing. Significant research projects for dramatically increased efficiency of heavy duty applications, including engine efficiency improvements as well as trailer design, are expected to commence in 2010.

The United States Congress recently introduced legislation for a cap and trade system of controlling carbon emissions, but it wasn't been passed into a law in 2009. Several states, most notably California, are in the process of passing their own legislation to limit greenhouse gases as well. Such proposed laws have sparked increased interest in consistent and accurate modeling of the greenhouse gas contribution of biofuels (well-to-wheel). This has prompted the United States government, as well as many state governments, to expand research programs in preparation for such legislation becoming law.

Conclusion

The United States has significantly expanded its goals for renewable fuel use, and is exploring several strategies to meet its aggressive targets. A very significant event for renewable fuels use would occur in 2010 if E15 were to be approved for use in the light-duty vehicle fleet, or a subset of it. Expansion of the E85 market is still being aggressively pursued in two main areas: infrastructure expansion and engine efficiency improvements aimed to lessen the fuel economy penalty of ethanol. Blender pumps which can dispense ethanol fuel blends between E0 and E85 are being pursued by ethanol industry groups, but the United States government does not have any activities promoting their use. Along with efforts to expand ethanol usage, significant efforts are being made to derive ethanol from cellulosic sources. Hydrogen is still being pursued as a transportation fuel, but is considered a longer-term solution to petroleum dependency and will be primarily used in fuel cells rather than internal combustion engines. Research into natural gas for transportation is expected to re-commence in 2010 as natural gas is being considered for displacement of petroleum products in the medium-duty vehicle market as CNG and in the heavy-duty vehicle market as LNG. Additionally, significant efforts were initiated in 2009 to research algae as a feedstock for biofuel production, including biodiesel and ethanol, and expanded programs are expected to continue throughout 2010.

2. How to Join the AMF Programme?

A number of IEA Member countries have found it efficient and cost effective to co-operate on research, demonstration and exchange of information regarding Advanced Motor Fuels (AMF) to develop new and improved technologies and facilitate their introduction into the market.

This collaboration programme takes the form of an ***Implementing Agreement*** under the legal guidance of the International Energy Agency (IEA). All countries concerned about energy and environment in the transport sector, whether or not they are members of the IEA, are welcome to join this international effort and share this experience.

We are facing a diversification of energies and vehicle technologies in the transport sector. Working together makes it easier to define the proper pathways for the future.

The participating governments designate a government organisation or a private entity (for example from industry) as their representative to the Programme.

The Advanced Motor Fuels collaboration programme was launched with 5 participating countries in 1984. Today 16 countries are actively involved in the programme and form a most interesting and efficient network

Austria, Thailand and the People's Republic of China joined the Advanced Motor Fuels collaboration programme in 2008 and Australia and Germany in 2009. Today Greece participates as Observer.

The following countries and designated bodies are active since the year of their joining AMF:

Austria	2008	Austrian Agency for Alternative Propulsion Systems (A3PS)
Australia	2009	Department of the Environment, Water, Heritage and the Arts
Canada	1984	Department of Natural Resources Canada (NRCan)
China	2008	China Automotive Technology and Research Center (CATARC)
Denmark	2001	Technical University of Denmark (DTU)
Finland	1989	VTT Technical Research Centre of Finland (VTT)
France	2000	Agence de l´Environnement et de la Maîtrise de l´Énergie (ADEME)
Germany	2009	Fachagentur Nachwachsende Rohstoffe e.V. (FNR)
Italy	1988	ENI S.p.A.
Japan	1988	New Energy and Industrial Technology Development Organization (NEDO)
	1998	Organization for the Promotion of Low-Emission Vehicles (LEVO)
Spain	2002	Institute for the Diversification and Saving of Energy (IDAE)
Sweden	1984	Swedish Energy Agency (STEM)
Switzerland	2004	Swiss Federal Office of Energy (SFOE)
Thailand	2008	National Science and Technology Development Agency (NSTDA)
UK	1994	Department for Transport (DfT)
USA	1984	US Department of Energy (DOE)

Those interested to participate as Observers at the meetings of the AMF Executive Committee (see Para. 3.9) with the intention of joining the programme are welcome to contact the IEA-AMF Secretary Claës Pilo, SDAB Transport & Environment, Karlavägen 93, SE-115 22 Stockholm, Tel +46 8 15 11 90, E-mail pilo.sdab@swipnet.se

3. The Implementing Agreement and the AMF Programme

(Status February 2010)

The AMF Implementing Agreement expired 31st August 2009. A request for extension was presented to the End Use Working Party (EUWP) and the Committee on Energy Research and Technology (CERT) together with the following required documents: AMF Profile, "End-of-Term Report 2005-2009", "Strategic Plan 2009-2014", and Self-evaluation Report.

EUWP discussed the request for extension at its meeting in April 2009 and recommended that CERT extends the AMF IA for a period of five years. CERT approved at its meeting in June 2009 the extension of the Implementing Agreement for a Programme on Research and Demonstration on Advanced Motor Fuels for the period 1 September 2009 to 31 August 2014.

The following conclusions of EUWP in its report to CERT are of special interest:

- Research areas: The AMF IA is considered an "integrating agreement" i.e. active in linking with and collaborating with other agreements, and producing valuable objective comparisons of alternate fuels which they can use.
- Management: The EUWP strongly commended the AMF on the work accomplished during the past term. The AMF IA is well managed, is tackling relevant research issues, and is at the cutting edge in the field of advanced motor fuels. It was also noted that other IAs could look to the AMF as an example of how to manage an IA.
- Outreach and communication: The AMF Outlook Report contains excellent information, which is valued and used in several member countries.

3.1 Strategic Plan, End-of-Term Report & Self-evaluation Report

A first strategic plan was prepared in 1995, a second "Strategic Plan for 1999-2004" in 1998, a third in 2004, and a fourth "Strategic Plan 2009-2014" together with an "End-of-Term Report 2005-2009" have been prepared during 2008 by Ralph McGill, US, in cooperation with an advisory group.

Since 2004, when the "Strategic Plan 2005-2009" was written, the world has changed, and even more change is foreseen in the next term. The new "Strategic Plan 2009-2014" has been framed in the context of world events, the changing scene with regard to energy supplies, transport fuels, local environmental conditions, and global challenges. The plan provides a synopsis of the framework in which the AMF must operate for the next five years and a look forward in terms of the evolution of sustainable new fuels that might be expected in the marketplace with the next several years.

3.2 Change of the name AMF

In 1984 the ”Implementing Agreement for a Programme of Research, Development and Demonstration on ***Alcohol and Alcohol Blends as Motor Fuels (AMF)*** was signed in Paris. During the first period 1984-90 the Agreement focused on alcohols (such as methanol, ethanol, and higher alcohols) as well as on related oxygenated hydrocarbons (such as MTBE, and ETBE).

In 1990 it was broadened to address also other alternative motor fuels and was renamed ”Implementing Agreement for a Programme of Research, Development and Demonstration on ***Alternative Motor Fuels (AMF)***.

Following the proposals in the ”Strategic Plan for 1999-2004” the name was changed in October 1998 to ”Implementing Agreement for a Programme on Research and Demonstration of ***Advanced Motor Fuels (AMF).*** This was done to make provisions to include reformulated hydrocarbon fuels in the scope of AMF.

3.3 Vision of AMF

According to the new “Strategic Plan 2009-2014” AMF has the following vision:

To contribute to sustainable solutions through our system view of the entire fuel chain from resource development to end-use. Our cooperative research in the field of transport fuels helps to facilitate the widespread use of sustainable fuels of high quality.

3.4 Mission of AMF

According to the new “Strategic Plan 2009-2014” AMF has the following mission:

AMF is one of the key players in the promotion of international collaboration in R&D, deployment and dissemination of clean, energy-efficient and sustainable fuels and related vehicle technology. It will continue to provide a fuel neutral platform for co-operative R&D, deployment and dissemination, make use of the multifaceted expertise of its partners and networks, and provide a respected clearing-house for information facilitating the wide spread deployment of technologies for sustainable transport. We foresee increased need for cooperation and collaboration with other transport-related Implementing Agreements, such as Bioenergy, HEV, and Combustion. Together with new AMF member countries we are able to address a more diverse set of challenges in technology and local conditions. We also work actively for energy conservation in transport.

3.5 Objectives

According to the new "Strategic Plan 2009-2014" AMF has the following objectives:

Objective 1 (Information, Dissemination and Membership): To gather, evaluate and disseminate information on advanced motor fuels and to act as a clearing-house on related information. Provide an easy-access platform for interested parties to become member of AMF.

O**bjective 2 (Cooperative R&D):** To create, maintain and make use of networks among partners involved in research, development, and demonstration related to advanced motor fuels.

Objective 3 (Markets and Deployment): To facilitate large-scale market deployment of advanced motor fuels by contributing to the removal of technical and economic barriers and by providing solid data to decision makers.

3.6 Definition of advanced motor fuels

Advanced motor fuels encompass alternative fuels as well as advanced, petroleum-based fuels, and the scope of the AMF Implementing Agreement includes all such fuels. Additionally, AMF has the license to work on the entire spectrum of fuels from feedstock, through fuel processing, distribution, and, finally, end use in vehicles. Directly and indirectly AMF is also promoting fuel efficiency of vehicles.
Fuels included under the definition of Advanced Motor Fuels are fuels that fulfill one or more of the following criteria:

- Low toxic emissions
- Improved life cycle efficiency
- Reduced greenhouse gas emissions
- Renewable energy sources
- Fuels for new propulsion systems
- Sustainability in transportation
- Security of supply

Advanced motor fuels studied in the framework of the AMF Programme are:

- Alcohols (ethanol, methanol), ethers (DME, ETBE, MTBE, etc), esters (RME, etc), gaseous fuels (natural gas, biogas, hydrogen, LPG, etc)
- Reformulated gasoline and diesel fuels, including oxygenated versions
- Synthetic fuels, such as Fischer-Tropsch fuels
- Fuels for new types of engines and fuel cells

3.7 Participating countries

16 countries participate actively in the IEA collaboration on advanced motor fuels:

Austria, Australia, Canada, China, Denmark, Finland, France, Germany, Italy, Japan, Spain, Sweden, Switzerland, Thailand, United Kingdom, and United States.

Of these Austria, China, and Thailand joined in 2008 and Australia and Germany in 2009.

Each participating country has designated one Contracting Party to sign the Implementing Agreement (IA), except Japan that has designated two Contracting Parties (NEDO and LEVO). One Delegate and one Alternate represent each Contracting Party in the Executive Committee.

3.8 Cooperation with other Implementing Agreements

AMF has a history of working together with other Implementing Agreements, having already completed one annex that was jointly supported by AMF and HEV. The newly started Annex XXXVII has support from both AMF, Bioenergy, and HEV. This is the first time in IEA´s history that three IAs are involved in the same Annex.

AMF welcomes participation by other Implementing Agreements in AMF's ExCo meetings, and AMF delegates are encouraged to communicate with and, perhaps, join meetings of other IA's ExCo meetings. Recently representatives of the AMT, Bioenergy, and HEV Agreements have attended AMF ExCo meetings.

Because of AMF's interest and capabilities in all phases of the fuel spectrum, we are well positioned to work with other Implementing Agreements as is illustrated in Figure 6 below.

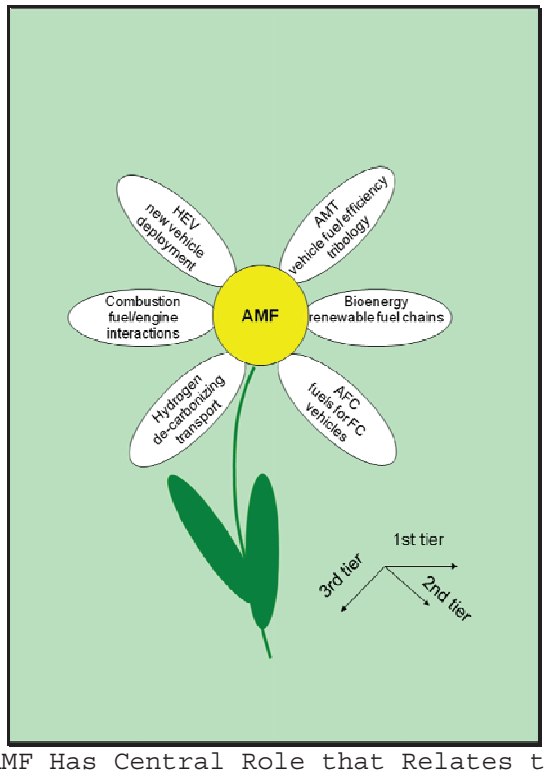


Figure 6 - AMF Has Central Role that Relates to Other IA's

AMF also reaches out to other countries for them to consider membership in AMF. These activities will continue into the future, and emphasis will be placed on the "Plus Five" countries of Brazil, China, India, Mexico, and South Africa (China has already joined AMF).

3.9 Executive Committee and Secretariat

The Executive Committee consists of the National Delegates and Alternates of Member Countries to the Agreement. The ExCo is the decision-making body of the Agreement. The ExCo can take decisions to invite Observers and Experts to the ExCo meetings. Representation of the IEA Secretariat at the ExCo meetings is desirable.

The ExCo meets every 6 months. It is an active and authoritative group representing independent organisations. Thus, it is possible to supply governments participating in this IA with the results of studies that are objective and not coloured by industrial or political interests.

The ExCo appoints a Chairman and an appropriate number of Vice Chairmen to give the AMF "Board of Directors" a geographically balanced constitution.

The ExCo appoints a Secretary to handle day-to-day administration. An annual Membership Fee is collected to cover the costs for the Secretariat and other activities decided upon by the ExCo. Such activities could be e.g. starting up new research activities using collective funds as seed money.

Normally a technical seminar is arranged in conjunction with the ExCo meeting. This gives, e.g., the hosting country an opportunity to present national R&D activities.

3.10 Projects/Annexes

Altogether, 31 collaborative projects (Annexes) have been completed since the programme started in 1984 (see Electronic Attachment No 1: Tables A-E). Six others are presently running (see Table 1 and 2). All reports prepared within the AMF Annexes are listed in Electronic Attachment No 2.

The following areas have been covered since the start of the programme:

	Annexes
• General information	I, II, IX, XXIV, XXVIII
• New fuels	VI, X, XIV, XVIII, XIX, XX, XXV, XXXIII, XXXIV, XXXV, XXXVII, XXXVIII,
• Emissions – particles	V, XII, XIII, XXII, XXV, XXXIII, XXXVI, XXXVII, XXXVIII, XXXIX
• Test procedures	XVII, XXIX, XXXIII, XXXVI
• Health effects	XXX
• Environment	VII, XXXVII
• Standardization	XXVII, XXVIII
• Lubricants	XVI, XXXIII
• Engines	XXXIX
• Non-road engines	XXV
• Life cycle analysis	XXXI, XXXIV, XXXVII

- Production IV, XXXI
- Demonstration II, III, VIII
- Implementation XI, XV, XXI
- Operational experience XXVI

3.11 Recent initiatives

During its last meetings ExCo 37 in May 2009 in Helsinki, Finland, and ExCo 38 in November 2009 in Bangkok, Thailand, the Executive Committee took a number of initiatives.

