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IEA

Advanced Motor Fuels

Annual Report 2007

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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 2008

To IEA

IEA Advanced Motor Fuels

Annual Report 2007

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 2007 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

Steve Goguen
Chairman

Claës Pilo
Secretary

Preface

Oil supply and prices continued in 2007 the trends seen in the previous two or three years, namely higher oil prices and shortages during the high-demand seasons. The price of oil reached nearly \$100 (USD) per barrel by the end of the year, an unprecedented figure in terms of prices unadjusted for inflation. Some projections suggest that prices will remain at \$80 (USD) per barrel or more throughout 2008. With the rising economies of China and India and their increasing appetites for oil, it is clear that we are at crossroads in worldwide energy availability and security, and decisions and actions taken by developed nations now will shape the destinies of future generations.

In response to these challenges nations around the world are taking aggressive actions to promote the greater use of alternatives, particularly bio-based fuels. In the U.S. several incentives and initiatives are in place. In 2004 the Congress passed the Biodiesel Tax Credit, which provides a tax credit for using biodiesel blends. The credit is 1 cent (\$0.01) for each percentage point of vegetable oil based biodiesel blended with petroleum diesel and on-half cent (\$0.005) for each percentage point of biodiesel made from recycled cooking oils. For example, 20% of biodiesel made from soy or other vegetable oils blended with petroleum diesel will enjoy a 20-cent tax credit, while 20% of biodiesel made from used vegetable oils will receive a 10-cent tax credit. This savings is generally passed on to the consumer. The incentive was intended to lower the cost of biodiesel close to the cost of petroleum diesel. In addition, The Department of Energy's Office of the Biomass Program has implemented the Biofuels Initiative, with the goal of reducing U.S. dependence on foreign oil by meeting the following targets:

- To make cellulosic ethanol (or ethanol from non-grain biomass resources) cost competitive with gasoline by 2012.
- To produce 36 billion gallons of ethanol, for use in the transportation sector, by 2022.

The policy in effect in Europe for biofuels is the EU Directive 2003/30/EC, which promotes the use of biofuels or other renewable fuels for transport. The Directive set a voluntary target of 2% biofuel consumption (by energy content) in 2005 with a provision that the target will rise by 0.75% each year till reaching 5.75% in 2010. The Directive includes both ethanol and biodiesel. Individual member states have also set additional standards and incentives.

A large number of countries have set forth additional policies and initiatives, most of which relate to "conventional" biofuels, ethanol and biodiesel (fatty acid methyl esters.)

In this backdrop of world events, the IEA-AMF finds itself well positioned to carry out meaningful, timely research and to help frame the platforms for future generations of alternative and advanced fuels. The year 2007 was the third year of the current strategic plan, the objectives of which are:

To contribute to the growing market penetration of advanced motor fuels and the widespread deployment of sustainable technologies for transport. Improved emissions and improved energy efficiency and security are the goals of this vision. To achieve its vision the AMF's aim is to become a leading international player in the promotion of international collaboration in R&D, deployment, and dissemination of clean, energy-efficient, and sustainable fuels and related vehicle technology. The AMF will seek annex proposals that are consistent with the goals and objectives of the strategic plan.

In 2007 two meetings of the Executive Committee were held, both in the U.S. The first was ExCo 33 and held as a "mini-ExCo" in April and in Detroit, Michigan in conjunction with the Society of Automotive Engineers annual Congress and Exposition. Since many of the ExCo's delegates were planning to attend the SAE meeting, it was practical to hold a brief ExCo meeting at that time. Three new annex proposals were presented and discussed, and the currently operating annexes were reviewed. Administrative matters and the prospects for new participating countries were also discussed.

The second ExCo of 2007, held in Honolulu, was a full-agenda ExCo meeting. It included a day-long tour of Hawaiian research facilities located on the island of Oahu. These included the Oceanic Institute where considerable research is in progress on sea life and the development of "farm-raised" fish, and the Pacific Biodiesel facility where they are producing biodiesel fuel from used vegetable oils collected from restaurants and other facilities. In addition, a number of speakers made presentations while at the Oceanic Institute on a variety of subjects ranging from algae as a feedstock for biodiesel to 2nd generation cellulosic ethanol technologies. Two new country observers were in attendance representing New Zealand and Austria. The prospects that they will join the agreement seem to be very promising. Again, new proposals for annexes (carried over from the meeting in Detroit) were discussed, and the status of ongoing Annexes was discussed as well as administrative and IEA-related matters. It was tentatively proposed by the Austrian delegate that Austria would host the next ExCo in the time frame of May or June.

The chairman wishes to thank all of the participants for their efforts throughout 2007. Dr. Nils-Olof Nylund 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.

Steve Goguen
Chairman of the Executive Committee
Implementing Agreement on Advanced Motor Fuels

1. International Situation

2007 brings large rise in crude oil prices but also significant gains in biofuels production and consumption

In 2007 oil supplies continued to be under pressure due to rising worldwide demand, and as a result, crude oil prices spiralled up to new records, approaching \$100 (USD) per barrel near the end of the year. Figure 1 illustrates the dramatic rise in oil prices since 1994. While this figure does not show the price actually reaching \$100 per barrel, it did reach that value on January 2, 2008.

