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IEA
Advanced Motor Fuels

Annual Report 2004

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Updated information on IEA/AMF is found on

a) www.iea-amf.vtt.fi

b) www.iea.org/impag

February 2005

To IEA

IEA Advanced Motor Fuels

Annual Report 2004

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 2004 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

The transport sector today faces many challenges as they relate to the security of supplies and sustainability of motor fuels. Carbon dioxide emissions from transport continue to rise at a time when they need to be reduced. Demand for petroleum fuels is beginning to outpace the growth in production. Vehicles must comply with increasingly stringent emissions controls thus placing additional strain on efforts to improve fuel efficiency of cars and trucks. Many long-term alternatives are receiving great attention worldwide. The foremost of these is hydrogen which will require radically different prime movers and infrastructure development to realize its potential. Fuels derived from biomass are also demanding great attention because of their potential to be CO_2-neutral. The Executive Committee of the Implementing Agreement on Alternative Motor Fuels has taken all of these forces into consideration in its new five-year strategic plan and will be pursuing a course of research and information exchange that will contribute to solutions to these challenges.

Two meetings of the Executive Committee were held in 2004; the first in Linköping, Sweden in January, and the second in Sao Paulo, Brazil in October.

At the Linköping meeting the committee reviewed a draft of the end-of-term report (a brief report of accomplishments for the past five-year period) and also approved in principle the draft of a new five-year Strategic Plan for the period 2005-2009. Highlights of this plan include the following:

> The vision of the AMF is 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 goal 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 goals and objectives of the strategic plan.

At this meeting eight of the ten member countries were represented. In addition, there were observers from Switzerland and Brazil. The committee was treated to a tour of the Linköping biogas plant during the week. In informal sessions, the committee heard progress reports on seven existing annexes and proposals for four new annexes. In executive sessions, the committee officially closed five of the annexes which had concluded. Three of the new annex proposals were approved to start. The chairman and vice chairmen had been elected to two-year terms at the last meeting and they, therefore, continue to serve for another year. Dr. Claës Pilo of Sweden was elected to continue as the Committee Secretary. The gentleman representing Brazil as an observer, Dr. Oswaldo Lucon, generously offered to host the next ExCo meeting in Brazil, provided that he could secure support for it in Brazil.

The committee met for the second time in 2004 in October in Sao Paulo, Brazil for its 30th ExCo meeting. Prior to the committee meeting, a separate meeting was held with Brazilian representatives to familiarize them with the AMF and for the committee to learn more about the alternative fuel programs in Brazil. Tours of the Sugar Cane Technology Centre and the Costa Pinto Ethanol Plant were included in the agenda.