ExCo 37 in Helsinki, Finland

- **Australia was welcomed as new participating country** in the AMF program.
- **Main Issues** for the ExCo meeting were: **"Putting the Strategic Plan 2009-2014 into action"** and **"Increased Membership".**
- A summary of "**Most important questions/projects** AMF should work with during the coming five years" was distributed.
- Long discussions took place on **putting the Strategic Plan into action** and a number of valuable conclusions were drawn.
- A new special **Sub-Committee on Membership and Outreach** was set up.
- **Five Observers** from Germany, Greece, The Netherlands, IEA-Bioenergy, and IEA-AMT participated.
- The ExCo decided to **invite Germany, Greece, and The Netherlands to join AMF**.
- The ExCo **decided to deem Belgium withdrawn.**
- **A new Annex XXXVIII was started** with a Japanese Operating Agent: "Evaluation of Environmental Impact of Biodiesel Vehicles in Real Traffic Conditions".
- **A new Annex XXXIX was started** with a Swedish Operating Agent: "Enhanced Emission Performance and Fuel Efficiency for HD Methane Engines".
- **A new Alternative Fuels Information System** will be introduced for Annex XXVIII.
- **AMF decided to undertake its own cost-shared project on algae**, keeping close contact with Bioenergy IA. Focus within AMF's project will be on engineering and end-use, whereas Bioenergy will focus on "upstream" issues.
- **Annex XXXIII was closed.**
- **The final report of Annex XXXV was approved.**
- **A SAE paper will be prepared for Annex XXXVI.**
- **Proposals were presented for new annexes** on: "Toxicity of Combined Aerosols from Diesel Engines", and "Ammonia for Road Transportation", and "Marine Fuels for Combustion Engines".
- The ExCo **decided to make available seed-money for pre-studies.**
- **International development presentations** were given about: Australia, Germany, Thailand, US, and New EU directives.
- **R&D presentations** were given on: Life Cycle Analysis, Alternative Propulsion Concepts, and Biofuels-Toxicity project.
- **Reports from Workshops** were presented from workshops in Espoo, Finland, and Lyngby, Denmark.

- A number of **interesting presentations** were given during **technical visits** to VTT Technical Research Centre of Finland, Helsinki University of Technology, Helsinki City Transport, and Neste Oil.

ExCo 38 in Bangkok, Thailand

- **Germany joined AMF** on 22nd December, that is after the Bangkok meeting.
- **Main Issues** for the ExCo meeting were: **"Putting the Strategic Plan 2009-2014 into action"** and **"Increased Membership".**
- Further discussions took place on **putting the Strategic Plan into action.**
- The new **Sub-Committee on Membership and Outreach** presented a report on the reasons why countries decided to join or not to join AMF.
- The Sub-Committee was asked to present a proposal for at **developed Annual Report** 2010 at the next ExCo meeting in Ottawa.
- The ExCo commissioned one of the Operating Agents to **accomplish the Outreach** (flyer, web text, outlook, etc).
- The AMF Chairman has as Vice Chairman of the new Contact Group for Transport within EUWP **regular contacts with the other transport related IAs.**
- **This is the first time in IEA´s history that three IAs are involved in the same Annex.** Bioenergy and HEV have joined Annex XXXVII.
- **"Division of labor" between IAs** will be further discussed.
- **Annex XXXVII is the largest AMF project so far.**
- **A number of annex proposals were discussed** and several Delegates were asked to come back with developed proposals at the next ExCo meeting in Ottawa.
- Four redesigned **AMFI Newsletters** have been published via Internet in 2009 (Annex XXVIII).
- **Annex XXXVIII has started** with 5 participating countries.
- **Sub-task No 1 of Annex XXXV was closed.** The final report will be **translated to Japanese and Thai.**
- A **new Secretary** will be elected at the next ExCo meeting in Ottawa. The applicants must come from AMF member countries and have to be endorsed by the National Delegations.
- The **Membership Fee for 2010** was set to € 9 500.
- **International overviews** were presented on: Asia, Australia, China, Europe, Japan, and Thailand.
- **R&D presentations** were given on: Bioenergy Task 39 and Outlook for electric vehicles.
- A number of **interesting presentations** were given during **technical visits** to a biodiesel pilot plant, a palm oil plantation, Bangshack Petroleum PCL, and National Metal and Materials Technology Center (MTEC).
- **Next ExCo meeting** will be in Ottawa, Canada, 12-14 May 2010.

3.12 AMF Focus

AMF is committed to evaluating its performance on a regular basis. The main vehicle for the evaluation and for communicating progress toward fulfilling the AMF mission and objectives

will be the Annual Report of the AMF. This will review the activity of the Agreement against the objectives set out in this Strategic Plan.

In its self-evaluation, AMF will be guided in part by the Action Plan adopted by the Committee on Energy Research and Technology (CERT) in 2006 and focused on the following:

- **Stronger focus on the role of policy** in developing cleaner, more efficient energy technologies, and in deploying them
- **More frequent, more effective communication** to policy makers
- **More fruitful liaison within the IEA family**
- **More vigorous outreach to non-IEA countries**

AMF has performed well in these goals in the past and will continue to emphasize these in every activity.

3.13 IEA-AMF on Internet

- As a part of the Information System, Annex XXVIII, the AMF website is updated regularly. For the Delegations, a password protected section including e.g. ExCo documentation is provided.

Updated information on IEA/AMF is found on:

www.iea-amf.vtt.fi and **www.iea.org/impag**

4. RUNNING PROJECTS/ANNEXES

(Status February 2010)

Table 1
Running Projects/Annexes

The following six projects/annexes are presently running.

Annex	Title	Run time	Operating Agent	Participating Countries
Annex XXVIII	Information Service & AMF Website (AMFI)	2009 - - - - 2004 – 2008	VTT (FI) TEC (FI)	16
Annex XXXIV Sub-task No 2	Algae as a Feedstock for Biofuels	2009 – 2010	Sentech, Inc. (US)	4
Annex XXXVI	Measurement Technologies for Ethanol (METEV)	2007 – 2010	SRA (SE)	4
Annex XXXVII	Fuel and Technology Alternatives for Buses	2008 – 2011	VTT (FI)	6 + 2 IA
Annex XXXVIII	Environmental Impact of Biodiesel Vehicles	2009 – 2011	NTSEL (JP)	5
Annex XXXIX	Enhanced Emission Performance of HD Methane Engines	2009	SRA (SE)	3

Table 2
Participating Countries and their Contributions

(Œ denotes the Operating Agent. Amounts are given in 1 000 €.)

	AT	CA	CH	CN	DK	ES	FI	FR	IT	JP	SE	TH	UK	US	Total
XXVIII	**X**	**X**	**X**	**X**	**X**	**X**	**Œ X**	**X**	**X**	**X**	**X**	**X**	**X**	**X**	**35***
XXXIV Sub-task No 2							**X**			**X**				**Œ 50**	**150**
XXXVI		**20**					**40**				**Œ 50**			**40**	**150**
XXXVII **		**X**					**Œ X**	**X**		**X**	**X**			**X**	**1 100**
XXXVIII							**X**			**Œ X**	**X**	**X**		**X**	**120**
XXXIX		**X**					**X**				**Œ X**				**25**
TOTAL															**1 580**

* Annual budget € 30 000 in 2010 plus € 5 000 for Fuel Info

** In addition to the 6 AMF participants 3 participants from Bioenergy IA (EC, DE, and FI) and 2 participants from Hybrid and Electric Vehicles IA (CH and US)

5. Progress Reports by the Operating Agents

(Status February 2009)

5.1 Annex XXVIII Information Service & AMF Website (AMFI)

Operating Agent	VTT Technical Research Centre of Finland
Started	Started 2004-01-28 (ExCo 29, Decision #14)
Project Duration	Continuous
Participants	All Contracting Parties (16 countries)
Total Budget	€ 20 000 in 2005, € 36 000 in 2006 (AMF Outlook extension), € 40 000 in 2007 (Standardisation extension by Atrax), € 25 000 in 2008 (extension of renewal of website) € 25 000 in 2009 € 30 000 in 2010 plus € 5 000 for Fuel Info Paid via the Common Fund
Responsible	Mrs. Päivi Aakko-Saksa VTT Technical Research Centre of Finland P.O. Box 1000 (Biologinkuja 5) FI – 02044 VTT Phone: +358 40 505 57 50 Fax: +358 20 722 70 48 E-mail: paivi.aakko@vtt.fi

Background

AMF has been running an Information Service called IEA AMF/AFIS (Automotive Fuels Information Service) under two previous Annexes, Annex IX and Annex XXIV. Annex IX produced, among other things, five volumes of the "Automotive fuels survey" for AMF. In 2000-2004 Annex XXIV produced three yearly Newsletters on the subject of automotive fuels and related issues. Innas BV of Holland handled both Annexes. Since 1999, VTT Processes (Finland) has been maintaining a website for AMF.

In 2004 AFIS was replaced by a new information system, AMFI (Advanced Motor Fuels Information, Annex XXVIII). AMFI now combines an electronic Newsletter service and maintaining the AMF website.

Objectives

Sharing and providing information are very important elements in IEA cooperation. The new information system AMFI makes use of electronic communication. AMFI comprises the production of electronic Newsletters and the maintenance of the AMF website.

AMFI/Annex XXVIII is a low budget Annex, and all participants of the AMF Agreement share its costs. AMFI/Annex XXVIII provides an easy access platform for those parties interested to join the cooperation of the Advanced Motor Fuels Agreement.

Deliverables

AMFI provides four yearly electronic Newsletters describing recent developments in transportation fuels, vehicles, energy, and environmental issues in general. So far, 20 issues have been distributed, one in October 2004, four in 2005, three in 2006, four in 2007, four in 2008, and four in 2009. Each issue covers a list of fixed themes: Natural gas and LPG, ethanol, bioesters, synfuels and sunfuels, other advanced fuels (hydrogen, DME etc.). In addition, each issue is focused on one particular theme with a general section. E.g., the following focus themes were discussed in special articles:

- Policies on alternative fuels, biofuels, and energy efficiency
- Process technologies on alternative fuels, Coal to liquids, Biomass to liquids, Hydro treatment of oils and fats
- Plant oils as feedstock and their sustainability (jathropa, palm oil, algae)
- Development of emission regulations
- Engines and fuels go hand in hand into the future

All material presented in the Newsletters is assembled in a special Newsletter database on the website. The Newsletters can bee freely downloaded on the AMF website.

The AMF website serves both the general public interested in transportation fuel related issues and the Members of the Advanced Motor Fuels Implementing Agreement. For the Members, a special password protected area is provided. The website, originally built up in 1999, was renewed in 2008 to utilise today's possibilities of website technology.

A highly topical "Outlook Report" on projections for transportation energy, vehicle technology and advanced/alternative fuels was distributed as a restricted version to the Executive Committee in February 2007. A condensed version of the "AMF Outlook" report was prepared in co-operation with EU Bioenergy NoE, and this report is now publicly available. As of December 2009 this document had been downloaded from the AMF website over 50,000 times since it was made available online earlier in 2009.

The Operating Agent has recently proposed to introduce an Alternative Fuels Information System presenting:

- Basic information on alternative fuels at AMF website
- Extensive information from feedstock to end-use issues - focusing on end-use
- Increased visibility of AMF

The new system will be built up gradually covering 1-2 fuels per year. The first year 2010

will cover ethanol and biodiesel. The work will continue according to yearly decisions.

Sub-task No 1 "Fuel Standards"

Björn Rehnlund, Atrax, has earlier presented proposals on "Co-operation with ISO and CEN on Standardization" and "International Standard for Fuel Ethanol". In October 2006 it was decided to include this work with modified content in the AMFI Annex XXVIII in the form of a Sub-task No 1 "Outlook on Standardization" prepared by Atrax and published on the AMFI website. Thus, all the member countries will be involved. Atrax will under the AMFI Annex XXVIII carry out the work and prepare the reports. A sum of € 20 000 has been allocated from the Common Fund to include Atrax's work on "Outlook on Standardization" in Annex XXVIII during 2007 (ExCo 32, Decision #8) and 2008 (ExCo 34 Decision XX). A draft report was sent out for comments at ExCo 34 and the final report was distributed in October 2008.

5.2 Annex XXXIII Particle Emissions of 2-S Scooters

(Reduction technology and Inputs for Legislation)

Operating Agent	Univ. of Applied Sciences Bern (AFHB) Lab. for Exhaust Emissions Control, Switzerland
Assistant	Prof. Jesper Schramm, DTU, Denmark
Started	Started 2004-10-21 (ExCo 30, Decision #8)
Project Duration	July 2004 – December 2009 (5,5 years)
Participants	CA, CH, DK, FI, FR, IT, and JRC EU Laboratories (6 countries + EU)
Total Budget	No AMF budget. Task-sharing. Total cost CH € 20 000.
Responsible	Prof. Jan Czerwinski Univ. of Applied Sciences Bern (AFHB) Lab. for Exhaust Emissions Control Gwerdtstrasse 5 CH-2560 Nidau Switzerland Phone: +41 32 321 66 80 Fax: +41 32 321 66 81 E-mail: jan.czerwinski@hti.bfh.ch
Assistant Background	Prof. Jesper Schramm, DTU, Denmark

The serious health effects of particle emissions from traffic are known from the discussions about diesel engines technology and legislation. In this context the particle emissions of small 2-S engines with lost oil lubrication cannot be neglected any more.

A particular concern is about the 2-S scooters, small motorcycles and 2-S 3-wheelers which in several countries are used very much in congested city centers.

Objectives

According to the participation of different partners there are following objectives of the activities:

- basic research of the 2-S aerosols, their composition with different lube oils and fuels and with different engine technology
- study of sampling and measuring procedures for particle mass and particle size distribution
- research of improvements of exhaust gas after-treatment systems
- toxicity and new methods of health effects research
- new inputs for industrial partners concerning their products
- new inputs for the legal authorities
- including of new partners, who actively work in this field and creation of further collaboration and/or information exchange.

Content of Work

- Technical topics of the Swiss working network:
  - emission factors of 2-S scooters with consideration of particle mass and counts
  - catalyst ageing
  - research of sampling for particle analysis
  - research of influences of different oils and fuels on the particle emissions
  - research of emissions, of catalyst ageing and VOC-analytics at the EMPA Federal Laboratories
- Analytical works at the JRC EU Laboratories, Ispra (PAH, TEQ)
- Preparations of the joint activities with the French toxicity network
- Preparations of activities with Asian countries and authorities
- Requests for participation and/or information by other interested parties under leadership of Prof. J. Schramm, DTU

Results and Reports

The summaries of the results is given in the information reports for Annex XXXIII, (see: www.iea-amf.vtt.fi):

1st information report (B169) for Annex XXXIII (Oct. 2005)
2nd information report (B189) for Annex XXXIII (Nov./Dec. 2006)
3rd information report (B209) for Annex XXXIII (Nov./Dec. 2007)
4th information report (B249) for Annex XXXIII (Jan. 2009)

In this reports some additional information about 4-stroke 2- and 3-wheelers and other activities from literature and Internet were presented.