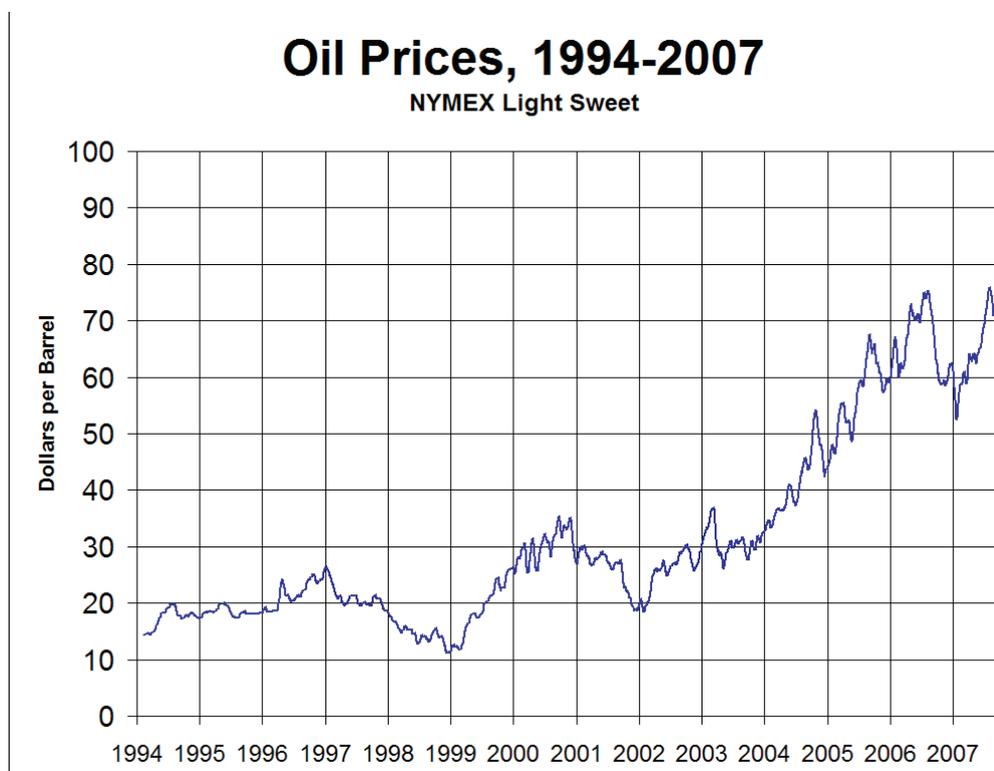
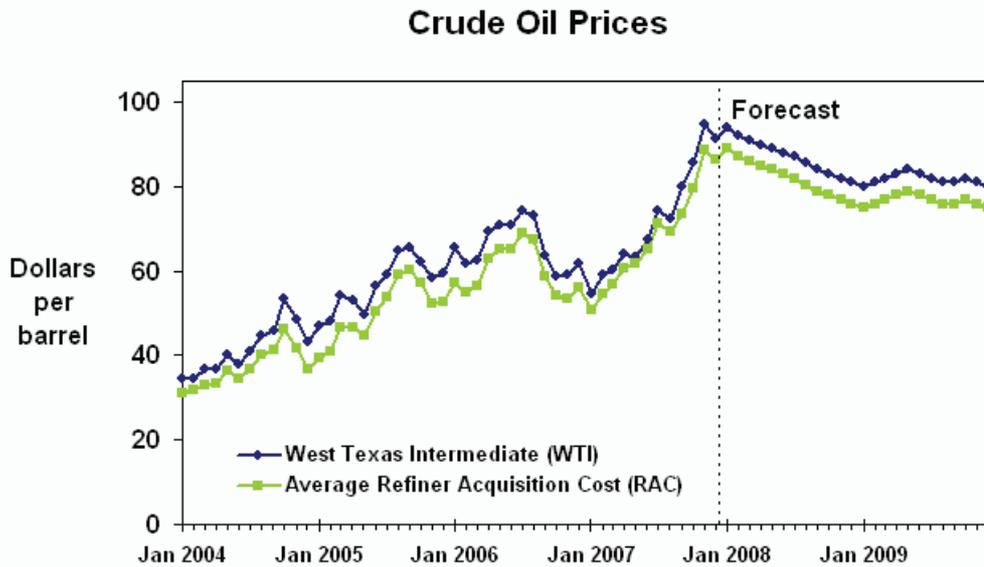


Figure 1 - Oil Prices from 1994 to 2007

While that represents a significant, one-time event, it is more important to examine forecasts of future prices. Will they stay high, or will there be some relief in the future? The U.S. Energy Information Administration has the task of tracking and forecasting energy usage and pricing for the U.S., and they also track worldwide statistics. Their forecast for oil pricing for the next two years is shown in Figure 2, where they forecast that oil prices will remain at levels of \$80 per barrel and above through 2009.

Recent high prices and large price swings reflect the current tight and volatile world crude oil market. The WTI price is expected to average \$94 per barrel in January 2008. The WTI price, which averaged \$72 per barrel in 2007, is expected to average about \$87 per barrel in 2008 and \$82 in 2009.



Short-Term Energy Outlook, January 2008



Figure 2 - EIA Forecast of Oil Prices Through 2009

It is instructive to examine some of the production statistics and demographics behind the oil pricing. Figure 3 shows world oil production since 1960 and the changing picture of where the oil comes from.

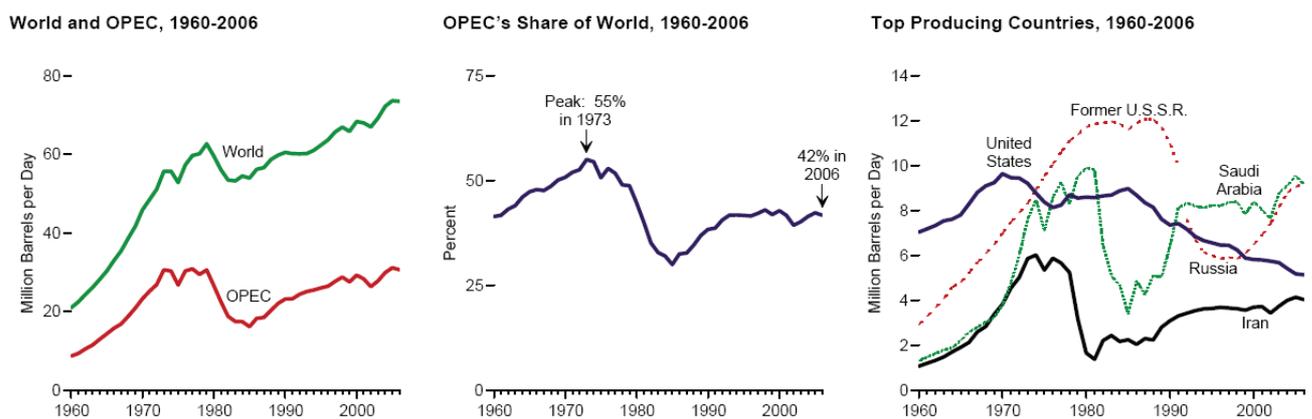


Figure 3 - World Oil Production - 1960 to Present

It is interesting that Russia is beginning to displace Saudi Arabia as the world's top oil-producing nation, and that OPEC's share of the total oil production has apparently reached a plateau and might possibly be turning downward. Figure 4 shows the rankings of the oil-producing nations.