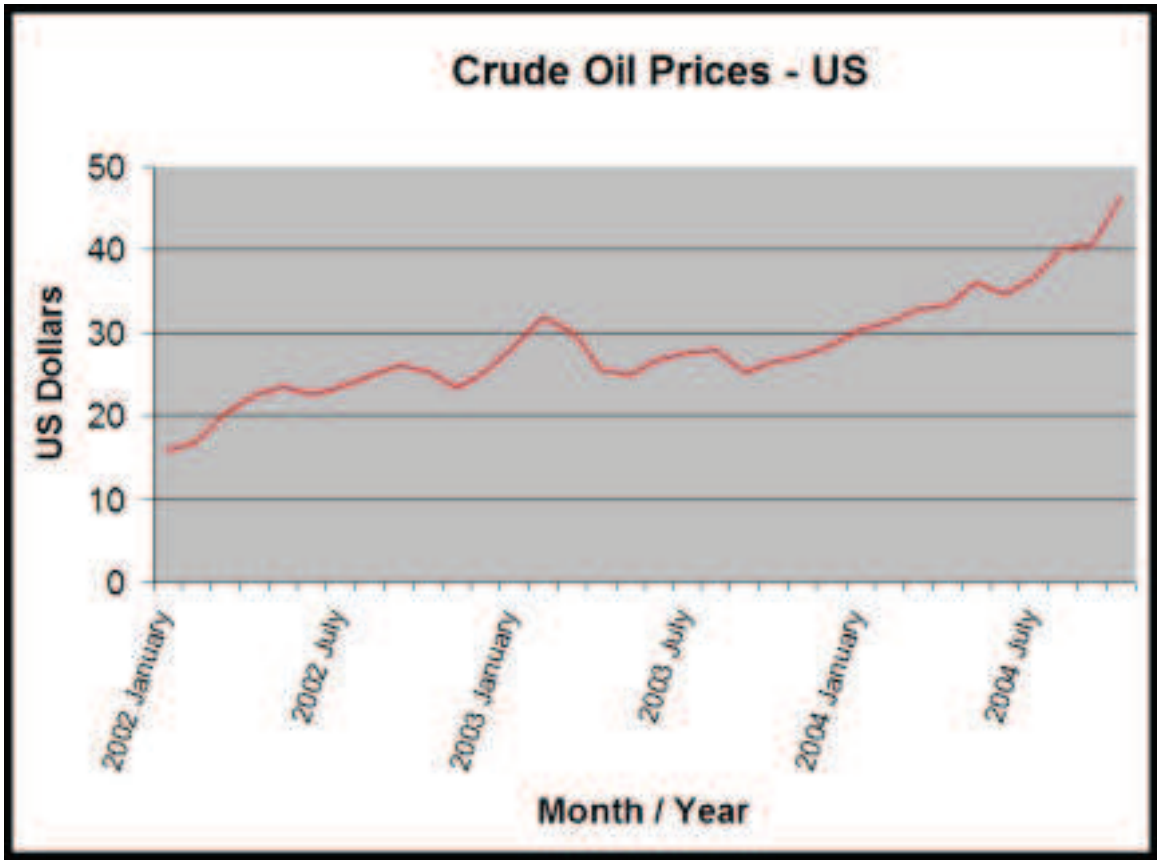
Switzerland has joined the agreement and was represented at the meeting as were eight other member nations of the total of eleven. Observers were present from Brazil and the Czech Republic, both of whom announced their interest in joining the committee. An observer was to have been present from the Republic of China but at the last minute was not able to attend. In informal sessions the committee heard progress reports from six annexes and proposals for three. One of the existing annexes was concluded and was officially closed by the committee. They also voted to start the three newly proposed annexes.

Steve Goguen of the U.S. Department of Energy was re-elected to a two-year term as Chairman, and Nils-Olof Nylund of Finland along with Shigeaki Tonomura of NEDO (Japan) were re-elected to two-year terms as Vice Chairmen. Claës Pilo was re-elected to another one-year term as secretary. The chairman wishes to thank all of the participants for their efforts for the committee throughout 2004. Special thanks are due to Dr. Nils-Olof Nylund and Shigeaki Tonomura for their efforts as Vice Chairmen and to Dr. Claës Pilo for his work as secretary for the committee.

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

1. Positioning the IEA Advanced Motor Fuels Programme in a Changing World

The world is changing in many ways, but perhaps in no way more dramatic than in the supply, demand, and pricing of crude oil. The graph below illustrates crude oil prices just since the beginning of 2002, showing a more than doubling of price.



Source: Energy Information Administration, US DOE

This price increase results from, among other reasons, the coincidence of several events including unrest in the Middle East oil-producing region, fiscal difficulties with Russia's biggest oil company, and storm damage in the US and elsewhere. However, a more permanent factor bringing about rising prices is represented in the burgeoning economies of China and India, putting great pressure on the balance of world supply and demand.

At the same time, the concern for global warming and CO_2 emissions makes it imperative that we look for more efficient processes that employ combustion of hydrocarbons and effective technologies that could replace hydrocarbon combustion with CO_2 – neutral processes. The other major part of the backdrop for fuels is the fact that emissions standards for vehicles continue to be regulated downward, with major new goals in the US, Europe, and Japan late in this decade.