The most important conclusions are:

- The importance of 2-S 2-wheelers emissions and their contribution to the air pollution in the cities is recognized and investigated in several countries.
- The primary source of particle emissions is lubricating oil, which consumption has to be minimized.
- Several improvements of particle emissions can be achieved by right choice of oil quality, by increasing the catalytic post oxidation, by using more efficient particle trap systems and eventually using of alternative fuels.
- Very sophisticated technical solutions, like hybrid scooter, or H_2-mobike are possible, but difficult from the point of view of costs.
- There is an interest of the EU-authority to further lower the emission levels and the toxic effects of 2-S 2-wheelers. Nevertheless the legal limits for particle mass, or counts are still not taken into consideration, for this sensible market sector.

Special Event

- Organization of the Scooter Emissions Conference, Monza (Milan), June 11-12, 2009 in collaboration of BAFU CH, EC JRC It and IA AMF.

Future Plans

- Adaptation of the results to the engine/vehicle technology from other markets
- Further studies of health effects and toxicology, further information
- Support by legal authorities
- Continuation of information work and knowledge transfer (publications and conferences).

5.3 Annex XXXIV Biomass Derived Diesel Fuels

5.3.1 Sub-task No 2 Algae as a Feedstock for Biofuels

Operating Agent	Sentech, Inc., USA
Started	Started 2008-12-04 (ExCo 36, Decision #4)
Project Duration	December 2009 – December 2010 (1 year)
Participants	FI, JP, TH, and US (4 countries) Greece has declared interest in Task sharing
Total Budget	Funding required: € 150 000, of which US Department of Energy will supply € 50 000. Details of contributions from the other countries are to be determined.
Responsible	Dr. Ralph McGill, Sentech, USA
Assistants	- Martijn van Walwijk, covering Europe, and - Nuwong Chollacoop, covering Asia, will each provide ¼ of the work - Sentech, the Operating Agent, will provide half the work

Background

The ultimate potential of algae is huge:

- Could harvest crop every day instead of once per growing season
- Algae productivity is 30 to 50 times as great per hectare as conventional crops
- Potential for algae is too large to ignore

The interest in algae has exploded worldwide:

- Industry and interest groups have formed
- Investments being made in start-up activities, worldwide
- National and international conferences being held
- Researchers face challenges in every aspect of algae fuel production

During ExCo 36 McGill presented a proposal for a new Annex and gave a short presentation of the proposal. Four countries Finland, Japan, Thailand, and USA declared interest. Denmark and Sweden had to consult national authorities first. The Committee than decided to start a new Sub-task No2 "Algae as a Feedstock for Biofuels – An Assessment of the State of the Technology and Opportunities" under the umbrella Annex XXXIV with Sentech as Operating Agent – on condition that the Bioenergy IA has no objections.

The outcome of the following discussions during ExCo 37 in Helsinki was a confirmation that AMF will undertake its own cost-shared project on algae, but keeping close contact to

Bioenergy. Bioenergy will have its own task of algae. There is a need to co-ordinate the activities. Focus within AMF's project will be on engineering and end-use, whereas Bioenergy will focus on "upstream" issues.

Objectives of the Sub-task

- Inventory and assess the important R&D activities in the area of algae fuels
- Make recommendations about the most promising pathways to large-scale production of algae-based fuels

Content of Work

Main tasks of the Sub-task:

- Inventory important R&D projects in algae fuels. Focus on challenges.
- Using discussions with researchers and visits to R&D projects, develop an assessment of the R&D directions that have most promise.
- Develop recommendations intended to aid governments and policy-makers in their decisions on funding R&D in this area.
- Identify a particular area of work in algae fuels that would be attractive to the IEA-AMF for funding in a 2nd phase.
- Report progress in ExCo meetings, and provide a final report.

Financial Status

Funding required: €150 000 of which US Department of Energy will supply €50 000 (tentative agreement) and 10 other member countries will provide €10 000 each.

Canada, Finland, Japan, and USA declared interest (4). Denmark and Sweden had to consult national authorities first.

5.4 Annex XXXV Ethanol as Motor Fuel

During ExCo 33 it was decided to start a new Annex XXXV "Ethanol as Motor Fuel" as an umbrella for various Sub-tasks with Jesper Schramm as Annex Coordinator (ExCo 33, Decision #3). It was also decided that all Member Countries participate in the new Annex XXXV without committing any funds (ExCo 33, Decision #4). Finally, it was decided to start a new Sub-task No 1 "Ethanol as a Fuel for Road Transportation" under the umbrella Annex XXXV with Jesper Schramm as Operating Agent (ExCo 33, Decision #5).

5.4.1 Sub-task No 1 Ethanol as a Fuel for Road Transportation

Operating Agent	Technical University of Denmark (DTU), Denmark
Started	Started 2007-04-20 (ExCo 33, Decisions #3-5)
Project Duration	April 2007 – December 2009 (2,5 years)
Participants	All Contracting Parties (15 countries)
Total Budget	No AMF budget. Task sharing. € 5 000 used for printing.
Responsible	Prof. Jesper Schramm Technical University of Denmark (DTU) Bldg 403 DK-2800 Lyngby Denmark Phone: +45 4525 4179 Fax: +45 4593 0663 Mail: js@mek.dtu.dk

Background

Ethanol is an excellent alternative fuel for road vehicle application. If the application of ethanol is going to increase, there is a demand for rather technical, but easily understood, information about the applicability of ethanol as an engine fuel.

Objectives

The purpose of this project is to provide an easily read technical report about the applicability of ethanol as an engine fuel. The final report describes the potential for ethanol application in the member countries participating in this annex. The results from the investigations of the member countries´ situations have been extrapolated to recommendations for worldwide implementation in a near future

Content of Work

The project has been inspired by the AMF Executive Committee discussions in addressing the following questions:

- "Gasoline/ethanol blends. How much ethanol can be tolerated by gasoline vehicles?"
- "True performance of FFV vehicles?"
- "Conceptual studies for optimized ethanol engines"
- "Diesel/ethanol blends?"
- "The need for ethanol blended fuels"
- "Differentiation of bio from mineral derived ethanol"
- "How ethanol blends perform in GDI vehicles"
- "The need for fuel specifications for ethanol blended fuels"

The main report has been followed up by individual implementation reports from the member countries.

Financial Status

The Annex is task shared. The internal Danish budget for the main report is € 70 000.

Results and Reports

The final technical report can be downloaded from the AMF website. The main report including a number of country reports will be printed. It will also be translated into Japanese and Thai.

The Sub-task No 1 was closed in December 2009.

5.5 Annex XXXVI Measurement Technologies for Hydrocarbons, Ethanol, and Aldehyde Emissions from Ethanol Powered Vehicles

Operating Agent	Swedish Road Administration (SRA), Sweden
Started	Started 2007-11-15 (ExCo 34, Decision #5)
Project Duration	November 2007 – May 2010 (2,5 years)
Participants	CA, FI, SE, and US (4 countries)
Total Budget	Total cost € 150 000 + contributions from industry

Responsible Mr. Olle Hådell
Swedish Road Administration (SRA)
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Phone: +46 243 753 98
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Mail: olle.hadell@vv.se

Assistant Mr. Lennart Erlandsson, AVL MTC, Sweden

Background

In recent year's hydrocarbon, aldehyde and alcohol tailpipe emissions from flexible fuelled vehicles fuelled by alcohols have received an increased attention in Europe together with an increased and expanding interest in alternative fuels for vehicle propulsion.

Due to the fact that alcohol fuel blends have different fuel properties compared to conventional fuels such as gasoline/diesel, it is important to study factors, which affect the reproducibility and repeatability of the HC measurements from such vehicles.

Aldehyde and alcohol tailpipe emission measurements need to be further evaluated i.e. comparing different measurement methods.

Objectives

The aim of the project is to provide crucial information for developing the methodology for measuring HC, aldehyde and alcohol tailpipe emissions from ethanol-powered vehicles. The project also aims to find a simplified method using today's legislative measurement technology that can account for differences in harmfulness between exhausts from gasoline and ethanol powered vehicles.

Content of Work

The project is divided into three different tasks:

Task 1: Fact finding (literature and interviews)

- Regulation (including EU)
- Measurement specification (level, sensitivity, cost indication, time etc)
- Lab experience
- Question area

Task 2: Measurement and Correlation study of HC and ethanol

- FID measurement of ethanol, propane calibration gases with different concentration and oxygen content in carrying gas.
- Measurement of ethanol and propane calibration gases in bags with different waiting time.
- Using different type FID and individuals for measuring ethanol, propane calibration gases.
- Using FID at different sampling and detector temperature for measuring ethanol, propane calibration gases.

- Comparing MS, Photo acoustic and FTIR for measuring ethanol calibration gas.
- Ethanol and propane bomb test in CVS system.
- Measurement of an unknown gas bottle with ethanol and propane mixture in different labs.
- Analyse ethanol solutions at different labs.

Task 3: Vehicle tests

- Emission tests at different temperature (22°C, -7°C, -15°C).
- Emission tests with different CVS flow.
- FTP tests and NEDC tests
- Emission tests with different fuels.
- Comparing FTIR with MS for ethanol measurement
- Comparing photoacoustic with MS for ethanol measurement
- Comparing two MS for ethanol measurement
- Comparing FTIR and cartridge for aldehyde measurement
- Comparing different cartridge setup and sampling flow rate for aldehyde measurement.

The tasks will be performed at different test labs. Some tasks may be combined and performed simultaneously.

Financial Status

Financing of the project is arranged according to initial plan. Participating countries have fulfilled their obligations. Input for the vehicle industry has not been as expected due to the turbulence in the automotive business. The output of the project is in line with the originally approved project plan.

Results and Reports

The project has been almost completed and that financing has been arranged according to plans. Test of vehicles and validation of calibration gases including measurement procedure has been finalized. Due to the turbulence within the vehicle industry, minor adjustments of the original test program were needed. However, the main objective with the project has been fulfilled.

A draft report has been distributed to the Annex Participants for comments. After consideration of submitted comments, the report will be modified accordingly. The Participants have earlier approved that a SAE-paper is prepared. When and where the SAE publication will be presented will be announced at the next ExCo meeting May 2010 in Ottawa.

In late December 2009 an abstract was submitted to SAE with the intention to be presented at the SAE International Powertrains, Fuels & Lubricants Meeting arranged by SAE Brazil beginning of May 2010. A final decision from SAE is expected late February 2010.

5.6 Annex XXXVII Fuel and Technology Alternatives for Buses

Operating Agent VTT Technical Research Centre of Finland, Finland

Started	Started 2008-05-30 (ExCo 35, Decision #4)
Project Duration	June 2008 – July 2011 (3 years, modified)
Participants	**AMF IA:** CA, FI, FR, JP, SE, and US (6 confirmed participants) **Bioenergy IA:** European Commission, DE, and FI (3 conf. participants) **Hybrid and Electric Vehicles IA:** CH and US (2 conf. participants)
Total Budget	€ 1 100 000 (confirmed)
Responsible	Dr. Nils-Olof Nylund VTT Technical Research Centre of Finland P.O.Box 1000 FIN-02044 VTT, Finland Phone: +358 20 722 5518 Mobile: +358 400 703 715 Fax: +358 20 722 7048 Mail: nils-olof.nylund@vtt.fi
Assistant	Dr. Ralph McGill, FEEC, USA Liaison officer for North America

The objectives are:

- To access overall energy efficiency, emissions and costs, both direct and indirect costs, of various technology options for buses
- To provide solid IEA sanctioned data for policy- and decision-makers and
- To bring together the expertise of various IEA Implementing Agreements (Bioenergy, AFC, AMF, AMT, Combustion, HEV, and HIA).

Present time schedule (modified):

- Preparations June 2008 - March 2009
- Actual testing April 2009 - July 2010
- Collecting WTW and WTT data April 2009 - July 2010
- Estimating direct and indirect costs March 2010 - September 2010
- Modelling environmental performance March 2010 - September 2010
- Synthesis of results September 2010 - June 2011
- Final report July 2011

The tasks and the working partners are:

Well-to-tank analyses:

- Argonne National Laboratory
- Natural Resources Canada
- VTT
- Additional support from Bioenergy Task 39

Tank-to-wheel (vehicle performance):

- Environment Canada
- VTT
- AVL MTC (Sweden) as a subcontractor to VTT for on-board emission measurements

Overall assessment of energy, emissions externalities and costs:

- ADEME
- Argonne National Laboratory
- Environment Canada
- Natural Resources Canada
- VTT

Actual city bus tests (tank-to-wheel) are currently running in both vehicle laboratories, at Environment Canada and VTT. Environment Canada is evaluating North American vehicles, VTT European vehicles. Both laboratories are carrying out measurements with complete buses on transient-type heavy-duty chassis dynamometers.

Environment Canada has performed preliminary tests on a MY 2008 40 foot bus powered with an 8.9 liter Cummins ISM (with EGR) engine and hybrid transmission. Exhaust emissions were measured using an oil sands derived fuel, along with B5 and B20 biodiesel (FAME) blends over the SAE Manhattan drive cycle. Currently, a 2008 6.7 liter Cummins ISB (with EGR) engine with hybrid transmission is being tested with the same fuels and additional drive cycles including the Heavy Duty Urban Dynamometer Driving Cycle, the Orange County Drive Cycle, and the ADEME/RATP bus cycle. Next year, it is planned to test a hybrid urban bus meeting 2010 emissions standards along with other conventional and advanced bus technologies with a combination of fuels, including second generation biodiesel fuels, and drive cycles.

VTT has started its measurements on buses with conventional drivelines. Two older buses representing Euro II and Euro III emission certification have been measured as reference. Also three new buses with EEV certification (enhanced environmentally friendly vehicle) have been measured: one diesel vehicle representing SCR technology (selective catalytic reduction), one diesel vehicle representing EGR technology (exhaust gas recirculation) and one natural gas bus with a stoichiometric engine. The diesel buses were tested with several types of fuels, including EN590 (baseline European diesel fuel), HVO (paraffinic hydro treated vegetable oil), GTL (synthetic gas-to-liquids paraffinic diesel), FAME (conventional biodiesel) and blended fuels. Scania´s ethanol technology also will be evaluated.

Discussions regarding testing of European hybrid buses are under way with the vehicle manufacturers. Two different parallel hybrids are already scheduled for measurements, and further discussions on serial and hydraulic hybrids are under way.

The first set of on-board emission measurements will take place in November 2009. These tests are included in the project to demonstrate the effect of real world driving conditions, congestion, payload and environmental conditions on energy consumption and emissions. The work is carried out in cooperation with AVL MTC and VTT. In the first phase, one Euro III diesel bus, one EEV diesel bus and one EEV natural gas bus will be measured.

The well-to-tank analyses also have commenced at Argonne National Laboratory, Natural Resources Canada and VTT. A review of 25 LCA studies for biofuels has been done. The results of the various LCA studies vary remarkably and are currently analysed and documented.

Different calculation models (US GREET, Canadian GHGenious, EU Directive (2009/28/EC) are under evaluation and a number of fuels have been selected as references for comparison.

Biofuels analysed so far are: FAME from rapeseed, FAME from soybeans, FAME from palm oil, HVO from palm oil, HVO from rapeseed, HVO from soybeans, HVO from Jatropha, HVO from animal fats, BTL from wood residues, BTL from energy crops, ethanol from grain, ethanol from sugarcane, ethanol from cellulosic feedstock and ethanol from waste.