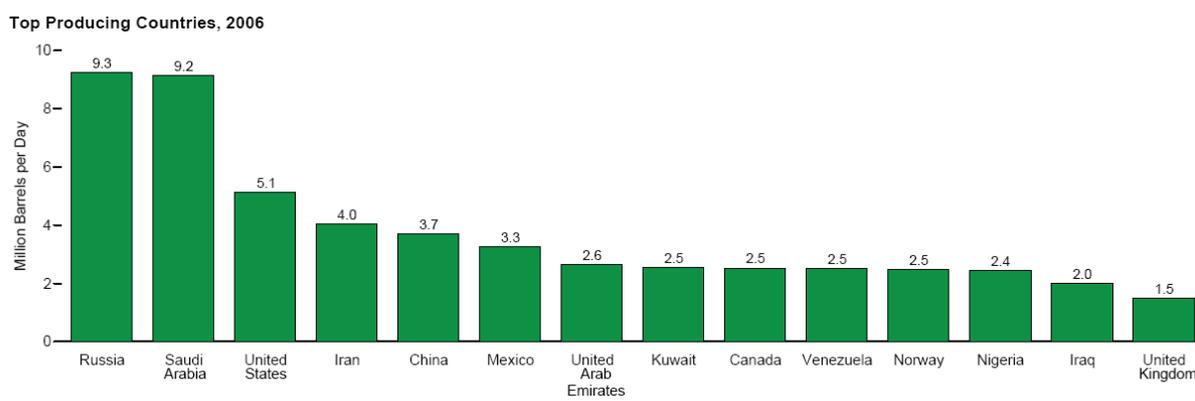


Figure 4 - Top Oil-Producing Countries, 2006

Discussions of carbon dioxide emissions are commonly included in any discussion of energy production and use today. Therefore, we include Figure 5 to show the increase in CO₂ emissions 1995-2004, and the world distribution of CO₂ emissions by region.

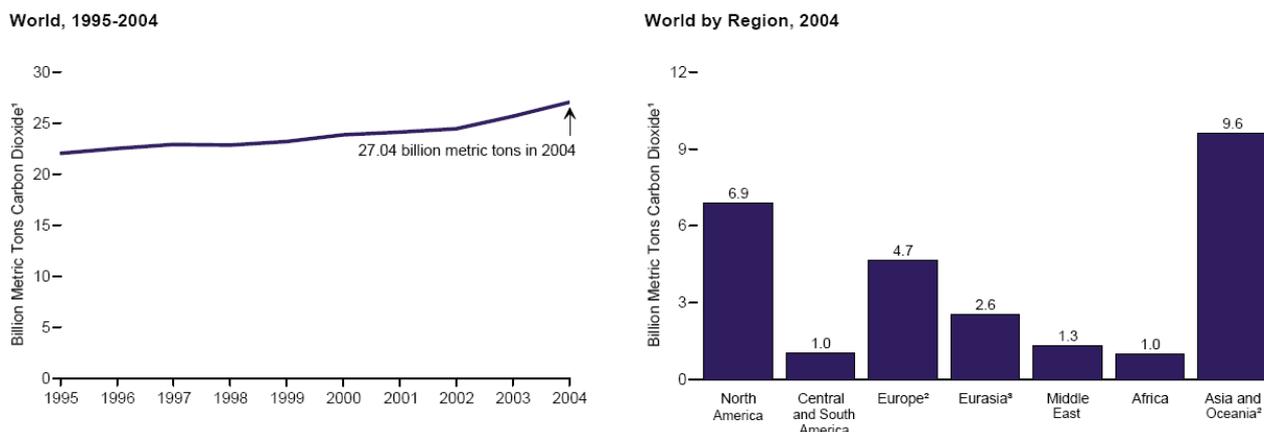


Figure 5 - World Carbon Dioxide Emissions from Energy Consumption

The good news in liquid fuels is that the production and consumption of biofuels worldwide is soaring, and rapid development continued in 2007. Figure 6 shows the world and regional fuel ethanol production from 1975 to 2003. Note the near doubling of production from 1995 to 2003, only eight years. Ethanol is the most widely used biofuel for transportation, most of the use coming in the U.S. and Brazil. Fuel ethanol from corn now provides over 25 billion litres of fuel per year, about 4.5% of total U.S. consumption of gasoline. The U.S. produces nearly 20 times as much as any other IEA country, nearly all of it made from corn. Brazil uses sugar cane for producing ethanol, and their production now exceeds that of the U.S. All gasoline in Brazil contains 22% to 26% ethanol.

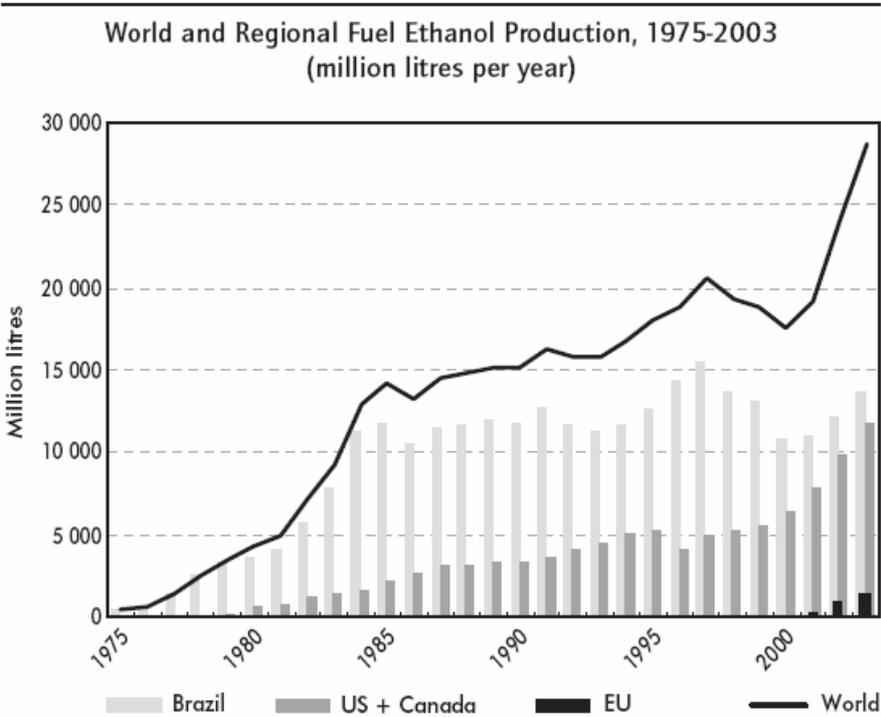


Figure 6 - World and Regional Fuel Ethanol Production
 (Source: IEA Publication: "Biofuels for Transport – An International Perspective")

Figure 7 shows world and regional biodiesel production **capacity** from 1991 to 2003. Biodiesel production is, by far, highest in Europe where diesel-powered light-duty vehicles are in great numbers compared to the rest of the world. Biodiesel production worldwide is still small relative to ethanol production, but it's growing rapidly. In this figure, production capacity is shown rather than actual production, but it mirrors the rise in actual production quite well.