All of this leads to the conclusion that there has, perhaps, never been a more compelling argument for the world to turn its attention to petroleum alternatives. Indeed, that is what the world is doing.

In the quest for non-petroleum-based fuels, the emphases worldwide are, by and large, on the same fuels, hydrogen, biofuels, and gaseous fuels. Hydrogen offers the added benefit of potentially being free of the normal pollutants – nitrogen oxides, hydrocarbons, carbon monoxide, and particles.

The US is pursuing a large hydrogen fuel initiative involving both hydrogen fuel cell development as well as technology that would support the development of a hydrogen distribution infrastructure. The drivers for a hydrogen economy are:

- Energy security
- CO2 and criteria emissions reductions
- Economic competitiveness

Technology is being pursued that would support a decision in 2015 to go forward with the goals. If such a decision is made in 2015 then it is forecast that by 2030-2040 the benefits of hydrogen would be realized.

In the meantime, other intermediate fuel-saving technologies are being pursued. These include hybrid vehicle technologies, advanced combustion engines, and improved petroleum-based fuels as well as alternative fuels.

There is a notable move to biofuel blends in the US. Ethanol is blended in much of the gasoline stock, and most of states have either mandated the use of biodiesel or are considering a mandate for its use in diesel fuels. The percentage blend ranges from 2% to 5%. Additionally, the federal government is considering a requirement for a biofuel content in diesel fuel for the entire country.

Europe is embracing biofuels and other alternatives as well. The European Commission is targeting up to 20% displacement of petroleum based fuels by alternative fuels in transportation by 2020. This will include biofuels in the short term, natural gas in the mid-term and hydrogen in the long term. The plan is to replace petroleum fuels in increasing proportions starting with biofuels at 2% (in energy content) and increasing to 5.75% in 2010 (indicative requirements). Biomass-to-liquid fuels could enhance the market share of biofuels beyond the 5.75% in 2010. One study estimated the maximum potential for all biomass-derived fuels to be about 15%.

In 2002 the European Commission authorized a stakeholders group, the Alternative Fuels Contact Group, to advise on the technical and economic status of alternative fuels for road transport. Their report, issued in December 2003, highlighted the potential for natural gas and hydrogen to replace motor fuels. Regarding the future of natural gas, they said that "natural gas is the only alternative fuel with potential for significant market share well above 5% by 2020 which could potentially compete with conventional fuels in terms of the economics of supply in a mature market scenario." They also went on to say that natural gas would have advantages over conventional motor fuels in CO2 (comparable to diesel fuel today) and local air quality (comparable to projected future improvements of emissions of diesel vehicles.)

Regarding the future of hydrogen in transportation, the group indicated that hydrogen could be a future main energy carrier. They said that, "hydrogen offers the long-term potential for full reliance on renewables. The choice of production pathways will be essential to minimize greenhouse gas emissions and energy use."

They also pointed out that internal combustion engines could provide an interim shortcut to market penetration of hydrogen vehicles. Although, it would be important to produce the hydrogen from low-carbon resources in order to avoid exacerbating the CO2 emissions.

Japan has proposed ambitious reductions in CO2 emissions for developed countries that would reduce those emissions by 2050 to one-fourth the levels that existed in 2002. To accomplish this would require all use of oil other than in transportation to be eliminated by 2050. It is expected that by 2100 natural gas will remain as an energy source for industry and transportation, but most other energy needs would be met by nuclear power, hydrogen, and solar energy.

In this backdrop of changing times, the Implementing Agreement on Advanced Motor Fuels serves the member countries by providing a forum for the exchange of information and ideas. Cooperative work pursued by the participants in annexes help government and industry in their respective countries make the best decisions on future fuels. With so much change on the horizon, staying abreast of the worldwide developments is imperative, and this partnership helps to facilitate those efforts.