On request from the European Commissions, DME has been added to the fuel matrix. This means both WTT evaluations and actual vehicle tests using a prototype DME truck to simulate bus operation.

AMF invited both Bioenergy Implementing Agreement and Hybrid and Electric Implementing Agreement to join the Annex and contribute with cost sharing. For Bioenergy, participation was confirmed in September 2009 and for Hybrid and Electric Vehicle in November 2009.

5.7 Annex XXXVIII Evaluation of Environmental Impact of Biodiesel Vehicle in Real Traffic Conditions

Operating Agent	National Traffic Safety and Environment Laboratory (NTSEL), Japan
Started	May 2009 (ExCo 37, Decision #6)
Project Duration	June 2009 – May 2011 (2 years)
Participants	FI, JP, SE, TH, and US (5 confirmed participants)
Total Budget	US $ 170,000 (confirmed) plus US $ 30 000 (pending)
Responsible	Dr. Susumu Sato Environment Research Department National Traffic Safety and Environment Laboratory (NTSEL) 7-42-27 Jindaiji-higashimachi Chofu, Tokyo, 182-0012, Japan Phone: +81-422-41-3220 Fax: +81-422-76-8604 E-mail: su-sato@ntsel.go.jp

Background

From the view point of GHG and Carbon Neutral, Biodiesel fuel (BDF) has been paid attention because of its potential to greatly contribute to global environmental protection. Due to this, the promotion to produce and use BDF has proceeded all over the world.

On the other hand, the diesel vehicles adapted to the latest emission regulation have the most recent elemental technologies and the precise electronic control of these technologies to reduce exhaust emissions. However, these technologies have been optimized for the vehicles fuelled with light oil. Therefore, when the latest diesel vehicles are fuelled with BDF whose property is much different from light oil, emission characteristics will grow worse.

Thus, the promotion of BDF is highly effective for the reduction of GHG emission and recycling, at the same time, it is concern that there is a possibility to affect atmospheric environment. To eliminate these sources to inhibit BDF promotion, it is necessary to research the emission characteristics of the latest vehicles fuelled with BDF.

Objectives

- How does biodiesel fuels (BDF) affect emissions of the newest diesel vehicles?
- The real-world emissions of the diesel vehicles fuelled with BDF
- Diesel vehicles applied to BDF without special customizing
- Comparison of the real-world emissions between the case of light oil and that of BDF
- Effect of BDF on the real-world fuel economy

Content of Work

- Chassis dynamometer test (Light oil, 1st generation BDF and 2nd generation BDF)
- Real-world driving test for emission and fuel economy measurement (Light oil, 1st generation BDF and 2nd generation BDF)
- Real-world driving test under the cold start condition

Financial Status

- The invoice was sent by the end of October 2009.
- The contributions from all the participating countries at this moment will be paid by early 2010.
- The project has already started with 5 participating countries.
- Total cost is US$200,000. US$170,000 is confirmed, US$30,000 is pending.

Present time schedule

- Light oil chassis dynamometer test (done)
- 1st generation BDF chassis dynamometer test (in progress)
- Transport of 2nd generation BDF from Neste Oil (Finland) to NTSEL (in progress)

5.8 Annex XXXIX Enhanced Emission Performance of HD Methane Engines

Operating Agent Swedish Road Administration (SRA), Sweden

Started May 2009 (ExCo 37, Decision #8))

Project Duration	May 2009 – February 2010 (10 months) (for the literature survey)
Participants	CA, FI, and SE (3 countries)
Total Budget	€ 25 000 + contributions from industry
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Assistant	Mr. Lennart Erlandsson, AVL MTC, Sweden

Background

Vital components for reduction of greenhouse gases, except for reduction of VMT, is to use biofuels to a larger extent and to enhance the fuel efficiency of an engine/drivetrain. For heavy duty vehicle applications, methane fuelled engins have been introduced and in case the methane is produced by biomass, the GHG will be reduced significantly. However, methan fuelled HD engines has not yet been a success story since the engines used normally are desigend to operate of diesel fuel. Those engines are then "converted" either by OEM´s or as retrofit systems to operate on methane gas. Late technology methane fuelled engines meeting Euro VI/US10 emission requirements show a high potential for low emissions but might have some difficulties in meeting durability requirements.

Further, the EU and ECE regulatory systems do not allow engines using a simultanious mix of two fuels (methane gas and diesel) to be approved according to present legislation. This is considered as a hurdle for the future development of DDF concepts.

Objectives

The aim of the project is to present a literature survey to define state-of-the-art for fuel efficient HD methane engines. Consepts subjected to the study is spark ignited engines as well as engine fuelled with a variable mix of diesel and methan gas (Diesel Dual Fuel, DDF). The result of the study will be the base for the further work within this Annex.

Content of Work

The report will eloborate the following main issues:

- Engine technology (lean burn vs. stoichiometric & diesel dual fuel)
- Technology for after treatment of the exhaust (TWC, SCR, EGR, DPF)
- Market and literature survey
    - Engine and system manufacturer
    - Field experience

    - Emission measurement in laboratories
- Possibility for international (EU, ECE) approval of DDF concepts
- Summary of position papers from some (IEA-AMF) member countries
- Conclusions
- Road map for recommended further work (to be presented at next IEA-AMF meeting)

Member states participating in task sharing activities have supplied technical reports, but obstacles due to confidential issues have been identified. Support from vehicle manufacturers has not reached expected levels. However legislators have supported the project with comments and proposals for further development of administrative procedures.

Financial Status

Financing is in principal agreed upon, but some administrative issues have to be concluded before finalizing the report.

Time Schedule

A decision (#8) to start a new Annex was formailzed at the ExCo meeting 37 (Helsinki). A Final Draft Report was presented at ExCo meeting 38 and the report was distributed to Annex participants for comments. The Final Report will finalised in the next couple of weeks.

Results and Reports

The Final Report will placed on the Public domain after finalizing. At the next ExCo meeting a proposal for further work will be presented.

Future Plans

The result from the study will be presented as further recommended work. During the work the following areas where indetified as areas with low level of information:

- Operating cost for methane fuelled vehicles
- Benchmarking by actual vehicle testing of state-of –the-art concepts
- Verification of potential for reaching loe emission levels for DDF concepts
- Development of a first proposal for testing engine concepts using two fuels simultanious.

Appendix 1

AMF ExCo Meetings

1984-90 AMF = Alcohols as Motor Fuels
1990-98 AMF = Alternative Motor Fuels
1998- AMF = Advanced Motor Fuels

		Date	*Chairman*	*Secretary*	
a	Madrid	80/3	Staffan Ulvönäs, SE	Folke Schippel, SE	
b	Stockholm	80/7	"	"	
1.	Ottawa	84/5	Gene Ecklund, US	Folke Schippel, SE	
2.	Stockholm	84/11	"	"	
3.	Dearborn	85/7	"	"	
4.	Vancouver	86/2	"	"	
5	Paris	86/10	"	"	
6.	Tokyo	87/5	"	"	
7.	Milano	87/11	"	"	
8.	Kiruna, S	88/6	"	Kjell Isaksson, SE	
9.	Tokyo	88/11	Shinichi Nakayama, JP	Folke Schippel, SE	
10.	Vancouver	89/6	"	"	
11.	Rome	89/11	PierPaolo Garibaldi, IT	"	
12.	Los Angeles	90/6	"	"	
13.	Stockholm	90/11	"	"	
14.	Espoo/Helsinki	91/8	"	"	
15.	Kyoto	92/6	"	"	
16.	The Hague	93/4	Bernie James, CA	Kerstin Larsson, SE	
17.	Antwerpen	94/2	"	Irene Kolare, SE	
18.	Toronto	94/10	"	"	
19.	Saltsjöbaden, S	95/9	"	Lars Vallander, SE	
20.	Oxford	96/6	"	"	
21.	Charleston	97/3	Ben van Spanje, NL	Claës Pilo, SE	
22.	Rovaniemi, FIN	98/1	"	"	
23.	Tokyo	98/10	"	"	
24.	Espoo/Helsinki	99/6	Nils-Olof Nylund, FI	"	
25.	Toronto	00/6	"	"	
26.	Copenhagen	01/5	Arie Brouwer, NL	"	
27.	Milano	02/4	Nils-Olof Nylund, FI	"	
28.	Paris	03/3	"	"	
29.	Linköping	04/1	Steve Goguen, US	"	
30.	Sao Paulo	04/10	"	"	
31.	Prague	05/11	"	"	
-	Toronto	06/06	"	"	(Short planning meeting)
32.	Beijing	06/10	"	"	
33.	Detroit	07/04	"	"	(Mini-meeting)
34.	Honolulu	07/11	"	"	
35.	Vienna	08/05	"	"	
36.	Osaka	08/12	Nils-Olof Nylund, FI	"	
37.	Helsinki	09/05	"	"	
38.	Bangkok	09/11	"	"	

Appendix 2

Executive Committee on Advanced Motor Fuels

(Status February 2010)

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MAIN RESULTS OF COMPLETED AMF PROJECTS/ANNEXES

(Annex I – XXXV)

Detailed information about participating countries and their contributions is found in Tables A-D at the end.

Annex I — Alcohols and Alcohol Blends as Motor Fuels

Operating Agent: SDAB (SE)

This initial project/annex resulted in a state-of-the-art publication in three volumes printed in 2 000 copies which became a best seller in 1986.

Annex II — Technology Information Exchange on Alternative Motor Fuels

Operating Agent: SDAB (SE)

A number of studies on specific issues concerning various alternative motor fuels were reported in a series of ”TRENDS”. Altogether 21 different reports were prepared and distributed to the participating countries.

Annex III Alcohol Diesel Field Trials

Operating Agent: Sypher (CA)

Data were collected, assessed and disseminated on the use of various methanol fuels in heavy-duty compression ignition engines used in trucks and buses as well as in rail, marine and stationary applications. The project resulted in 13 reports.

Annex IV Production of Alcohols and Other Oxygenates from Fossil Fuels and Renewables

Operating Agent: Natural Resources Canada (CA)

The activities of the Annex were conducted in two phases. The second phase, which was completed in 1995, consisted of four studies, dealing with

- Natural Gas Supply, Demand and Price;
- Economic Comparisons of the LNG, Methanol and Synthetic Distillate;
- A Comparison of the Production of Methanol and Ethanol from Biomass;
- Greenhouse Gas and Other Emissions to Air Resulting from Ethanol and Methanol Use as Alternative Fuels.

These studies demonstrated that feedstock availability for production of alternative fuels is not of concern, especially with regard to fossil fuels-based processes.

The production cost of alternative fuels, including the costs of feedstock, processing and transportation, has been provided for a large number of locations around the world.

The environmental benefits, as expressed in carbon dioxide-equivalent vehicle emissions, showed a great reduction for biomass-derived fuels, but minor variations for fossil fuel-based alternative fuels.

Annex V Cold Test Emissions

Operating Agent: VTT Processes (FI)

The first final report was published in March 1995 as a restricted report. After completing the later approved addendum on diesel vehicles, a new final report was published in February 1996 as a public report, according to decisions taken by the Executive Committee.

Altogether 3 engines and 14 cars were measured at 5 ambient temperatures, using new sophisticated emission analysis methods. The fuels used were different types of gasoline and diesel fuels as well as methanol and ethanol blends, LPG and CNG. The results indicated that M85 fuel can give lower emissions than gasoline in warm conditions, though the emission of unburned methanol must be controlled. Natural gas and LPG proved to be inherently clean fuels, which, using up-to-date engine technology, give low emissions in all conditions.

Annex VI Natural Gas as Motor Fuel

Operating Agent: Sypher (CA)

Assistant: SDAB (SE)

International information and experience of present and future use of natural gas as a motor fuel was collected, analysed and synthesised. The project included the use of compressed natural gas (CNG) and liquefied natural gas (LNG) in light-duty vehicles and heavy-duty vehicles. The potential of methane produced from biomass (biogas) was also explored.

Annex VII Comparison of Relative Environmental Impacts of Alternative and Conventional Fuels

Operating Agent: ORNL (US)

Assistant: Phase 1: SDAB (SE). Phase 2: Innas (NL)

Results of the project were (1) a paperback book detailing the findings of the study and (2) an addendum to the book updating the findings with results of more recent research on environmental impacts of alternative fuels. Both publications are useful to policy makers when a decision is necessary on whether to employ alternative fuels in transportation.

Annex VIII Heavy-Duty Vehicles on Alternative Fuels

Operating Agent: VITO (BE)

This annex was carried out in two phases. In the first phase an analysis of the results of 73 different demonstration projects set up in several countries around the world was carried out. Because demonstration projects have different goals, use different test methods and procedures, it was hard to compare the results. A unification of test methods, especially for emissions and energy consumption, will increase the value of the outcome of a demonstration for third parties.

In a second phase a leaflet with recommendation for demonstrations was developed based on the results of the first phase and on the results of a workshop with demonstration experts.

Annex IX Automotive Fuels Information Service (IEA AFIS)

Operating Agent: Innas (NL)

Assistant: Atrax Energi och Miljö AB (SE)

The result of this annex is an independent information service (IEA AFIS) that can answer strategic questions on automotive fuels. This information service has assisted in many other annexes of the Advanced Motor Fuels Implementing Agreement.

During the three operating years of the annex, five books have been produced in a series "Automotive Fuels Survey".

The first two volumes "Raw Materials and Conversion" and "Distribution and Use" describe the relevant aspects of the well to wheel fuel chain of automotive fuels. Fuels included are: gasoline, diesel oil, LPG, natural gas, alcohol fuels, vegetable oils and biodiesels, hydrogen and dimethyl ether. Aspects covered are for example: energy consumption, emissions, costs, technology, infrastructure, legislation and safety.

The third volume "Comparison and Selection" describes a method to use the enormous amount of available information when a decision on automotive fuels has to be made.

Examples are presented to clarify the working method. The examples include the fuels that are addressed in the first two volumes.

Volume four "Innovations or Illusions" addresses some special fuels that are not discussed in the first two volumes. Volume five "Mobile Machinery: Sector analysis" describes energy consumption and emissions of the mobile machinery sector, compared to road vehicles. It also discusses the role of alternative fuels in this sector.

Annex X Characterisation of New Fuel Qualities

Operating Agent: VTT Processes (FI)

The final report was distributed in September 1997 as a restricted report.

The results showed that the traditional cetane number measurement well describes the ignition delay of heavy-duty engines at low and medium loads, but is more suitable for hydrocarbon fuels than for alternative fuels. Thus, the cetane number does not describe the combustion process with advanced light-duty vehicles. The cetane number overestimates the effect of cetane improvers, especially for biodiesels. Esters were also found to act as effective lubricity additives according to HFRR tests.

Annex XI Forecasting and Planning Tools for Alternative Fuels and Related Infrastructure

Operating Agent: Sypher (US)

The final report provided an overview of the major computer models studied. Detailed comparisons were made of the U.S. DOE´s TAFVM, California's CALCARS, Canada's AFIM, and the Netherlands´ Electric Vehicle Impact models. The Canadian alternative fuels infrastructure model (AFIM) was tested using Australian and New Zealand experience. The AFIM model was also used to predict electric vehicle demand in Finland.