This is the world situation in which the IEA-AMF finds itself well positioned to contribute to the international discussion on advanced fuels including biofuels. Recent and past Annexes have included the following topics relevant to recent world developments in biofuels as detailed above:

- Emission Performance of Selected Biodiesel Fuels
- Future Greener Diesel Fuels
- Alcohols and Ethers as Oxygenates in Diesel Fuel
- Standardization of Alternative Motor Fuels
- Animal Fat in Biodiesel
- Fischer-Tropsch Fuels
- Future Fuels for Road Transport
- Analysis of Biodiesel Options
- Ethanol as a Fuel for Road Transportation

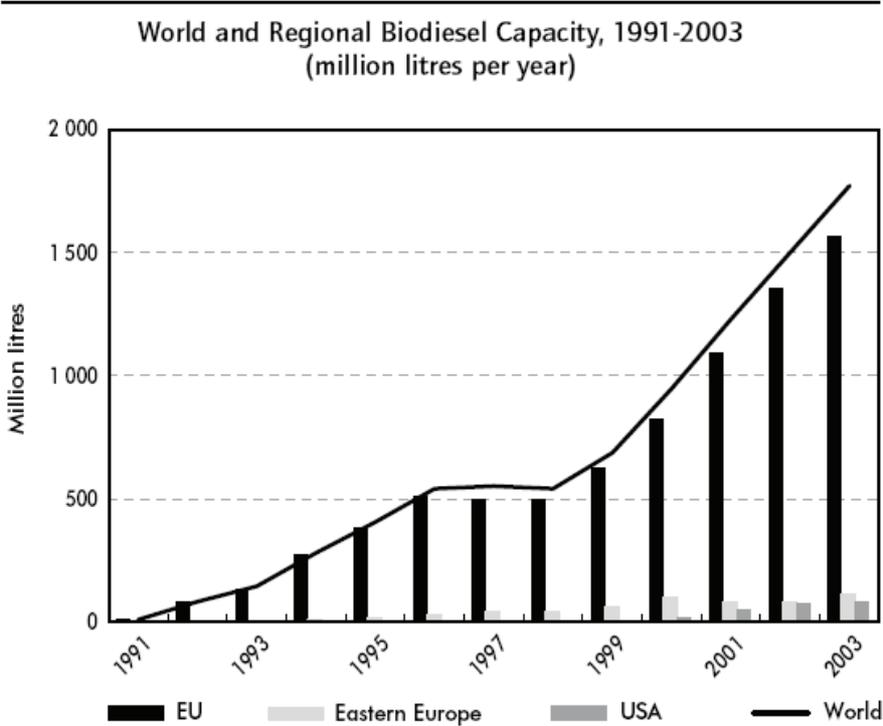


Figure 7 - World and Regional Biodiesel Capacity from 1991 to 2003
 (Source: IEA Publication: "Biofuels for Transport – An International Perspective")

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 Fuel collaboration programme was launched with 5 participating countries in 1984. Today 12 countries are involved in the Programme and form a very interesting and efficient network.

France joined the Advanced Motor Fuels collaboration programme in 2000, Denmark in 2001, Spain in 2002, Switzerland in 2004 and Austria in January 2008. The Czech Republic and the People's Republic of China have announced that they will join soon.

The following countries and designated bodies are active today:

Austria	Austrian Agency for Alternative Propulsion Systems (A3PS)
Canada	Department of Natural Resources Canada (NRC)
Denmark	Technical University of Denmark (DTU)
Finland	Technical Research Centre of Finland (VTT)
France	Agence de l'Environnement et de la Maîtrise de l'Energie (ADEME)
Italy	ENI S.p.A.
Japan	New Energy and Industrial Technology Development Organization (NEDO)
	Organization for the Promotion of Low-Emission Vehicles (LEVO)
Spain	Institute for the Diversification and Saving of Energy (IDAE)
Sweden	Swedish Road Administration (SRA)
Switzerland	University of Applied Sciences Bern (AFHB)
UK	Department for Transport (DfT)
USA	US Department of Energy (DOE)

Those interested to participate as Observers at the meetings of the AMF Executive Committee (see Para. 3.7) 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, Fax +46 8 15 11 91, E-mail pilo.sdab@swipnet.se

3. The Implementing Agreement and the AMF Programme

(Status February 2008)

3.1 Strategic Plans

A first strategic plan was prepared in 1995 and a second "Strategic Plan for 1999-2004" in 1998. The current "Strategic Plan 2005-2009" (see IEA/AMF website www.iea-amf.vtt.fi) was approved by the IEA Committee on Energy Research and Technology (CERT) in June 2004. (For details see Chapter 3.9).

The AMF Implementing Agreement expires 31st August 2009. A request for extension will need to be presented to the End Use Working Party (EUWP) and the Committee on Energy Research and Technology (CERT). The required documents are the End-of-Term Report 2005-2009 and the Strategic Plan 2010-2014 and self-evaluation in the Criteria Table. In order to meet the deadline a first draft of these reports should be presented spring 2008, with the final documents available end- 2008.

3.2 Change of the Name

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 Objectives

Every new fuel has impacts on the whole fuel chain, on feedstock, fuel processing, fuel distribution and end-use including environmental impacts and possible vehicle modifications. It is therefore necessary to have a good understanding of the whole complex system when choosing future fuel options.

The objective of the Advanced Motor Fuels collaboration programme is to deal with such aspects by co-operation on research and demonstration, by exchange of information and creation of a network of experts in the field of advanced motor fuels. Participants are concerned about emissions, energy efficiency, field trials as well as system aspects (such as life-cycle analysis on energy use and greenhouse gas emissions). The AMF collaboration programme forms a suitable platform for co-ordinated efforts on an international level to evaluate new fuel options where experts in Advanced Motor Fuels share experiences and results of their endeavours.

The current “Strategic Plan for 2005-2009” sets the emphasis on:

Information & Membership

- Info service & database
- Country-specific updates
- Website for AMF activities
- Promote membership
- Share info with developing countries
- Provide reliable info to policy & decision makers
- Promote awareness of the need for sustainable transport

RDD&D

- Define R&D priorities
- Encourage collaborative actions (member countries and related IAs)
- Seek co-operation with other programs on new fuels and new vehicle technology (EU, World Bank, etc)
- Seek alliances with industry

Market Facilitation

- International harmonization of fuel specifications and standards
- International harmonization of test procedures
(for vehicles using new types of fuels & propulsion systems)

Participants in the Programme welcome the submission of proposals for exploratory projects on fuels and emission control in areas such as road transport, other transport modes, off-road vehicles and other working machines, lubricants and standardisation of fuels, components and tests.

3.4 Definition of Advanced Motor Fuels

Fuels included under the definition of Advanced Motor Fuels are fuels that fulfil 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

In the current “Strategic Plan 2005-2009” two new, partly overlapping criteria have been added:

- 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

3.5 Participating Countries

From 1st January 2008 twelve countries participate in the IEA collaboration on advanced motor fuels:

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

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.