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 (industry) as their representative to the Programme.

The Advanced Motor Fuel collaboration programme was launched with 5 participating countries in 1984. Today 11 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, and Switzerland in 2004.

The following countries and designated bodies are active today:

Canada	Department of Natural Resources Canada (NRC)
Denmark	Technical University of Denmark (DTU)
Finland	Technical Research Center of Finland (VTT)
France	Agence de l´Environnement et de la Maîtrise de l´Energie (ADEME)
Italy	AgipPetroli Centro Ricerche EURON
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 Energy Agency (STEM)
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 2005)

3.1 Strategic Plans

A first strategic plan was prepared in 1995 and a second ”Strategic Plan for 1999-2004” in 1998. A new “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 more details see Chapter 3.9).

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) and 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 new "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 new "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 gasolines and reformulated diesel fuels, including oxygenated versions.

- Special interest is given to fuels for new types of engines and fuels as energy/hydrogen sources for fuel cell vehicles

3.5 Participating Countries

Presently, eleven countries participate in the IEA collaboration on advanced motor fuels:

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 each 9-12 months in different participating countries, reviews the progress and results of Annexes, approves new Annexes as proposed by participants, and determines other specific activities.

An IEA/AMF Secretariat 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.

3.7 End-of-Term Report 1999-2004

An End-of-Term Report for the period 1999-2004 (see IEA/AMF website **www.iea-amf.vtt.fi**) was presented to and approved by the IEA End-Use Working Party (EUWP) in March 2004.

The report summarized the **financial commitments** since start:

Period		*Total budget (1 000 $)*	*Project budget (1 000 $)*
1984-1992	(4 proj)	1 193	298
1993-1998	(7 proj)	1 379	197
1999-2004	(12 proj)	3 018	252
Running projects	(6 proj)	1 252	209
		---	---
	Total	6 842	236

The **involvement of industry** during the period 1999-2004 was summarized as follows:

- Chemical industry — Akzo-Nobel
- Catalyst industry — Haldor Topsöe, Ecocat
- Energy industry — Amoco, Fortum, Statoil
- Vehicle industry — Ford, Honda R&D, PSA, Renault, Volvo Trucks
- Engine industry — Sisu Diesel

Some **examples of added value** were given in the End-of-Term Report:

- Getting access to: Analysis, R&D Results, Market Experiences, R&D Teams, Lab Equipment, Fuels, Vehicles
- Developing international fuel standards
- Facilitating future market introduction
- Creating international contacts: Government, Fuel & Vehicle Industry, Research

3.8 Projects/Annexes

Altogether, 25 collaborative projects (Annexes) have been completed (see Table 3 and 4) since the programme started in 1984 and 7 others are presently running (see Table 1 and 2).

In the End-of-Term Report are summarized the different areas covered during the period 1999-2004:

	Annexes
• General information	IX, XXIV, XXVIII
• New fuels	XIV, XVIII, XIX, XX, XXV, XXXII
• Emissions – particles	XIII, XXII, XXV, XXXIII
• Health effects	XXX
• Test procedures	XVII, XXIX
• Lubricants	XVI
• Non-road engines	XXV
• Standardization	XXVII
• Implementation	XV, XXI
• Operational experience	XXVI

3.9 Strategic Plan 2005-2009

A Strategic Plan for the period 2005-2009 (is found on the IEA/AMF website **www.iea-amf.vtt.fi**) was approved by the IEA Committee on Energy Research and Technology (CERT) in June 2004.

Some important **challenges in the transport sector** are summarized in the plan as a background:

- Number of vehicles increase rapidly around the world
- Energy conservation, security of supply and sustainability become increasingly important
- Transport related CO2 emissions increase – in contrast to other sectors
- Technology leaps and major changes in consumer behaviour are needed to reduce CO2 emissions substantially
- The choice of technical options is widening. How pick the best alternatives?