Annex XII Particulate Emissions from Alternative-fuelled Vehicles

Operating Agent: ETSU (UK)

Annex XIII Emission Performance of Selected Biodiesel Fuels

Operating Agent: VTT Processes (FI)

Assistant: ORNL (US)

Oak Ridge National Laboratory (ORNL) and Technical Research Centre in Finland (VTT) carried out the project with complementary work plans. The work generated an extensive analysis of the exhaust emissions using biodiesel in new diesel engines. Several different engines were tested at the two sites, and some engines were tested also with emission control catalysts, both at ORNL and at VTT. ORNL concentrated on light and medium duty engines, while VTT emphasized a heavy-duty engine and also used a light duty car as a test bed. Common test fuels for two sites were rape methyl ester in 30 % blend and neat, soy methyl ester in 30 % blend and neat, used vegetable oil methyl ester (UVOME) in 30 % blend, and the Swedish environmental class 1 reformulated diesel (RFD). Results covered regulated emissions, aldehydes, composition of particulate matter, polyaromatic hydrocarbons and limited results of Ames tests on the mutagenicity (particulate matter).

Generally, the biodiesel fuels had higher NOx emissions but lower values of HC, CO, and particulates. Unregulated emissions varied greatly between fuels and engines. VTT's tests showed that the particulates generally seemed to be less harmful for neat bioesters than for diesel fuel. The changes in emissions were not as significant when 30 % bioester blends were compared with EN590 or RFD as when neat esters were used. No major differences were seen in emission performance between RME, SME (soy bean oil methyl ester) and UVOME, even though some benefit was seen for the UVOME fuel regarding CO, HC and aldehyde emissions with the TDI vehicle. The ethanol emulsion fuel gave some emission benefits regarding particulates. The hydrated tall oil blend gave worse emission figures than the other fuels, which is believed to be due to differences in the base fuel.

Both laboratories, ORNL and VTT, prepared final reports. In addition two publications are available.

Annex XIV Investigation into the Feasibility of Dimethyl Ether as a Fuel in Diesel Engines

Operating Agent: TNO (NL)

Annex XIV has been split up in the following seven tasks lead by different industrial enterprises.

- *Trade-off fuel quality versus costs:* Haldor Topsoe (DK) and Statoil (NO)
- *Safety investigation (DME distribution and vehicles):* Renault (FR), Akzo-Nobel (NL), TNO-WT and TNO-MEP (NL) and NRCanada (CA)
- *Design guidelines:* AVL-List (AT), AET (CA), Renault (FR) and DTU (DK)
- *DME from renewable feedstock:* IEA AFIS (Atrax Energi, SE)
- *Life cycle analysis (LCA):* IEA AFIS (Innas, NL), Amoco (US), Statoil (NO), Haldor Topsoe (DK), Volvo Truck (SE), Renault (FR) and TN-WT (NL)
- *Costs of DME infrastructure:* IEA AFIS (Innas), Statoil (NO) and Amoco (US)
- *Workshops / newsletters:* TNO-WT (NL)

Annex XV Implementation Barriers of Alternative Fuels

Operating Agent: Innas (NL)

The report that has been produced under this annex presents an overview of the practical barriers associated with the introduction of an alternative fuel and analyses alternative fuels in broad terms with respect to these practical barriers. Fuels addressed in the report are: LPG, natural gas, ethanol, methanol, biodiesel and hydrogen. Also electric vehicles are included. Some remarks are made on the barriers that may be expected for dimethyl-ether.

Annex XVI Environmental and Economical Aspects of Implementing Biodegradable Lubricants in Vehicle Engines

Operating Agent: DTU (DK)

The results of the project are described in 3 reports that were published in 1999, 2002 and 2004 respectively. Report 1 one was a state-of-the-art report. Report 2 was describing performance experiments, carried out with a diesel vehicle, where an ester based biodegradable lubricant was applied. This situation was compared to experiments where a reference lubricant was applied. In both cases the lubricants where applied in connection with conventional diesel fuels and biodiesel. Report 3 was describing performance experiments, carried out with a gasoline vehicle, where the same ester based biodegradable lubricant was applied. This situation was then compared to experiments where a reference lubricant was applied. In both cases a reference gasoline fuel was applied together with E85.

Annex XVII Real Impact of New Technologies for Heavy-Duty Vehicles

Operating Agent: VITO (BE)

The final report was distributed between the participants in December 2000.

Within this project, three city bus technologies were selected to compare emissions and fuel consumption in real traffic (city and rural), in several vehicle test cycles (CBDC, DUBDC, De Lijn) and in the main official engine test cycles (ESC, ETC, US-FTP, Japan 13-mode). The purpose was to look for clear relations between these test procedures.

The three buses were a Euro-2 diesel bus, a natural gas bus with stoichiometric fuel control and three-way catalyst and a natural gas bus with lean burn fuel control.

The stoichiometric natural gas bus reached very low emission levels compared to the diesel bus (regulated emissions were about 10 times lower). The lean burn natural gas bus needed some adjustments in the lambda control settings to lower its relatively high NO_x emissions.

The test results showed that there is no unique relation between real city traffic emissions and the different engine or vehicle test cycles. The relation depends on engine technology, gearbox (and gear shifting strategy), and the engine load vs. speed distribution during the test cycle.

Annex XVIII Future Greener Diesel Fuels

Operating Agent: Battelle Memorial Institute (US)

In order to support the use of oxygenates in diesel fuels, this annex provided data on the miscibility, flash point, cloud point, water tolerance, vapour pressure, and ignition quality over a range of diesel fuel-oxygenate blends and environmental temperatures through laboratory tests with diesel fuel and oxygenate samples.

The diesel fuels included a USA reference diesel, a Fischer-Tropsch diesel, and an oil sands diesel. The oxygenates tested included:

1. dipentyl ether,
2. tripropylene glycol monomethyl ether,
3. glycerol tributrate (tributrin),
4. 2-ethoxyethyl ether (diethylene glycol diethyl ether),
5. dibutyl maleate,
6. dibutoxymethane (butylal), and
7. diethyl maleate [Only limited work because of miscibility difficulties].

Oxygenate blend levels were 0 (diesel only), 5, 10, 30, and 100 (oxygenate only) volume percent. Test temperatures ranged from -30 to 30 C. Vapour pressure measurements were made using a gas chromatographic technique that distinguished fuel and oxygenate contributions to the total vapour pressure. Ignition quality measurements were made using the IQT constant volume combustion apparatus.

Annex XIX New Fuels for New Engines

Operating Agent: Innas (NL)

The final report was published in January 2001 as volume 6 in the Automotive Fuels Survey series of IEA AMF/AFIS under the title "Fuels for HCCI engines". It describes homogeneous charge compression ignition (HCCI) operation in four-stroke, two-stroke and free piston engines. The relation between fuel characteristics and HCCI operation is discussed. The report contains an extensive list of references and also lists organizations working on HCCI engines. Outside AMF the report has been distributed within the Clean Diesel III consortium, co-ordinated by SwRI in the USA.

Annex XX DME as an Automotive Fuel II

Operating Agent: TNO (NL)

The result of the Annex XX is twofold:

A) Technical research in the area of DME fuel injection systems.
B) Support for international cooperation to stimulate the development of DME as a new fuel.

This was supported by organising workshops and distributing newsletters.
The work also resulted in the foundation of the International DME Association and in a EU project about the development of a DME fuelled truck.

The technical work:
- A test procedure to test material (wear) properties with DME
- Advise on wear resistant coatings for DME fuel injection system parts
- Selection of elastomers suitable for sealing DME fuel systems
- Determination of influence of additives on DME lubricity and viscosity.

Annex XXI Deployment Strategies for Hybrid, Electric and Alternative Fuel Vehicles

Operating Agent: Innas (NL)

In the last years the harmful effects and the greenhouse gases resulting from the use of conventional vehicles created many concerns on continuing in the same direction. Hybrid or electric vehicles and alternative fuels like natural gas, ethanol or hydrogen are considered an essential element in reducing urban pollution and greenhouse gases. But only a wide dissemination of „clean vehicles and fuels“ can have noticeable effects on the environment. Therefore governments, in addition to the support of research and development, more and more implement measures with the aim of promoting the market introduction of these new vehicle technologies – with different approaches and various effects.

Between 2000 and 2002 an international task force collected information on more than 100 programs run in 18 countries. Evaluations and analyses of case studies showed that some approaches are successful, but they also identified weaknesses that are often repeated. The report elaborated by the task force provides recommendations on the base of conclusions drawn by the analyses. They will help government officials responsible for administering fleets, incentives and regulations with assessing the most promising strategy for their country for the market introduction of hybrid, electric and alternative fuel vehicles.

Annex XXII Particle Emissions at Moderate and Cold Temperatures Using Different Fuels

Operating Agent: VTT Processes (FI)

The Annex XXII was active from 2000 to 2003 as a task sponsored by the (IEA/AMF). The research work on particulate emissions of road traffic has been carried out at normal ambient temperature. Even a slight reduction in temperature can increase particulate emissions. For many years, it has been obvious that the knowledge of the total particulate mass emissions is not enough. Quality of these particles, like polyaromatic hydrocarbon content, has already been studied widely. Now there is also a need to gain more information on fine particles. Especially, the possible effect of temperature on particle size has not been studied much. This project was targeted to cover different fuel and engine technologies, including gaseous fuels and biodiesel. Research work focused on different light-duty technologies. However, preliminary tests were conducted with a medium-duty engine to evaluate the suitability of different measuring techniques at low-test temperatures. Light-duty vehicles were as follows: two diesel cars (direct and indirect-injection), stoichiometric gasoline fuelled car (multi-port fuel-injection), direct-injection gasoline car, FFV car running with E85 fuel, CNG and LPG cars. Four fuels with diesel cars were studied: European grade diesel, Swedish Environmental Class 1 fuel and blends of these fuels and RME.

With medium-duty engine the effect of temperature on particles was clear and seen both in the particle mass and number results, which was assumed to be related to the condensed hydrocarbons. Generally, both particle mass and number emissions were high with diesel cars when compared to the other cars. Particle emission increased as test temperature decreased in

the beginning of the test (cold start) with both diesel cars, but the effect of temperature diminished when engine warmed up. RME showed benefit concerning particle mass emissions, but indication of higher number of particles and peak at lower size class was seen when compared to EU2000 at -7 °C, but similar effect was not seen when RME was blended with the reformulated diesel fuel. Particle emissions were extremely low at +23 °C with MPI, E85, CNG and LPG cars, but significantly higher with the G-DI car. Particle mass and number emission from MPI, E85, LPG and G-DI cars after cold start increased to some extent as temperature decreased. The particle mass and number emissions from the CNG car stayed at the "zero" level at all temperatures studied. Typically, if the effect of temperature on particle results was seen, it occurred after the cold start and diminished as engine, catalyst and/or EGR system warmed-up.

Annex XXIV Information Exchange IEA AMF/AFIS

Operating Agent: Innas (NL)

Three newsletters were produced and distributed annually under this Annex. Distribution was inside the AMF community and also to a large audience outside AMF. The newsletters provided the latest worldwide news on advanced motor fuels. In every issue there was a section describing activities and results of the Implementing Agreement, including the results of the work in other Annexes.

Annex XXV Fuel Effects on Emissions from Non-Road Engines

Operating Agent: VTT Processes (FI)

The Annex came active on May 2001 and was completed summer 2003. Existing data has been put on the IEA AMF web site since the autumn of 2001. Measurements were carried out with small gasoline engines and non-road diesel engines. The objective of this Annex was to study how fuel quality affects the exhaust emissions from engines mentioned above.

The measured small engines were a 2-stroke chainsaw engine, and a 4-stroke OHV engine, which could be used in different applications. Measurements were done with three different fuels, with and without catalyst. The results clearly demonstrate that using a good quality fuel (e.g. low sulphur, low aromatics) and a catalyst gives the best outcome in overall emission levels from these small engines.

In the second part two different diesel engines were tested with five different fuels. Two of the fuels were biodiesel blends. The engines were chosen to represent old and new engine technology. The old engine (MY 1985) was produced before EU emission regulations were in place, and the new engine fulfilled the current EU Stage 2 emission limits. With the new engine comparison with and without oxidation catalyst was done using two fuels. The results in general are similar compared to the results from the small gasoline engines: fuel quality has an effect on the emissions and when combining a good quality fuel (e.g. low sulphur, low aromatics) and an oxidation catalyst the emission levels are significantly reduced.

Annex XXVI Alcohols and Ethers as Oxygenates in Diesel Fuel

Operating Agent: Befri Konsult (SE) & TEC TransEnergy Consulting Ltd (FI)

In Milan in April 2002, at its 27th meeting, the Executive Committee of the IEA Implementing Agreement of Advanced Motor Fuels (AMF) decided to start a new Annex on alcohols and ethers as oxygenates in diesel fuel (Annex XXVI). Originally the Annex was designed to focus on practical experiences of using alcohols/ethers as oxygenates in diesel fuel. Compared with the original project plan, a more detailed chapter about fuel properties was added to the final report, also dealing with limitations of blending low-boiling components into diesel fuel. Befri Konsult of Sweden carried out the initial part of the work. The report was finalised by TEC TransEnergy Consulting Ltd (Finland) in cooperation with Turku Polytechnic (Finland).

Storage and handling regulations for fuels are based on the flash point. The problem with, e.g., ethanol blended into diesel is that ethanol lowers the flash point of the blend significantly even at low concentrations. Regarding safety, diesel-ethanol blends fall into the same category as gasoline. Currently, various standards and specifications set rather tight limits for diesel fuel composition and properties. It should be noted that, e.g., E-diesel does not fulfill any current diesel specification and it cannot, thus, be sold as general diesel fuel. Some blends have already received approvals for special applications.

The critical factors of the potential commercial use of these blends include blend properties such as stability, viscosity and lubricity, safety and materials compatibility. The effect of the fuel on engine performance, durability and emissions is also of importance. So far, no engine manufacturers have indicated they will extend warranty coverage to their equipment when operating with E-diesel.

The reports on field tests with oxygenated diesel fuels are rather scarce, especially reports on recent tests. There are, however, some reports available on engine tests and tests with trucks, buses and even off-road equipment. Most of the available test results identified fuel economy and cost as the only appreciable differences between E-diesel and conventional diesel fuel. Most emissions tests with heavy-duty engines confirm the effect of a substantial reduction in PM when running with E-diesel. The typical range for PM reduction is 20 – 40 %. Most studies also report reduced NO_x emissions. Earlier, there were a lot of activities with E-diesel in Sweden. For the time being, California and Brazil are leading the development of E-diesel.

Annex XXVII Standardization of Alternative Motor Fuels

Operating Agent: Atrax Energi och Miljö AB (SE)

The annex was established by IEA/AMF in April 2002. During Phase I a state of the art report was produced concerning standardization of alternative fuels in Canada, Finland, France, Japan, Sweden, USA and the European Standardisation Organisation CEN as well as the International Standardisation Organisation ISO. During Phase I was also a first investigation carried out concerning a possible co-operation between IEA/AMF and CEN and/or ISO. The result of Phase I was presented to the ExCo in January 2004 and a written report was distributed to all IEA/AMF participants.