3.6 Executive Committee and Secretariat

The practical work within the IA is co-ordinated by an Executive Committee (ExCo). The ExCo of the IA on AMF is an active and authoritative group of persons, 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 Executive Committee meets 1-2 times a year in different participating or new countries, reviews the progress and results of Annexes, approves new Annexes as proposed by Participants, and determines other specific activities.

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

An IEA/AMF Secretary assists the Executive Committee in planning meetings, initiating new Annexes, assisting Operating Agents, providing information to the IEA Secretariat, disseminating information and responding to member's inquiries. In its meetings in June 2006 in Toronto and October 2006 in Beijing the Committee prepared guidelines for the functions and duties of the Chairpersons and the Secretary.

3.7 Projects/Annexes

Altogether, 29 collaborative projects (Annexes) have been completed since the programme started in 1984 (see Electronic Attachment No 1: Tables A-E). Five 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, XXXII, XXXIII, XXXIV, XXXV |
| • Emissions – particles | V, XII, XIII, XXII, XXV, XXXIII, XXXVI |
| • Test procedures | XVII, XXIX, XXXIII, XXXVI |
| • Health effects | XXX |
| • Environment | VII |
| • Standardization | XXVII, XXVIII |
| • Lubricants | XVI, XXXIII |
| • Non-road engines | XXV |
| • Life cycle analysis | XXXI |
| • Production | IV, XXXI |
| • Demonstration | II, III, VIII |
| • Implementation | XI, XV, XXI |
| • Operational experience | XXVI |

3.8 Recent Initiatives

During its last meetings ExCo 33 in April 2007 in Detroit, USA, and ExCo 34 in November 2007 in Honolulu, USA, the Executive Committee took a number of initiatives.

ExCo 33 took place in Detroit, USA, 2007

- This was the first ExCo Mini-Meeting. These special meetings should be focused on developing new ideas, new activities and starting up of new Annexes.
- Four newsletters were published in 2007 within the Annex XXVIII “Information Service & AMF Website (AMFI)”. All material is assembled in a special Newsletter database on the website. The AMFI website is used widely and updated regularly.
- The highly topical final report “Outlook for Biofuels, Advanced Motor Fuels, and New Vehicles” prepared within Annex XXVIII was approved.
- A Sub-task No 1 “Analysis of Biodiesel Options” was started under Annex XXXIV.
- A Sub-task No 1 “Ethanol as a Fuel for Road Transportation” was started under Annex XXXV.
- Sweden proposed a new Annex “Measurement Technologies for Hydrocarbons, Ethanol and Aldehyde Emissions from Ethanol Powered Vehicles”.
- Two Annexes were closed (XXIX and XXXI).

ExCo 34 took place in Hawaii, USA 2007

- Austria will join from 1st January 2008 with Austrian Agency for Alternative Propulsion Systems (A3PS) under the Bundesministerium für Verkehr, Innovation und Technologie as Contracting Party.
- The ExCo decided to invite New Zealand and Thailand to join AMF.
- Updates on progress in the US, Europe, China, Japan, New Zealand and Thailand were presented.
- The ExCo decided to start a new Annex XXXVI “Measurement Technologies for Hydrocarbons, Ethanol and Aldehyde Emissions from Ethanol Powered Vehicles”.
- Finland presented a proposal to start a new Annex “Fuel and Technology Alternatives for Buses – Overall Energy Efficiency and Emission Performance”. The intention is to carry out the Annex in cooperation between the three Implementing Agreements AMF, Bioenergy and HEV.

3.9 IEA/AMF on Internet

- As a part of the new Information System, Annex XXVIII, the AMF website was completely reworked in 2005. Public reports are now easily accessible. 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 2008)

Table 1. Running Projects/Annexes

The following five projects/annexes are presently running.

Annex	Title	Run time	Operating Agent	Participating Countries
Annex XXVIII	Information Service & AMF Website (AMFI)	2004 - - - -	TEC (FIN)	11
Annex XXVIII Sub-task No 1	Outlook on Standardization	2007 – 2008	Atrax (S)	11
Annex XXXIII	Particle Emissions of 2-S Scooters	2004 – 2008	AFHB (CH)	6 + EU
Annex XXXIV Sub-task No 1	Analysis of Biodiesel Options	2007 – 2008	FEEC (USA)	5
Annex XXXV Sub-task No 1	Ethanol as a Fuel for Road Transportation	2007 – 2008	DTU (DK)	11
Annex XXXVI	Measurement Technologies for Ethanol	2008	SRA (S)	>3

Table 2. Running Projects/Annexes

Participation and financial commitments are shown in the following table.

Annex	Participating Countries and their Contributions											
	€ denotes the Operating Agent. Amounts are given in 1 000 €.											
	CDN	CH	DK	ES	FIN	FR	I	J	S	UK	US	Total
XXVIII Information Service & AMF Website	X	X	X	X	€ X	X	X	X	X	X	X	25*
XXVIII Sub-task No 1 Outlook on Standardization	X	X	X	X	X	X	X	X	€ X	X	X	20
XXXIII Particle Emissions of 2-S Scooters	0	€ 20	0		0	0	0					20
XXXIV Sub-task No 1 Analysis of Biodiesel Options	15				15		15	15			€ 15	75
XXXV Sub-task No 1 Ethanol as a Fuel for Road Transportation			€ 70									70
XXXVI Measurement Technologies					?				€ 50		?	150
TOTAL												360

* Annual budget 2008

5. Progress Reports by the Operating Agents

(Status February 2008)

5.1 Annex XXVIII Information Service & AMF Website (AMFI)

Operating Agent	TEC TransEnergy Consulting Ltd, Finland
Decision to start	January 2004 (ExCo 29)
Project Duration	Continuous
Participants	All Contracting Parties (11 countries)
Total Budget	€ 20 000 in 2005, € 36 000 in 2006 € 40 000 in 2007, € 25 000 in 2008 Paid via the AMF Fund
Project Leadership	Ms. Päivi Aakko-Saksa TEC TransEnergy Consulting Ltd Teknikantie 14 FIN – 02150 Espoo Phone: +358 40 505 57 50 Fax: +358 9 2517 2361 E-mail: paivi.aakko@teconsulting.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 joint 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, 12 issues have been distributed, one in October 2004, four in 2005, three in 2006, and four in 2007. 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 special article. 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 be freely downloaded on the AMF website.

The AMF website serves both the general public interested in transportation fuel related issues and also the Members of the Advanced Motor Fuels Implementing Agreement. For the Members, a special password protected area is provided.

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.

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 have been allocated from the AMF Fund to include Atrax’s work on “Outlook on Standardization“ in Annex XXVIII during 2007 (ExCo 32, Decision #8).