The **AMF Objectives** are described in Chapter 3.3.

The **AMF Mission** is defined as follows:

- To become a leading international player in RDD&D of clean, energy efficient and sustainable fuels and related vehicle technology
- To remain a fuel neutral platform for RDD&D and a respected clearing-house for information

AMF should have **main focus** on:

- Forming policies and strategies to facilitate the market introduction of advanced motor fuels and related vehicle technology

Examples of **future projects** are also mentioned:

- Cost-effectiveness of various ways to reduce CO2 emissions from transport
- Production capacity of various fuels
- Fuels and emissions – Marine transport
- Concerted demonstration activities
- Joint efforts for market deployment of clean fuels and clean vehicles
- Technology transfer to developing markets

3.10 Recent Initiatives

During its last meetings ExCo 29 in January 2004 in Linköping, Sweden, and ExCo 30 in October 2004 in Sao Paulo, Brazil, the Executive Committee took a number of initiatives.

- Observers from Brazil and Switzerland were present at ExCo 29
- Switzerland joined AMF in 2004
- ExCo 30 took place in Brazil
- Observers from Brazil and the Czech Republic were present during ExCo30
- An End-of-Term Report 1999-2004 was adopted
- A new Strategic Plan 2005-2009 was adopted
- 5 Annexes were closed
- 6 new Annexes were started
- A new Annex for "Information Service & AMF Website" was started -common for all Contracting Parties and funded through the AMF Fund
- Decisions were taken to use the AMF Fund for a number of specific purposes - incl. support to the Windsor Workshop 2004.

3.10 IEA/AMF on Internet

Updated information on IEA/AMF is found on:

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

4. RUNNING PROJECTS/ANNEXES

(Status February 2005)

Table 1. Running Projects/Annexes

The following seven projects/annexes are presently running.

Annex	Title	Run time	Operating Agent	Participating Countries
Annex XXVI	Oxygenates in Diesel	2002 – 2005	Befri (S) TEC (FIN)	4
Annex XXVIII	Information Service & AMF Website	2004 - - - -	TEC (FIN)	11
Annex XXIX	Heavy-Duty Urban Vehicles	2004 – 2006	VTT (FIN)	4-5
Annex XXX	Animal Fat in Biodiesel	2004 – 2005	ATFCan (CDN)	4
Annex XXXI	Fischer-Tropsch Fuels	2004 – 2006	Atrax (S)	3
Annex XXXII	Future Fuels for Road Transport	2005	Atrax (S)	4-5
Annex XXXIII	Particle Emissions of 2-S Scooters	2004 – 2006	AFHB (CH)	4-6

Table 2. Running Projects/Annexes

Participation and financial commitments are shown in the following table.

Annex	Participating Countries and their Contributions Œ denotes the Operating Agent. Amounts are given in 1 000 €.											
	CDN	CH	DK	ES	FIN	FR	I	J	S	UK	US	Total
XXVI Oxygenates in Diesel	8				(Œ)		8	8	Œ -	8		32
XXVIII Information Service & AMF Website	X	X	X	X	Œ X	X	X	X	X	X	X	20
XXIX Heavy-Duty Urban Vehicles	56				Œ 140	40					152	388
XXX Animal Fat in Biodiesel	Œ 13	400			13						50	476
XXXI Fischer-Tropsch Fuels			40		30				Œ		60	130
XXXII Future Fuels for Road Transport						?	?	?	Œ		?	?
XXXIII Particle Emissions of 2-S Scooters	0	Œ ?	0		0		0					?
TOTAL												?