In March 2003 IEA/AMF decided to start a Phase II of the Annex with the purpose to further and more thoroughly analyse the possibility and if so also the forms for a co-operation between IEA/AMF and CEN and/or ISO. The result was presented to IEA/AMF in October 2004 and a written report was distributed to all IEA/AMF participants. The result of Phase II was a recommendation to IEA/AMF to seek for co-operation with both CEN and ISO since it would be of importance for IEA/AMF in its work to i.a. disseminate knowledge and experiences from work done with support from IEA/AMF and also would contribute to make IEA/AMF more known by countries around the world. For the moment is a proposal being discussed concerning how to carry out such a co-operation. The proposal is to establish a new Annex for co-operation with CEN and ISO concerning standardization of alternative as well as advanced motor fuels.

A report covering data and information collected during Phase I as well as proposals for future work has been distributed in November 2003.

In October 2004 a report of Phase II concerning co-operation between IEA/AMF and CEN and/or ISO was distributed

Both reports are publicly available through Atrax, the ExCo members and the AMF Secretary. *The reports can also be downloaded from the AMF website ("Downloadable Documents").*

Annex XXVIII Information Service & AMF Website (AMFI)

Sub-task No.1 Outlook on Standardization

Operating Agent: Atrax Energi och Miljö AB (SE)

Sub-task 1, "Outlook on Standardization", of IEA/AMF Annex XXVIII, "AMFI Information Service", was established in November 2006 by the IEA/AMF ExCo meeting in Beijing, China. Sub-task 1 can be seen as a follow up or to some extent a prolongation of Annex XXVII "Standardization of Alternative Motor Fuels".

The intention of Sub-task 1 was to collect and present as much as possible of all available information concerning standardization of alternative fuels. With information was meant not only facts and data about already existing standards but also pre-standards, ongoing work and discussions about standards as well as planned work on this item. Country specific standards and information as well as regional and global standards should be covered in the report.

In May 2008 a first draft report was presented at the ExCo 35 meeting in Vienna, Austria and in August a final draft was sent out by e-mail to all Delegates and Alternates.

In the report information can be found concerning standardization of liquid as well as gaseous alternative fuels. The following organizations/ countries and organizations/regions are presented in the report:

- APEC (Asia-Pacific Economic Cooperation)
- ASTM (covering i.a. the U.S. and Canada
- Brazil
- CEN (Europe)
- India
- ISO (global level)
- Japan
- People's Republic of China
- South Africa
- Thailand

In the report there is also some information concerning standards on test methods for alternative fuels.

The work on Sub-task 1 was financed by all participants in IEA/AMF through its Common Fund. The report is publicly available (see *AMF website for "Downloadables").*

Annex XXIX Heavy-Duty Urban Vehicles

Operating Agent: VTT Processes (FI)

The Annex was established in 2004, and completed in 2007. Three laboratories, VTT, Environment Canada and West Virginia University measured standard size urban buses driving various duty cycles on chassis dynamometers. The number of transient test cycles per laboratory varied from 6 to 16. Included in the vehicle matrix were European and North American diesel and natural gas vehicles. Environment Canada performed a comparison of a conventional diesel vehicle and a diesel-electric hybrid vehicle. Fuel consumption as well as exhaust emissions were measured.

The main objective of the project was to evaluate how various duty cycles affect fuel consumption and exhaust emission figures. As could be expected, the results vary significantly not only by test cycle, but also by vehicle technology. In some cases increased fuel consumption or load results in increased emissions, in other cases reduced emissions. However, for most, vehicles emissions can be directly proportioned to the amount of fuel consumed. In this respect NOx-emissions from SCR-vehicles form an exception, as well as particle emissions from vehicles producing very low absolute particle emission levels. Scaling factors to be used for comparing emission results generated with different duty cycles were developed.

Most of the evaluated test cycles provide coherent fuel consumption and emission results. Some specific test cycles result in abnormalities, and must therefore not be considered representative for buses. All three laboratories performed measurements on three common cycles, the ADEME/RATP Paris bus cycle, the Orange County Transport Authority cycle and the Braunschweig bus -cycle. This made it possible to also compare European vehicles and North American vehicles with each other. However, such a comparison is only indicative, as

there are differences in vehicle specifications, testing equipment and also in test procedures and testing conditions.

The results of the Annex are presented in a public report which can be downloaded via VTT's website at http://www.vtt.fi/inf/pdf/tiedotteet/2007/T2396.pdf or via the IEA AMF website at http://virtual.vtt.fi/virtual/amf/download.html.

Annex XXX Biosafety Assessment: Animal Fat in Biodiesel

Operating Agent: ATFCAN (CA)

Annex XXX of the IEA's AMF began in 2004 and was completed in 2006. The final report "Biodiesel from Specified Risk Material Tallow" resulting from the biodiesel workshop and research concluded that biodiesel made from specified risk material tallow, such as tallow potentially contaminated with bovine spongiform encephalopathy (BSE), poses negligible risk to human and animal health.

The potential for BSE contamination of bovine tissues has led government regulatory agencies to designate certain high risk tissues as specified risk material (SRM), and prohibit their inclusion in either human or ruminant food, or in various other products such as biologicals, pharmaceuticals, medical devices, cosmetics and fertilizers. Subsequently, a substantial tonnage of animal tissue that would otherwise have been used in commercial enterprises is destroyed. The use of SRM to produce tallow for biodiesel production is one possible means to recoup at least some of this lost resource.

The report, written by leading experts on transmissible spongiform encephalopathies (TSE) and BSE, animal rendering, and vehicular emissions, provides an in-depth study of BSE, from the first incident until 2006. It then examines the biodiesel production process using SRM-infected tallow, and the potential effects of using the end product (biodiesel fuel manufactured from specified risk material). As the BSE concern is constantly changing around the world, an addendum is included in the report, which can be obtained by emailing biodiesel@atfcan.com or from the AMF website. Also identified in the study were several gaps in current knowledge where additional research would be beneficial prior to undertaking a quantitative risk assessment.

To supplement the data currently available, the University of Toronto is developing a methodology for testing various biodiesel production processes, to assess deactivation capabilities. A screening method for proteins in non-aqueous media is also being developed at Queen's University. This methodology should become a valuable tool for confirming the absence of TSE-inducing agents in biodiesel produced from SRM and other animal waste products. In a separate segment of work, the Saskatchewan Research Council is creating new in-house capacity to produce protein materials for use in related research programs.

Annex XXXI Fischer-Tropsch Fuels

Operating Agent: Atrax Energi och Miljö AB (SE)

Subcontractors: The Swedish Transport and Research Institute (TFK)
Technical University of Denmark (DTU)

In October 2004, at its 31st ExCo-meeting, IEA/AMF decided to start a project concerning production and use of synthetic vehicle fuels produced by Fischer-Tropsch (FT) technology. The project was carried out as Annex XXXI, with financial support from Denmark, Finland and USA. Atrax Energi AB was appointed as Operating Agent for Annex XXXI. The work in the annex was carried out in co-operation with TFK, Sweden and DTU, Denmark.

The final report was delivered to Denmark, Finland and USA in June 2007. In the report the possibilities to produce synthetic gasoline and synthetic diesel oil from biomass, and also from natural gas, by FT-technology are analyzed and discussed.

After an introduction of the technology as such, environmental aspects and the life cycle perspective of synthetic gasoline and diesel oil are discussed.

To visualise the effect on the logistic system that a future large-scale biomass based production system will have, four different scenarios are assessed in terms of, e.g., the number of production plants needed and truck arrivals to the plant.

- Denmark and Poland, with a feedstock of cultivated energy forest (Salix),
- Finland from forest residues
- USA from natural gas.

Furthermore vehicle emission tests with synthetic gasoline carried out at DTU are described and discussed in the report.

Based on the result of the analysis and the vehicle emission tests presented in the report, a first SWOT analysis of Fischer-Tropsch technology is presented, and finally some main conclusions are drawn.

During the execution of the Annex the following installations were visited: Sasol in South Africa, Nykomb Synergetics in Sweden, Chemrec in Sweden, the Technical University of Denmark, VTT in Finland, the Värnamo gasification research project in Sweden, and the Black liquor gasification project in Piteå, Sweden.

Annex XXXIII Particle Emissions of 2-S Scooters

Operating Agent: AFHB (CH)

Assistant: Jesper Schramm, DTU

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Annex XXXIV Biomass Derived Diesel Fuels

Sub-task No. 1 Analysis of Biodiesel Options

Operating Agent: Fuels, Engines, and Emissions Consulting (US)

Assistant: VTT Technical Research Centre of Finland (FI)

Use of fatty acid esters (biodiesel, as they are commonly known today) as a substitute diesel fuel is on the rise around the world. Volumes of biodiesel used and produced are growing very rapidly from nearly zero in just the mid 1990s to several million metric tons per year currently. The outlook is very good for continued rapid growth in the market for fatty acid esters and hydrotreated oils and fats for at least the next decade. In addition, more advanced biodiesel options are expected from biorefineries.

This Annex documented the state-of-technology of Biodiesel fuel from a worldwide view including topics ranging from differences in biodiesel feedstocks to differences in methods of production of biodiesel fuel. The purpose was to provide decision-makers the information they need to form the best biodiesel policies for their own circumstances.

The Annex was supported by the U.S., Finland, Canada, Italy, and Japan, and a final report was issued to those countries in early 2008. It was released publicly in May of 2009.

Sub-task No. 2 Algae as a Feedstock for Biofuels

Operating Agent: Sentech, Inc. (U.S.)

Assistants: Martijn van Walwijk (France), and Nuwong Challacoop (Thailand)

Algae fuel (also known as algal fuel) is a biofuel made from algae in which there is much interest today because of the challenges with first generation biofuels as mentioned above. “Algaculture” (farming of algae) can be a route to making vegetable oils, biodiesel, bioethanol, biogasoline, and other biofuels. Microalgae are one-celled, photosynthetic microorganisms that are abundant in fresh water, brackish water, and marine environments everywhere on earth. The science and principles for making fuels from algae are simple:

Algae need water, sunlight, nutrients, and carbon dioxide to grow. Algae thrive in shallow, dirty water, and they grow easily and quickly. They produce oil that can then be harvested and converted into biodiesel or other fuels. Algae's carbohydrate content can be fermented into ethanol. Given the right conditions, algae can double its volume overnight. Research into algae for mass production of oil is mainly focused on microalgae rather than macroalgae, e.g. seaweed. This is due largely to microalgae's less complex structure, fast growth rate, and high oil content.

The objective of this Sub-Task is to inventory and assess the important R&D activities in the area of algal fuels and to make recommendations about the most promising pathways to success in making large quantities of transportation fuels from algae.

Countries participating in this Sub-Task are the U.S., Finland, Japan (LEVO), Canada, and Thailand. The project team is cooperating with Task 39 of the Bioenergy Agreement to coordinate efforts between similar efforts and to combine final reports. This AMF effort is focused toward the end-use end of the development spectrum. A final report is targeted for December 2010.

Annex XXXV Ethanol as Motor Fuel

During ExCo 33 it was decided to start a new Annex XXXV "Ethanol as Motor Fuel" as an umbrella for various Sub-tasks with Jesper Schramm as Annex Coordinator (ExCo 33, Decision #3). It was also decided that all Member Countries participate in the new Annex XXXV without committing any funds (ExCo 33, Decision #4). Finally, it was decided to start a new Sub-task No 1 "Ethanol as a Fuel for Road Transportation" under the umbrella Annex XXXV with Jesper Schramm as Operating Agent (ExCo 33, Decision #5).

Sub-task No. 1 Ethanol as a Fuel for Road Transportation

Operating Agent: Technical University of Denmark (DK)

Background
Ethanol is an excellent alternative fuel for road vehicle application. If the application of ethanol is going to increase, there is a demand for rather technical, but easily understood, information about the applicability of ethanol as an engine fuel. This is necessary in order to eliminate the skepticism among people, who do not know about this fuel.

Objectives
The purpose of this project is to provide an easily read technical report about the applicability of ethanol as an engine fuel. The report should describe the potential for ethanol application in the member countries participating in this annex. The results from the investigations of the member countries´ situations should be extrapolated to recommendations for worldwide implementation in a near future

Content of Work
The main project is inspired by the discussions from the IEA/AMF Executive Committee discussions in addressing the following questions:

- "Gasoline/Ethanol blends. How much ethanol can be tolerated by gasoline vehicles?"
- "True performance of FFV vehicles?"
- "Conceptual studies for optimized ethanol engines"
- "Diesel/ethanol blends?"
- "The need for ethanol blended fuels"
- "Differentiation of bio from mineral derived ethanol"
- "How ethanol blends perform in GDI vehicles"
- "The need for fuel specifications for ethanol blended fuels"

The main report will be followed up by individual implementation reports from the member countries.

Results and Reports
The main report was delivered in May 2009 and the individual country reports were edited and published in a common report in December 2009.

Table A. Completed Projects (Annex I – XV)

The following 15 projects/annexes have been completed during the period 1984-2000.

Annex	Title	Run time	Operating Agent	Participating Countries
Annex I	**Alcohols and Alcohol Blends as Motor Fuels**	**1984 – 1986**	**SDAB (SE)**	**5**
Annex II	**Technology Information Exchange on Alt Motor Fuels**	**1984 – 1992**	**SDAB (SE)**	**7**
Annex III	**Alcohol Diesel Field Trials**	**1987 – 1992**	**Sypher (CA)**	**6**
Annex IV	**Production of Alcohols and other Oxygenates**	**1987 – 1994**	**Energy, Mines and Resources (CA)**	**5**
Annex V	**Performance Evaluation of Alt Fuel/Engine Concepts**	**1990 – 1995**	**VTT (FI)**	**9**
Annex VI	**State-of-the-art Report on Natural Gas as a Motor Fuel**	**1990 – 1992**	**Sypher (CA) SDAB (SE)**	**6**
Annex VII	**Environmental Impacts of Alternative and Conventional Fuels**	**1992 – 1997**	**ORNL (US) Phase 1: SDAB (SE) Phase 2: Innas (NL)**	**8**
Annex VIII	**Heavy-Duty Vehicles on Alternative Fuels**	**1994 – 1998**	**VITO (BE)**	**8**
Annex IX	**Automotive Fuel Information Service (AFIS)**	**1995 – 1999**	**Innas (NL) Atrax (SE)**	**7**
Annex X	**Characterisation of New Fuel Qualities**	**1995 – 1997**	**VTT (FI)**	**7**
Annex XI	**Forecasting and Planning Tools for Alternative Fuels**	**1995 – 1996**	**Sypher (US)**	**3**
Annex XII	**Particulate Emissions from Alternative-Fuelled Vehicles**	**1996 –1997**	**ETSU (UK)**	**6**
Annex XIII	**Emission Performance of Selected Biodiesel Fuels**	**1997 – 1999**	**VTT (FI) ORNL (US)**	**7**
Annex XIV	**Feasibility of DME as a Fuel in Diesel Engines**	**1997 – 2000**	**TNO (NL)**	**7 +4 sponsors *)**
Annex XV	**Implementation Barriers of Alternative Fuels**	**1998 – 1999**	**Innas (NL)**	**5**

*) Sponsors: AVL from Austria and IFP, PSA, and Renault from France

Table B. Completed Projects (Annex XVI - XXXV)

The following 16 projects/annexes/sub-tasks have been completed during the period 1997-2009.