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	Jesper Schramm, DTU, Denmark
Decision to start	October 2004 (ExCo 30)
Project Duration	July 2004 –December 2008 (4,5 years)
Participants	CDN, CH, DK, F, FIN, I, and JRC EU Laboratories (6 countries + EU)
Total Budget	No AMF budget. Task-sharing. Total cost € 20 000.
Project Leadership	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

Background

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
- AMF Annex XXXIII: 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

Financial Status

The framework of Annex XXXIII is at task-sharing basis, i.e. each partner has own sources of financing his work.

For the activities of the Swiss Operating Agent a budget of € 20 000 is available.

Time Schedule

- Meeting Zurich, Jan. 12, 2005
- 1st technical report from the Swiss Network (June 2005)
- Meeting Zurich, June 15, 2005
- 1st information report for Annex XXXIII (Oct. 2005)
- 2nd technical report from the Swiss Network (Dec. 2005)
- Meeting Zurich, February 15th, 2006
- 2nd information report for Annex XXXIII (Nov./Dec. 2006)
- 3rd technical report from the Swiss Network (Dec. 2006)
- Meeting Zurich, February 14th, 2007
- 3rd information report for Annex XXXIII (Nov./Dec. 2007)
- AFHB annual technical report “2-wheelers” for Swiss EPA (BAFU) (Dec. 2007)

- Meeting Zurich, Mai 23rd, 2008 (Toxicity)

Results and Reports

The results will be presented in the technical reports, which will be officially available after approval by the industrial partners.

Other working groups of the network will be encouraged to give appropriate information about their activities. The summaries of this information will be given in the information reports for Annex XXXIII.

In the 1st information report for Annex XXXIII (B169) the activities and results of following institutes have been shortly presented:

- AFHB, Automotive Division Biel, CH of the University of Applied Sciences Bern, CH
- EMPA Federal Laboratories, CH
- ENEA & Municipality of Rome, I
- RICARDO Consulting Engineers, UK
- Technical University Graz, A
- EU Joint Research Center, Ispra, I
- Technical University of Denmark

In the 2nd information report for Annex XXXIII (B189) the following activities have been presented:

- AFHB, Automotive Division Biel, CH of the University of Applied Sciences Bern, CH
- EMPA Federal Laboratories, CH
- ENEA & Municipality of Rome, I
- Technical University Graz, A
- EMITEC, D
- ADEME, F
- Other activities from literature

In the 3rd information report for Annex XXXIII (B209) the following activities have been presented:

- AFHB, Automotive Division Biel, CH of the University of Applied Sciences Bern, CH
- EMPA Federal Laboratories, CH
- ENEA & Municipality of Rome, I
- Technical University Graz, A
- GEO₂ particle filtration
- AECC & ICCT
- Other activities from literature and internet

In this report some additional information about 4-stroke 2- and 3-wheelers is given.

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 H₂-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.

Future Plans

- Adaptation of the results to the engine/vehicle technology from other markets
- Further studies of health effects and toxicology
- Support by legal authorities

5.3 Annex XXXIV Biomass Derived Diesel Fuels

Sub-task No 1 Analysis of Biodiesel Options

Operating Agent	Fuels, Engines, & Emissions Consulting (FEEC), USA
Assistants	Nils-Olof Nylund and Päivi Aakko-Saksa, TEC TransEnergy Consulting Ltd, Finland
Decision to start	October 2006 (ExCo 32)
Project Duration	November 2006 – January 2008 (14 months)
Participants	CDN, FIN, I, J, and USA (5 countries)
Total Budget	5 x 15 000 = € 75 000

Project Leadership

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During ExCo 33 in Detroit it was decided to use Annex XXXIV as an umbrella for various Sub-tasks with Ralph McGill as Annex coordinator (ExCo 33, Decision #7). It was also decided that all Member Countries participate in Annex XXXIV without committing any funds (ExCo 33, Decision #8). Finally, it was decided to reclassify an existing Annex in this subject as Sub-task No. 1 “Analysis of Biodiesel Options” under the umbrella Annex XXXIV with Ralph McGill as Operating Agent (ExCo 33, Decision #9).

Background

Use of fatty acid methyl esters (FAME) as a substitute diesel fuel is on the rise around the world. Volumes of biodiesel use and production are growing very rapidly. In the US, for example, the volume of biodiesel used in transportation has grown by a factor of 6 to 7 times in only four years. While no national requirement for biodiesel content in diesel fuel is yet in place in the US, national tax incentives now promote the use of biodiesel, and individual states are beginning to enact requirements for biodiesel content in diesel fuel.

In Europe the situation is similar, with growing amounts of biodiesel being used in transportation. Additionally, the European Commission has adopted goals of a 2% minimum level of biofuels as a proportion of all fuels by 2005 and reaching 5,75% of all fuels by 2010.

Such a rosy outlook for biofuels is not without technical hurdles, though. Methyl esters face some serious technical barriers that either require special measures to accommodate the fuels or limit their practical use in some climates at some blend levels. Among these barriers are poor oxidative stability, incompatibility with some elastomers, low-temperature flow properties, and higher NOx emissions.

If we are to achieve greater impact of bio-derived fuels, we must utilize all varieties of feedstocks and produce a broader slate of fuel choices, ranging from gasoline replacements to diesel replacements. Therefore, the world’s attention is turning to concepts of more diverse manufacturing processes, and the notion of a flexible biorefinery is coming into being.

These biorefineries can take several forms in concept. One concept is for a manufacturing facility that would take all kinds of biomass and produce (1) alcohols or gasoline-like fuels through a sugar – fermentation platform and (2) diesel-like fuels through a thermochemical platform. Another concept put forward by Neste Oil of Finland would integrate a biorefinery into a normal petroleum refinery plant. Thus, the biomass-derived fuel would simply be adsorbed into a petroleum platform.

The new generation of Biorefineries will produce 2nd generation biobased fuels. The Biorefineries will use a wide spectrum of biomass as feedstocks – switch grasses, agricultural waste, animal waste, cellulosic biomass, even black liquor.

The fuel products will be versatile, ranging from alcohols to FT diesel and synthetic gasolines and diesel fuels. One combines a sugar platform (fermentation) with a syngas platform (thermochemical). Some would combine integrate fuel processing with power generation and district heating. Some would be combined with a petroleum refinery so that bio-based products become integrated with petroleum-based products.

Objectives

The overall objective of this annex is to provide a better picture for IEA/AMF of where the biodiesel industry is going in the future – how technical barriers will be overcome, what bio-derived fuels will replace significant quantities of diesel fuel, what will be the feedstocks for those fuels, and what will be the processes by which the fuels will be made. To accomplish this, we will make great use of literature, especially the results of ongoing research and development. We will have discussions with those in industry who can provide guidance. We will attend the most appropriate technical meetings. And, we will make an analytical assessment of competing biodiesel production concepts with a view to characterizing the efficiencies of the processes and the value of the products.