5. Progress Reports by the Operating Agents

(Status February 2005)

5.1 Annex XXVI Evaluation of Practical Experiences of ongoing Projects around the World using Alcohols/Ethers as Oxygenates in Diesel Fuels

Operating Agents	Befri Konsult, Sweden
	TEC TransEnergy Consulting Ltd, Finland
Decision to start	April 2002 (ExCo 27)
Project Duration	2002-2005
Participants	CDN, I, J (NEDO, LEVO), UK (4 countries)
Total Budget	USD 40 000 (= € 32 000 ca)
Project Leadership	Mr. Rolf Berg Befri Konsult Hantverkaregatan 25 SE-252 26 Helsingborg Sweden Phone: +46 70 634 63 71 Fax : +46 42 240 651 E-mail: befrikonsult@netscape.net Dr. Nils-Olof Nylund TEC TransEnergy Consulting Ltd Teknikantie 14 FIN – 02150 Espoo Phone: +358 9 2517 2360 Fax: +358 9 2517 2361 E-mail: nils-olof.nylund@teconsulting.fi

Background

Because diesel engines are more efficient than spark-ignited gasoline engines, diesel engines are becoming increasingly common not only in heavy-duty vehicles but also in private cars. This trend might lead to an increase in emissions of both particles and nitrogen oxides.

As we will continue to use diesel engines for a very long time before new systems such as fuel cells take over, it is necessary to develop not only the diesel engines but also the diesel fuels. Preliminary tests with alcohols/ethers added as oxygenates to conventional diesel fuels for use in existing diesel engines show that particulate and nitrogen oxide emissions are reduced. By blending renewable alcohols/ethers into fossil diesel fuel it is also possible to reduce greenhouse gas emissions.

Especially in Europe with the Biofuels Directive in place, it is of interest to evaluate every possibility to add bio components to conventional fuels.

Objectives

The objective is to get a truthful picture of the performance of such diesel blends containing alcohols or ethers that have reached pilot or commercial status.

Methodology and expected outcome

A literature study will be carried out. Data will be collected from ongoing and reported tests and projects. Focus will be on operability and vehicle performance. The results will be systematically evaluated to form a truthful picture of today's practical results and experiences of using alcohols/ethers as blending components in fuels for existing diesel engines. This study on options that have reached pilot stage or commercial maturity is complementary to Annex XVIII "Greener Diesel Fuels", which produced scientific data based on laboratory tests.

5.2 Annex XXVIII Information Service & AMF Website

Operating Agent	TEC TransEnergy Consulting Ltd, Finland
Decision to start	January 2004 (ExCo 29)
Project Duration	Continuous
Participants	All countries (11 countries)
Total Budget	Annual budget € 20 000 Paid by the AMF Fund
Project Leadership	Ms. Päivi Aakko 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. Both Annexes were handled by Innas BV of Holland. Since 1999, VTT Processes (Finland) has been maintaining a website for AMF.

AFIS was replaced a new information system, AMFI (Advanced Motor Fuels Information, Annex XXVIII) in 2004. 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 four yearly electronic Newsletters and the maintenance of the AMF website.

AMFI/Annex XXVIII is a low budget Annex, and its costs are shared by all participants of the AMF Agreement. 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 developments in transportation fuels, vehicles and energy and environmental issues in general. Each issue covers a list of fixed themes. In addition, each issue focuses on one particular theme. The Newsletter can bee 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.

5.3 Annex XXIX Evaluation of Duty Cycles for Heavy-Duty Urban Vehicles

Operating Agent	VTT Processes, Finland
Assistants	West Virginia University (WVU), USA Environment Canada, Canada
Decision to start	January 2004 (ExCo 29)
Project Duration	2004 – 2006 (2,5 years)
Participants	CDN, FIN, FR, S?, and USA (4-5 countries)
Total Budget	€ 390 000 ca
Project Leadership	Dr. Nils-Olof Nylund VTT Processes P.O. Box 1601 FIN – 02044 VTT Phone: +358 400 703 715 Fax: +358 9 460 493 E-mail: nils-olof.nylund@vtt.fi West Virginia University: Nigel.Clark@mail.wvu.edu Environment Canada: Greg.Rideout@ec.gc.ca

Background

Standardized emission certification methods for heavy-duty applications are based on stand-alone engine tests on engine dynamometers. However, this method has several limitations. Firstly, engine testing does not account for the properties of the vehicle itself (vehicle weight, drive train, body structure etc.). Moreover, engine testing is very impractical when evaluating in-service vehicles. Dismounting the engine from a vehicle is very laborious as such, and because the engine is coupled with forever more complex electrical system of the complete vehicle, even more work is needed to make the engine run as a stand-alone unit.