(Annex XXIII and Annex XXXII have never been carried through)

Annex XVI	**Biodegradable Lubricants**	**1998 – 2004**	**DTU (DK)**	**6**
Annex XVII	**New Technologies for Heavy-Duty Vehicles**	**1998 – 2000**	**VITO (BE)**	**7**
Annex XVIII	**Future Greener Diesel Fuels**	**1997 – 2002**	**Battelle (US)**	**7**
Annex XIX	**New Fuels for New Engines**	**2000 – 2001**	**Innas (NL)**	**5**
Annex XX	**DME as Automotive Fuel II**	**2000 – 2002**	**TNO (NL)**	**7**
Annex XXI	**Deployment Strategies**	**2000 – 2003**	**Innas (NL)**	**4 from AMF 7 from HEV**
Annex XXII	**Low Temperature Particles**	**2000 – 2003**	**VTT (FI)**	**6 +2 sponsors *)**
Annex XXIV	**Information Exchange IEA AMF/AFIS**	**2000 – 2004**	**Innas (NL)**	**10**
Annex XXV	**Non-Road Engines**	**2000 – 2003**	**VTT (FI)**	**4 **)**
Annex XXVI	**Oxygenates in Diesel**	**2002 – 2005**	**Befri (SE) TEC (FI)**	**4**
Annex XXVII	**Standardization of Alternate Fuels**	**2000 – 2004**	**Atrax (SE)**	**4-6**
Sub-task No 1 Annex XXVIII	**Outlook on Standardization**	**2007 – 2008**	**Atrax (SE)**	**15**
Annex XXIX	**Heavy-Duty Urban Vehicles**	**2004 – 2007**	**VTT (FI)**	**4**
Annex XXX	**Animal Fat in Biodiesel**	**2004 – 2006**	**ATFCan (CA)**	**4**
Annex XXXI	**Fischer-Tropsch Fuels**	**2004 – 2007**	**Atrax (SE)**	**3**
Annex XXXIII	**Particle Emissions of 2-S Scooters**	**2004 – 2009**	**AFHB (CH)**	**6 + EU**
Sub-task No 1 Annex XXXIV	**Analysis of Biodiesel Options**	**2006 – 2008**	**FEEC (US)**	**5**
Sub-task No 1 Annex XXXV	**Ethanol as a Fuel for Road Transportation**	**2007 – 2009**	**DTU (DK)**	**15**

*) Industrial partners: Ford Motor Co and Honda R&D Europe

**) Industrial partners: Fortum Oil and Gas Oy (fuels), Ecocat (former Kemira Metalkat Oy) (catalysts), and Sisu Diesel Oy (CI engines)

Table C. Completed Projects (Annex I-X)

Participation and financial commitments are shown in the following table.

Table in USD!

Annex	Participating Countries and their Contributions Œ denotes the Operating Agent. Amounts are given in 1 000 USD.													
	BE	**CA**	**DK**	**ES**	**FI**	**FR**	**IT**	**JP**	**NL**	**NZ**	**SE**	**UK**	**US**	**Total**
I Alcohols as Motor Fuels		35						35		15	Œ 25		35	145
II Information Exchange **Phase 1 (1984-88)** **Phase 2 (1988-92)**		40 60			60		40 60	40 60		30	Œ 40 60		40 60	200 390
III Alcohol Diesel Field Trials		Œ 40.5			5		40.5	40.5			40.5		40,5	208
IV Production of Alcohols **Phase 1 (1987-89)** **Phase 2 (1990-94)**		Œ 60 40					32.1	40			40		40	60 192
V Cold Test Emissions **Phase 1 (1990-93)** **Phase 2 (1993-94)** **Phase 2 (1994-95)**	30 7	20 30			Œ 36 50 21		20	32.3 29 7	12 17.5 7		20 30 7	12.5 7	20 37 7	160 236 63
VI Natural Gas as Motor Fuel		Œ 41.7			41.7		41.7	41.7			41.7		41.7	250
VII Environmental Impacts **Phase 1 (1992-95)** **Phase 2 (1996-97)**	25 8	25 8			25 8		25	25 8	25 8		45 8		Œ 45 8	235 56
VIII Heavy-Duty Vehicles **Phase 1 (1994-98)** **Addend (1996-98)**	Œ 5 5	5 3.5			5 5			5 3.5	5 5		5 3.5	5 3.5	5 5	40 34
IX Information Service AFIS	35	30			45				Œ 108		124	68.4	67.7	478
X New Fuel Qualities	8	8			Œ 40			8	8		12		8	92

Table D. Completed Projects (Annex XI-XXV)

Participation and financial commitments are shown in the following table.

Table in USD!

Annex	Participating Countries and their Contributions Œ denotes the Operating Agent. Amounts are given in 1 000 USD.												
	(BE) CH	CA	DK	ES	FI	FR	IT	JP	NL	SE	UK	US	Total
XI Forecasting and Planning Tools		15			10							Œ 50	75
XII Particulate Emissions	22.7	22.7			22.7				22.7		Œ 22.7	22.7	136
XIII Biodiesel Fuels	32	32			Œ 75			39.7	32	42		95	348
XIV DME as Fuel I		110	90		20			40	Œ 85	180		80	787*
XV Implementation Barriers					13			13	Œ 13	13		13	66
XVI Biodegradable Lubricants			Œ 62,7		27,7		20	20	7,7	27,7		32,7	199
XVII Heavy-Duty Vehicles	Œ 80				40		0**	40	40	40		40	280
XVIII Future Greener Diesel Fuels		5			10	10		10	10	10		Œ 10	65
XIX New Fuels for New Engines		8			8				Œ 8	8		8	40
XX DME as Fuel II			10		10	30	10	10	Œ 20	10		10	150***
XXII Low Temperature Particles		22,5			Œ 91,5		22,5	22,5		28,5		22,5	210
XXIV Information Exchange IEA AMF/AFIS		X	X	X	X	X	X	X	Œ X	X	X	X	58
XXV Non-Road Engines					Œ 60	20				20		20	120
TOTAL													$ 5 616

*) In the sum USD 787 000 are included also contributions from the Sponsors IFP/PSA/Renault (FR) with USD 55 000 and AVL (AT) with USD 32 000. The former IA member Norway contributed USD 95 000.

**) Italy contributed to this annex on a task sharing base carrying out engine tests.

***) In the sum USD 150 000 are also included contributions from the Sponsors PSA and Renault (FR), TNO and Helvoet (NL) with each USD 10 000.

Table E. Completed Projects (Annex XXVI-XXXV)

Participation and financial commitments are shown in the following table.

Table in EURO!

Annex	Participating Countries and their Contributions Œ denotes the Operating Agent. Amounts are given in 1 000 €.												
	CA	**CH**	**DK**	**ES**	**FI**	**FR**	**IT**	**JP**	**NL**	**SE**	**UK**	**US**	**Total**
XXVI Oxygenates in Diesel	8				Œ		8	8		(Œ) -	8		32
XXVII Standardization of Alternate Fuels	24				10	15		27		Œ 30		27	133
XXVIII Sub-task No 1 Outlook on Standardization										Œ 20			20
XXIX Heavy-Duty Urban Vehicles	56				Œ 140	40						152	388
XXX Animal Fat in Biodiesel	Œ 413				13							50	476
XXXI Fischer-Tropsch Fuels			40		30					Œ 0		60	130
XXXIII Particle Emissions of 2-S Scooters	0	Œ 20	0		0	0	0						20
XXXIV Sub-task No 1 Analysis of Biodiesel Options	15				15		15	15				Œ 15	75
XXXV Sub-task No 1 Ethanol as a Fuel	0	0	Œ 70	0	0	0	0	0	0	0	0	0	70
TOTAL													**€ 1 344**

Electronic Attachment No. 2
AMF Annual Report 2009

AMF REPORTS

(ANNEX I – XXXV)

List of Annual Reports 1994-2009
and all reports prepared within the AMF Annexes since 1986

Most of the recent reports and documents can be found in electronic form at "Downloadable Documents" www.iea-amf.vtt.fi

Annual Reports

- IEA Alternative Motor Fuels. Annual Report 1994, NUTEK, B 1995:5 (ISBN 91-7318-2885)
- IEA Alternative Motor Fuels. Annual Report 1995, NUTEK, B 1996:9 (ISBN 91-7318-3008)
- IEA Alternative Motor Fuels. Annual Report 1996, NUTEK, B 1997:6 (ISBN 91-7318-3083-SE)
- IEA Alternative Motor Fuels. Annual Report 1997, STEM, EB 4:1998 (ISBN 91-89184-03-3)
- IEA Advanced Motor Fuels. Annual Report 1998, STEM, EB 2:1999 (ISBN 91-89184-12-2)
- IEA Advanced Motor Fuels. Annual Report 1999, STEM, EB 1:2000 (ISBN 91-89184-16-5)
- IEA Advanced Motor Fuels. Annual Report 2000, STEM, EB 1:2001 (ISBN 91-89184-26-2)
- IEA Advanced Motor Fuels. Annual Report 2001, STEM, EB 2:2002 (ISBN 91-89184-28-9)
- IEA Advanced Motor Fuels. Annual Report 2002, STEM, ET 7:2003 (ISBN 91-89184-28-9)
- IEA Advanced Motor Fuels. Annual Report 2003, STEM, ET 1:2004
- IEA Advanced Motor Fuels. Annual Report 2004 (see **www.iea-amf.vtt.fi**)
- IEA Advanced Motor Fuels. Annual Report 2005 "
- IEA Advanced Motor Fuels. Annual Report 2006 "
- IEA Advanced Motor Fuels. Annual Report 2007 "
- IEA Advanced Motor Fuels. Annual Report 2008 "
- IEA Advanced Motor Fuels. Annual Report 2009 "

Annex I Alcohols and Alcohol Blends as Motor Fuels

Operating Agent: SDAB (SE)

Results were reported in an IEA/STU publication ”Alcohols and Alcohol blends as Motor Fuels”. This report was printed in 2 000 copies for the participants. *Publicly available through SDAB.*

Annex II Technology Information Exchange on Alternative Motor Fuels

Operating Agent: SDAB (SE)

Phase 1:

Results were reported in a series of ”TRENDS”.
Available only for Participating IEA-countries through SDAB.

- No 86:1 ”(Alcohol Fuels in) Sweden”
- No 87:2 ”USA - Policy”
- No 87:3 ”Europe - Environment”
- No 88:1 ”Utilisation of Alcohol Fuels” (State-of-the-art report)
- No 88:2 ”New Publications”
- No 88:3 ”Fuel Alcohol Formulations”
- No 88:4 ”Alcohol Fuels in Japan”

Phase 2:

Results were reported in a series of ”TRENDS”.
Available only for participating IEA-countries through SDAB.

- No 88:5 ”Diesel Exhausts. Environmental and Health Effect”
- No 89:1 ”U.S. Study on Flexible & alternative Motor Fuels”
- No 89:2 ”Catalysts and filters on Diesel Engines”
- No 89:3 ”Carbon dioxide”
- No 89:4 ”Clean Motor Fuels in the U.S.”
- No 90:1 ”California Clean Air”
- No 90:2 ”Reformulated Gasoline”
- No 91:1 ”Unregulated Emissions”
- No 91:2 ”Alcohol Vehicle Emissions”
- No 91:3 ”Vehicle Emissions and Cancer Risks”
- No 91:4 ”Catalytic Treatment of Emissions”
- No 92:1 ”Future Electric Vehicles”
- No 92:2 ”Automotive Emissions Test Systems”
- No 92:3 ”Trends in Canada”

Annex III Alcohol Diesel Field Trials

Operating Agent: Sypher (CA)

The following output has been submitted. *Available only for Participants in the Annex.*

- ”IEAMAIN” data collection system, Computer software, user guide and up-dates
- On-line methanol fuels database and access facilities
- Report (Nov. 1987), ”Catalytic Converters for Emissions Control on Methanol Engines - Current Research and Development”
- Report (May, 1988), ”Comparative Review of World-wide Emissions, Legislation & Trends in Correlating Methanol Emissions Data
- Report (May, 1988), ”Annex III field Trials, Data Collection Status
- Report (Oct, 1988), ”Progress Report on Annex III
- Report (Nov, 1988), ” Comparative Review of World-wide Emissions, Legislation & Trends in Correlating Methanol Emissions Data”, revised
- Report (May, 1989), ”Diesel Exhaust Emissions Legislation and Alcohol Fuelled Engines”
- Report (Oct, 1989), ”Alcohol Fuels for Heavy Duty Engines - A survey of Current Status”
- Report (Oct, 1989), ”Diesel Exhaust Emissions Legislation and Alcohol Fuelled Engines”, revised
- Report (June, 1990), ”Alcohol Fuels for Heavy Duty Engines - A survey of Current Status”, revised
- Final Report, June 1992

Annex IV Production of Alcohols and Other Oxygenates from Fossil Fuels and Renewables

Operating Agent: Natural Resources Canada (CA)

Phase 1

The results have presented in a final report, which was printed in 1990. *Available to all IEA countries through Natural Resources Canada.*

The contents are:

- Methanol production from coal, natural gas and biomass
- Production of methanol and higher alcohols
- Transportation of methanol and other oxygenates
- Ethanol production by fermentation
- Culture of fermentation precursors
- MTBE production
- Biomass liquefaction

In addition, the OA developed a series of computer models and databases.

Phase 2

Available only for participating IEA-countries through Natural Resources Canada.

- ”Natural Gas Supply, Demand, and Price”
- ”Economic Comparisons of LNG, Methanol and Synthetic Distillates
- ”A Comparison of the Production of Methanol and Ethanol from Biomass”
- ”Greenhouse Gas (and other) Emissions from Methanol and Ethanol Production Processes”

A final report ”Production of Alcohols and Oxygenates from Fossil Fuels and Renewables” was published in 1995. *Publicly available through Natural Resources Canada.*

Annex V Cold Test Emissions

Operating Agent: VTT Processes (FI)

Phase 1

Available only for Participants of the Annex through VTT.

- Current status of Phase 1, ”Engine tests”, 1992
- Cold-start and Cold Start Emissions of alcohol fuelled Light-Duty engines, *A literature study*, 1992

Phase 2

Available only for Participants of the Annex through VTT.

- Final report of Phase 2, also including the work of Phase 1:
  ”Performance Evaluation of Alternative Fuel/Engine Concepts”, 1995

- A final public report ”Performance Evaluation of Alternative Fuel/Engine Concepts 1990 -1995” including an addendum on diesel vehicles was published in 1996. *Publicly available through VTT.*

- Nylund, N.-O. & Lappi, M. Evaluating Alternative Fuels for Light-Duty Applications. Presented at: International Fall Fuels & Lubricants Meeting, October 1997, Tulsa. Society of Automotive Engineers, 1997. 18.p. (SAE Paper 972974).

Annex VI Natural Gas as Motor Fuel

Operating Agent: Sypher (CA)

Assistant: SDAB (SE)

The final report, ”Methane as Motor Fuel” (May 1992), was printed in book form. *Publicly available*.