Content of Work

The study will have three major parts:

- Review and analyze the situation with methyl esters as diesel substitutes – how far can we go?
- Make an in-depth study of the conceptual biorefineries to learn how broadly we can extend the range of biomass feedstocks as well as products.
- Make a technical analysis and comparison of various biorefinery proposals.

Financial Status

The total costs are estimated to € 75 000. With 5 countries participating the cost will be € 15 000 per country.

Results and Reports

A complete draft final report will be ready by the end of 2007 and the final report will be distributed to the Participants by the end of 2008.

A status report was presented by Ralph McGill at ExCo 34 in Honolulu, Hawaii, in November 2007. Three countries have made payments for their share of the project and the remaining two are processing the payments.

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).

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

Operating Agent Technical University of Denmark (DTU), Denmark

Decision to start April 2007 (ExCo 33)

Project Duration April 2007 – December 2008 (1,5 years)

Participants All Contracting Parties (11 countries)

Total Budget No AMF budget. Task sharing. Total cost € 70 000.

Project Leadership Prof. Jesper Schramm, DTU, Denmark
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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:

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

The main report will be 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 estimated to € 70 000.

Results and Reports

A draft of the main report will be delivered during summer 2008.

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

Operating Agent	Swedish Road Administration (SRA), Sweden
Decision to start	November 2007 (ExCo 34)
Project Duration	Approximately one year during 2007-2008
Participants	Sweden, Finland (preliminary), Canada (preliminary), USA (preliminary)
Total Budget	€ 150 000
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AVL MTC: Jan Gåsste: jan.gasste@avlmtc.com

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)

1. Regulation (including EU)
2. Measurement specification (level, sensitivity, cost indication, time etc)
3. Lab experience
4. Question area

Task 2: Measurement and Correlation study of HC and ethanol

1. FID measurement of ethanol, propane calibration gases with different concentration and oxygen content in carrying gas.
2. Measurement of ethanol and propane calibration gases in bags with different waiting time.
3. Using different type FID and individuals for measuring ethanol, propane calibration gases.
4. Using FID at different sampling and detector temperature for measuring ethanol, propane calibration gases.
5. Comparing MS, Photoacoustic and FTIR for measuring ethanol calibration gas.
6. Ethanol and propane bomb test in CVS system.
7. Measurement of an unknown gas bottle with ethanol and propane mixture in different labs.
8. Analyse ethanol solutions at different labs.

Task 3: Vehicle tests

1. Emission tests at different temperature (22°C, -7°C, -15°C).
2. Emission tests with different CVS flow.
3. FTP tests and NEDC tests
4. Emission tests with different fuels.
5. Comparing FTIR with MS for ethanol measurement
6. Comparing photoacoustic with MS for ethanol measurement
7. Comparing two MS for ethanol measurement
8. Comparing FTIR and cartridge for aldehyde measurement
9. 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

The project is still in the start up phase setting up the financing and agreements between the different parties.

Results and Reports

The project status will shortly be reported at the AMF ExCo-meetings held while the project is running. All participants will get the technical report after the project is finished and the project final results will be presented at the first ExCo-meeting held after the project has been finished.

AMF ExCo Meetings

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

	<i>Date</i>	<i>Chairman</i>	<i>Secretary</i>
a Madrid	80/3	Staffan Ulvönäs, S	Folke Schippel, S
b Stockholm	80/7	“	“
1. Ottawa	84/5	Gene Ecklund, US	Folke Schippel, S
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, S
9. Tokyo	88/11	Shinichi Nakayama, J	Folke Schippel, S
10. Vancouver	89/6	“	“
11. Rome>	89/11	PierPaolo Garibaldi, I	“
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, CDN	Kerstin Larsson, S
17. Antwerpen	94/2	“	Irene Kolare, S
18. Toronto	94/10	“	“
19. Saltsjöbaden, S	95/9	“	Lars Vallander, S
20. Oxford	96/6	“	“
21. Charleston	97/3	Ben van Spanje, NL	Claës Pilo, S
22. Rovaniemi, FIN	98/1	“	“
23. Tokyo	98/10	“	“
24. Espoo/Helsinki	99/6	Nils-Olof Nylund, FIN	“
25. Toronto	00/6	“	“
26. Copenhagen	01/5	Arie Brouwer, NL	“
27. Milano	02/4	Nils-Olof Nylund, FIN	“
28. Paris	03/3	“	“
29. Linköping	04/1	Steve Goguen, USA	“
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	“	“

Executive Committee on Advanced Motor Fuels

(Status February 2008)

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MAIN RESULTS OF COMPLETED AMF PROJECTS/ANNEXES

(Annex I – XXXI)

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 (S)

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 (S)

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 (CDN)

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 (CDN)

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 (FIN)

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 (CDN).
Assistant: SDAB (S)

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 (USA).
Assistant: Phase 1: SDAB (S). 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 (B)

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 (S)

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 (FIN)

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 (USA)

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 (FIN).
Assistant: ORNL (USA)

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 NO_x 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 (N)
- *Safety investigation (DME distribution and vehicles):* Renault (F), Akzo-Nobel (NL), TNO-WT and TNO-MEP (NL) and NRCanada (CDN)
- *Design guidelines:* AVL-List (A), AET (CDN), Renault (F) and DTU (DK)
- *DME from renewable feedstock:* IEA AFIS (Atrax Energi, S)
- *Life cycle analysis (LCA):* IEA AFIS (Innas, NL), Amoco (USA), Statoil (N), Haldor Topsoe (DK), Volvo Truck (S), Renault (F) and TN-WT (NL)
- *Costs of DME infrastructure:* IEA AFIS (Innas), Statoil (N) and Amoco (USA)
- *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 (B)

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 (USA)

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 tributate (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 (FIN)

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 (FIN)

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 (S) & TEC TransEnergy Consulting Ltd (FIN)

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

Standardisation of Alternative Motor Fuels

Operating Agent: Atrax Energi AB (S)

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 XXIX

Heavy-Duty Urban Vehicles

Operating Agent: VTT (FIN)

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 NO_x-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 (CDN)

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 (S)

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.