The objective of this study was to provide the International Energy Agency with a ”state-of-the-art” report regarding the current and potential future use of methane as a fuel for motor vehicles. In support of this overall objective, the study addressed the following topics:

- World-wide reserves and availability of natural gas; gas extraction, processing and distribution systems; potential supplies of biogas, adaptability of current situation to the transportation industry

- Current technologies used for operating vehicles on impressed and liquefied natural gas, and future trends in engine and vehicle development

- The economic and environmental consequences of expanding the use of methane as a vehicle fuel, and

- Technical and institutional barriers, which could act against the expansion of natural gas in the road transportation sector

The report provides conclusions regarding the current status of methane as a vehicle fuel, and recommendations for maximising the benefits of methane as a vehicle fuel, and expanding its use on a worldwide basis.

Annex VII Comparison of Relative Environmental Impacts of Alternative and Conventional Fuels

Operating Agent: ORNL (US)

Assistant: Phase 1: SDAB (SE). Phase 2: Innas (NL)

The final report ”Comparison of Relative Environmental Impacts of Alternative and Conventional Motor Fuels” was printed in book form 1995. *Publicly available through ORNL/DOE.*

Annex VIII Heavy-Duty Vehicles on Alternative Fuels

Operating Agent: VITO (BE)

A final report ”Heavy-duty Vehicles on Alternative Fuels” and a report ”Workshop on Demonstrations with Heavy-Duty Vehicles Running on AMF’s - Report of the Workshop” have been distributed to the Executive Committee. *Further distribution has not yet been decided upon.*

Annex IX Automotive Fuels Information Service (IEA AFIS)

Operating Agent: Innas (NL)

Assistant: Atrax Energi och Miljö AB (SE)

Five volumes have been published. *They are publicly available through Innas.*

- Raw Materials and Conversion (Dec 1996)
- Distribution and Use (Dec 1996)
- Comparison and Selection (Jan 1998)
- Innovations or Illusions (Jan 1999)
- Mobile Machinery: Sector analysis (May 1999)

Annex X Characterisation of New Fuel Qualities

Operating Agent: VTT Processes (FI)

A final restricted report ”Characterisation of New Fuel Qualities” was published and distributed to the Participants of the Annex in 1997.

- Nylund, N-O. & Aakko, P., Characterization of new fuel qualities. Presented at: State of Alternative Fuel Technologies 2000. Warrendale: Society of Automotive Engineers, 2000. 10 p. (SAE Paper 2000-01-2009).

Annex XI — Forecasting and Planning Tools for Alternative Fuels and Related Infrastructure

Operating Agent: Sypher (US)

A detailed progress report has been provided to the Participants of the Annex.

Annex XII — Particulate Emissions from Alternative-fuelled Vehicles

Operating Agent: ETSU (UK)

Interim report ”Size and Compositional Analysis of Particulate Emissions from Alternative-fuelled Vehicles”. *Available only for Participants of the Annex through ETSU.*

Annex XIII — Emission Performance of Selected Biodiesel Fuels

Operating Agent: VTT Processes (FI)

Assistant: ORNL (US)

Two final reports, which are available through ORNL and VTT.

- Aakko, P., Westerholm, M., Nylund, N.-O., Moisio, M., Marjamäki, M., Mäkelä, T., Hillamo, R. IEA/AMF Annex XIII: Emission Performance of Selected Biodiesel Fuels - VTT's Contribution. 2000. VTT report ENE5/33/2000.

- Storey, J., Irick, D., Lappi, M., McGill, R. IEA/AMF Annex XIII: Emission performance for selected biodiesel fuels - ORNL's contribution. 2001. Oak Ridge National Laboratory. Research Report

Two publications, which are available through FISITA and SAE Organisation.

- Aakko, P., Nylund, N.-O., Westerholm, M., Marjamäki, M., Moisio, M., Hillamo, R. and Mäkelä, T. The emissions from heavy-duty engine with and without aftertreatment using selected biofuels. 29th FISITA World Automotive Congress. Helsinki, FI, 2 - 7 June 2002.

- McGill, R., Storey, J., Wagner, R., Irick, D., Aakko, P., Westerholm, M., Nylund, N.-O. and Lappi, M. Emission performance of selected biodiesel fuels. JSAE/SAE International Spring Fuels & Lubricants Meeting, Yokohama, 19 - 22 May 2003. SAE Technical Paper 2003-01-1866.

Annex XIV Investigation into the Feasibility of Dimethyl Ether as a Fuel in Diesel Engines

Operating Agent: TNO (NL)

Task 1:

- ***End-Report of Annex XIV of the IA/AMF of IEA: "DME as an Automotive Fuel"***
  Number: 00.OR.VM.065.1/AvD Date: August 2000

Task 2:

- ***Toxicity aspects of Dimethylether in comparison with automotive fuels currently in use***
  Number: TNO-MEP-R99/015 Date: January 1998

- ***Proposal for safety provisions for DME fuelling systems and their installation in vehicles***
  Number: 98.OR.VM.051.1/JV Date: September 1998

- ***Failure mode and effect analysis DME vehicle storage tank systems***
  Number: TNO-MEP-R98/449 Date: November 1998

- ***Conversion of lPG distribution guidelines into DME distribution guidelines***
  Number: TNO-MEP-R99/050 Date: February 1999

Task 3:

- ***Dimethylether as an Automotive fuel Annex XIV***
  Number: BE 0472 (AVL) Date: March 1999

Task 4:

- ***DME from Biomass***
  Number: (Atrax) Date: February 1999

Task 5:

- ***Environmental effects of DME compared to other automotive fuels***
  Number: (Innas) Date: June 1999

Task 6:

- ***Automotive DME distribution infrastructure costs***
  Number: (Innas) Date: July 1999

Task 7:

- ***Workshop Dimethylether as an automotive fuel***
  Number: 97.OR.VM.003.1/RV Date: January 1997
  97.OR.VM.091.1/RV Date: December 1997
  98.OR.VM.016.1/RV Date: March 1998
  98.OR.VM.065.1/JV Date: November 1998
  99.OR.VM.025.1/JV Date: May 1999

- ***DME Newsletter***
  Number: 1 (June 1998), 2 (December 1998) and 3 (June 1999)

Annex XV — Implementation Barriers of Alternative Fuels

Operating Agent: Innas (NL)

A final report ”Implementation barriers of alternative fuels” was published in February 1999. *Publicly available through Innas.*

Annex XVI — Environmental and Economical Aspects of Implementing Biodegradable Lubricants in Vehicle Engines

Operating Agent: DTU (DK)

- van Walwijk, M., Hagenau, J., Schramm, J. “Biodegradable Lubricants”, IEA Advanced Motor Fuels Agreement – Annex XVI. Report published by Dep. of Energy Engineering on behalf of IEA Advanced Motor Fuels Agreement, December 1999.
- Schramm, J. “Biodegradable Lubricants – Phase 2. Diesel Type Vehicles.”, IEA Advanced Motor Fuels Agreement – Annex XVI. Report published by Dep. of Energy Engineering on behalf of IEA Advanced Motor Fuels Agreement, December 2002.

Annex XVII — Real Impact of New Technologies for Heavy-Duty Vehicles

Operating Agent: Vito (BE)

A final restricted report Pelkmans L., De Keukeleere D., IEA-AMF, Annex XVII: Real Impact of New technologies for Heavy Duty Vehicles, VITO-report, December 2000' has been distributed to the Participants of the Annex. *Available only for Participants of the Annex through VITO.*

Annex XVIII — Future Greener Diesel Fuels

Operating Agent: Battelle Memorial Institute (US)

A final report on “Future Greener Diesel Fuels” was completed in April 2002. *Available only for Participants of the Annex through Battelle.*

Annex XIX New Fuels for New Engines

Operating Agent: Innas (NL)

A final report has been published in January 2001 as volume 6 in the Automotive Fuels Survey, and is titled "Fuels for HCCI Engines**". *Publicly available through Innas.***

Annex XX DME as an Automotive Fuel II

Operating Agent: TNO (NL)

- TNO report: "The effect of DME on wear of fuel pump parts", December 2000
- TNO report: End report of Annex XX of the IEA/AMF: "DME as an Automotive Fuel II, Part 1", November 2001
- DTU report: End report of Annex XX of the IEA/AMF: "DME as an Automotive Fuel II, Part 2". November 2001

Available only for Participants of the Annex through TNO.

Annex XXI Deployment Strategies for Hybrid, Electric and Alternative Fuel Vehicles

Operating Agent: Innas (NL)

A final report "Deployment strategies for hybrid, electric and alternative fuel vehicles" has been published on CD-rom in December 2002. *Publicly available through Innas. Will soon be downloadable from www.ieahev.org.*

Annex XXII Particle Emissions at Moderate and Cold Temperatures Using Different Fuels

Operating Agent: VTT Processes (FI)

Three interim reports and one final report were distributed to the Participants of the Annex. *They are available only for Participants of the Annex through VTT.*

- Aakko, P. The results with the medium-duty engine. The 1st Interim report, May 2001. Restricted.
- Aakko, P. The results with two diesel cars. The 2nd Interim report, October 2001. Restricted.

- Aakko, P. The results with stoichiometric gasoline car and CNG car. The 3rd Interim report, April 2002. Restricted.

- Aakko, P. and Nylund, N.-O. IEA/AMF Annex XXII: Particle emissions at moderate and cold temperatures using different fuels. VTT report PRO3/P5057/03. Restricted.

The following publications are p*ublicly available through SAE and VTT.*

- Aakko, P. and Nylund, N.-O. Particle emissions at moderate and cold temperatures using different fuels. SAE Technical Paper 2003-01-3285

- Paper for Windsor Workshop, June 2004 (Windsor Workshop in 2003 was cancelled)

Annex XXIV Information Exchange IEA AMF/AFIS

Operating Agent: Innas (NL)

Three newsletters "IEA AMF/AFIS Fuels Update" per operating year.

Publicly available through Innas, the ExCo members and the AMF Secretary. Can be downloaded from www.innas.com/fuel news.

Annex XXV Fuel Effects on Emissions from Non-Road Engines

Operating Agent: VTT Processes (FI)

The complete final report is for the participants only and available through VTT. A public version of the final report can be downloaded on IEA-AMF web pages (http://www.vtt.fi/virtual/amf/annex_xxv/annexxxv.html).

- Murtonen, T. Fuel Effects On Emissions From Non-Road Engines, Interim Report, October 2002

- Murtonen, T. and Nylund, N.-O. Fuel Effects On Emissions From Non-Road Engines, Final Report, June 2003

Annex XXVI Alcohols and Ethers as Oxygenates in Diesel Fuel

Operating Agent: Befri Konsult (SE) & TEC TransEnergy Consulting Ltd (FI)

A final report "Alcohols/Ethers as Oxygenates in Diesel Fuel: Properties of Blended Fuels and Evaluation of Practical Experiences" was completed in June 2005. The report is available for downloading at www.iea-amf.vtt.fi

Annex XXVII Standardization of Alternative Motor Fuels

Operating Agent: Atrax Energi och Miljö AB (SE)

A report covering data and information collected during Phase I as well as proposals for future work has been distributed in November 2003.

In October 2004 a report of Phase II concerning co-operation between IEA/AMF and CEN and/or ISO was distributed

Both reports are now publicly available (see *AMF website for "Downloadables").*

Annex XXVIII Information Service & AMF Website (AMFI)

Operating Agent: TEC TransEnergy Consulting Ltd (FI)

- One AMFI Newsletter in 2004
- Four Newsletters in 2005
- Three Newsletters in 2006
- Four Newsletters in 2007
- Four Newsletters in 2008

(see *AMF website for "Downloadables")*

A highly topical "Outlook Report" on projections for transportation energy, vehicle technology and advanced/alternative fuels was distributed as a restricted version to the Executive Committee in February 2007.

A condensed version of the "AMF Outlook" report was prepared in co-operation with EU Bioenergy NoE:

Nylund, N-O., Aakko-Saksa, P. and Sipilä, K. Status and outlook for biofuels, other alternative fuels and new vehicles. VTT Research Notes 2426. 2008.

This report is now publicly available (see *AMF website for "Downloadables").*

Annex XXVIII Information Service & AMF Website (AMFI)

Sub-task No.1 Outlook on Standardization

Operating Agent: Atrax Energi och Miljö AB (SE)

A report covering data and information collected concerning standardization of alternative fuels on global, regional as well as country specific level has been distributed in August 2008.

This report is publicly available (see *AMF website for "Downloadables").*

Annex XXIX Heavy-Duty Urban Vehicles

Operating Agent: VTT Processes (FI)

The results of the Annex are presented in a public report, which can be downloaded via VTT's website at http://www.vtt.fi/inf/pdf/tiedotteet/2007/T2396.pdf or via the IEA-AMF website at http://virtual.vtt.fi/virtual/amf/download.html.

Annex XXX Biosafety Assessment: Animal Fat in Biodiesel

Operating Agent: ATFCAN (CA)

The complete final report "Biodiesel from Specified Risk Material Tallow: An Appraisal of TSE Risks and their Reduction" is available in hardcopy format. Copies have been distributed to the participants of the Biosafety Workshop in Ottawa, Canada, on June 2005. To obtain a hardcopy of the report, please email biodiesel@atfcan.com or info@atfcan.com. An electronic version of the report is available as a downloadable PDF at ATFCAN's website (www.atfcan.com), alternatively via AMF website/"Downloadable Documents".

Annex XXXI Fischer-Tropsch Fuels

Operating Agent: Atrax Energi och Miljö AB (SE)

Subcontractors: The Swedish Transport and Research Institute, TFK
Technical University of Denmark, DTU

A report was distributed in June 2007 covering literature survey, analysis of relevant life cycle data, 4 different scenario calculations including a well-to-wheel perspective and finally an environmental evaluation including new data from emission tests carried out at DTU on synthetic (FT) gasoline. The report is publicly available.

Annex XXXIII Particle Emissions of 2-S Scooters

Operating Agent: Univ. of Applied Sciences Bern
Lab. for Exhaust Emissions Control (CH)

Assistant: Jesper Schramm, DTU

1st Information Report about international activities 2004/2005 is available.
2nd Information Report about international activities 2005/2006 is available.
3rd Information Report about international activities 2006/2007 is available.

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Annex XXXIV Biomass Derived Diesel Fuels

Sub-task No. 1 Analysis of Biodiesel Options

Operating Agent: Fuels, Engines, and Emissions Consulting (US)

Assistant: VTT Technical Research Centre of Finland (FI)

A final report was issued to the participating countries in early 2008, and the report was issued publicly in May 2009. It is available for download at the AMF website (http://virtual.vtt.fi/virtual/amf/8annexreports.html).

Annex XXXV Ethanol as Motor Fuel

Sub-task No. 1 Ethanol as a Fuel for Road Transportation

Operating Agent: Technical University of Denmark (DK)

Larsen, U., Johansen, T. and Schramm, J. "Ethanol as a Fuel for Road Transportation". Report of IEA Advanced Motor Fuels Agreement, Annex XXXV, May 2009.

Schramm, J. "Ethanol as a Fuel for Road Transportation – Implementation report for the IEA Advanced Motor Fuels Agreement Countries". Report of IEA Advanced Motor Fuels Agreement, Annex XXXV, December 2009.