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 (S)	5
Annex II	Technology Information Exchange on Alt Motor Fuels	1984 – 1992	SDAB (S)	7
Annex III	Alcohol Diesel Field Trials	1987 – 1992	Sypher (CDN)	6
Annex IV	Production of Alcohols and other Oxygenates	1987 – 1994	Energy, Mines and Resources (CDN)	5
Annex V	Performance Evaluation of Alt Fuel/Engine Concepts	1990 – 1995	VTT (FIN)	9
Annex VI	State-of-the-art Report on Natural Gas as a Motor Fuel	1990 – 1992	Sypher (CDN) SDAB (S)	6
Annex VII	Environmental Impacts of Alternative and Conventional Fuels	1992 – 1997	ORNL (USA) Phase 1: SDAB (S) Phase 2: Innas (NL)	8
Annex VIII	Heavy-Duty Vehicles on Alternative Fuels	1994 – 1998	VITO (B)	8
Annex IX	Automotive Fuel Information Service (AFIS)	1995 – 1999	Innas (NL) Atrax (S)	7
Annex X	Characterisation of New Fuel Qualities	1995 – 1997	VTT (FIN)	7
Annex XI	Forecasting and Planning Tools for Alternative Fuels	1995 – 1996	Sypher (USA)	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 (FIN) ORNL (USA)	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 - XXXI)

The following 14 projects/annexes have been completed during the period 1997-2007.

Annex XVI	Biodegradable Lubricants	1998 – 2004	DTU (DK)	6
Annex XVII	New Technologies for Heavy-Duty Vehicles	1998 – 2000	VITO (B)	7
Annex XVIII	Future Greener Diesel Fuels	1997 – 2002	Battelle (USA)	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 (FIN)	6 +2 sponsors *)
Annex XXIV	Information Exchange IEA AMF/AFIS	2000 – 2004	Innas (NL)	10
Annex XXV	Non-Road Engines	2000 – 2003	VTT (FIN)	4 **)
Annex XXVI	Oxygenates in Diesel	2002 – 2005	Befri (S) TEC (FIN)	4
Annex XXVII	Standardization of Alternate Fuels	2000 – 2004	Atrax (S)	4-6
Annex XXIX	Heavy-Duty Urban Vehicles	2004 – 2007	VTT (FIN)	4
Annex XXX	Animal Fat in Biodiesel	2004 – 2006	ATFCan (CDN)	4
Annex XXXI	Fischer-Tropsch Fuels	2004 – 2007	Atrax (S)	3

*) 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 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												Total
	(B) CH	CDN	DK	ES	FIN	FR	I	J	NL	S	UK	US	
XI Forecasting and Planning Tools		15			10							CE 50	75
XII Particulate Emissions	22.7	22.7			22.7				22.7		CE 22.7	22.7	136
XIII Biodiesel Fuels	32	32			CE 75			39.7	32	42		95	348
XIV DME as Fuel I		110	90		20			40	CE 85	180		80	787*
XV Implementation Barriers					13			13	CE 13	13		13	66
XVI Biodegradable Lubricants			CE 62,7		27,7		20	20	7,7	27,7		32,7	199
XVII Heavy-Duty Vehicles	CE 80				40		0**	40	40	40		40	280
XVIII Future Greener Diesel Fuels		5			10	10		10	10	10		CE 10	65
XIX New Fuels for New Engines		8			8				CE 8	8		8	40
XX DME as Fuel II			10		10	30	10	10	CE 20	10		10	150***
XXII Low Temperature Particles		22,5			CE 91,5		22,5	22,5		28,5		22,5	210
XXIV Information Exchange IEA AMF/AFIS		X	X	X	X	X	X	X	CE X	X	X	X	58
XXV Non-Road Engines					CE 60	20				20		20	120
TOTAL													\$ 5 616

*) In the sum USD 787 000 are included also contributions from the Sponsors IFP/PSA/Renault (France) with USD 55 000 and AVL (Austria) 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 (France), TNO and Helvoet (NL) with each USD 10 000.

Table E. Completed Projects (Annex XXVI-XXXI)

Participation and financial commitments are shown in the following table.

Table in EURO!

Annex	Participating Countries and their Contributions												Total
	CH	CDN	DK	ES	FIN	FR	I	J	NL	S	UK	US	
XXVI Oxygenates in Diesel		8			€		8	8		(€) -	8		32
XXVII Standardization of Alternate Fuels		24			10	15		27		€ 30		27	133
XXIX Heavy-Duty Urban Vehicles		56			€ 140	40						152	388
XXX Animal Fat in Biodiesel		€ 413			13							50	476
XXXI Fischer-Tropsch Fuels			40		30					€ 0		60	130
TOTAL													€ 1 159



AMF REPORTS

(ANNEX I – XXXIII)

List of Annual Reports 1994-2007 and all reports prepared within the AMF Annexes

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 (see www.iea-amf.vtt.fi)
- IEA Advanced Motor Fuels. Annual Report 2006 (see www.iea-amf.vtt.fi)
- IEA Advanced Motor Fuels. Annual Report 2007 (see www.iea-amf.vtt.fi)

Annex I

Alcohols and Alcohol Blends as Motor Fuels

Operating Agent: SDAB (S)

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 (S)

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 (CDN)

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 (CDN)

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

Performance Evaluation of Alternative Fuel/Engine Concepts

Operating Agent: VTT Processes (FIN)

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

State-of-the-art Report on Natural Gas as a Motor Fuel

Operating Agent: Sypher (CDN).
Assistant: SDAB (S)

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 (USA)
Assistant: Phase 1: SDAB (S). 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 Using Alternative Fuels

Operating Agent: VITO (B)

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

The Automotive Fuels Information Service (AFIS)

Operating Agent: Innas (NL).
Assistant: Atrax (S)

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 (FIN)

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 (USA)

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

Annex XII

Size and Compositional Analysis of 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 (FIN).

Assistant: ORNL (USA)

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 (B)

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 (USA)

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 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

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 Temperature Using Different Fuels

Operating Agent: VTT Processes (FIN)

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 *publicly 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](http://www.innas.com/fuel_news).

Annex XXV **Fuel Effects on Emissions from Non-Road Engines**

Operating Agent: VTT Processes (FIN)

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 (S) & TEC TransEnergy Consulting Ltd (FIN)

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

Standardisation of Alternative Motor Fuels

Operating Agent: Atrax Energi AB (S)

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

Operating Agent: TEC TransEnergy Consulting Ltd (FIN)

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

(see AMF website for “Downloadable Documents”)

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.

Annex XXIX

Evaluation of Duty Cycles for Heavy-Duty Urban Vehicles

Operating Agent: VTT Processes (FIN)

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

Animal Fat in Biodiesel

Operating Agent: ATFCan (CDN)

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

Production and Use of Synthetic Vehicle Fuels made by Fischer-Tropsch Technique

Operating Agent: Atrax Energi AB (S)
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.

Annex XXXIII

Particle Emissions of 2-S Scooters

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

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.