Testing complete vehicles on a chassis dynamometer resolves many problems and overcomes the barriers mentioned above. Additionally, complete vehicle testing generates truthful specific emissions in grams per kilometer or mile instead of per difficultly approachable grams/kilowatt-hour. A number of test cycles have been developed for heavy-duty vehicles, especially for buses. The problem is that there are no universally recognized standards for testing of heavy-duty vehicles. It is also difficult compare and interpret results generated with various cycles.

Objectives

The main objective is to compare a number of duty cycles with several heavy-duty vehicles aiming at the following goals:

- to generate understanding of the characteristics of different duty cycles
- to produce a key for cross-interpretation of emission results generated with different cycles
- to study the interaction between vehicle and fuel technologies and test procedures
- to pin-point the need for international harmonization in emission testing

Methodology and test program

7 new buses will be run using the 7 most well-known duty cycles on chassis dynamometer. Different vehicle weights will be simulated. The test vehicles will be 3 European and 4 North American vehicles:

- diesel (Euro 3) without exhaust after-treatment (European)
- diesel (Euro 4/5) with exhaust after-treatment (European)
- natural gas, (Euro 5/EEV) (European)

- diesel (US 2004 specification), with EGR and particle filter (North American)
- natural gas (US specification)
- 2 hybrid buses (North American)

The measurements include both modal analysis of emissions and integrated values over the whole cycle. The operating parameters of the engines (derived from the engine control module) are recorded. Also fuel consumption will be measured

VTT will measure the European vehicles. West Virginia will test two North American buses with conventional drive train, and Environment Canada will test two buses with hybrid drive train. A description on VTT's new heavy-duty test facility can be found at: www.vtt.fi/

Each laboratory will use 3 common cycles: the German Braunschweig bus cycle, the US Orange County bus cycle and the RATP Parisian bus cycle. In addition, each laboratory will run tests on at least 4 additional cycles.

The project combines both Cost Sharing and Task Sharing.

Expected outcome

The expected outcome is a decoder, which will make it possible to compared and normalize data which has been generated using various test cycles. As the test vehicles represent a number of different technologies, the testing will demonstrate how running conditions affect the performance of various technologies. Vehicles with advanced exhaust after-treatment can be expected to be sensitive to e.g. load and exhaust temperature. Energy savings with hybrid drive trains will be highly cycle dependent. The project will also contribute to world wide harmonization of test methods.

5.4 Annex XXX Bio-safety Assessment: Animal Fat in Biodiesel

Operating Agent	ATF Advanced Technologies & Fuels Canada Inc. (ATFCan)
Decision to start	January 2004 (ExCo 29)
Project Duration	Jan 2004 – October 2005 (2 years)
Participants	CDN, CH, FIN, and USA (4 countries)
Total Budget	CAD 600 000 (= € 380 000 ca)
Project Leadership	Mr. Rodney Semotiuk ATF Advanced Technologies & Fuels Canada Inc. (ATFCan) 80 Aberdeen Street Suite 400 Ottawa, ON K1S 5R5 Canada Phone: +1 613 231 3298 Fax: +1 613 231 4353 E-mail: semotiuk@atfcan.com

Background

ATFCan is undertaking a study to evaluate the risks of using animal tallow derived from specified risk materials (SRMs), dead stock, and downer animals as feedstock for the production of biodiesel. Given the presence of bovine spongiform encephalopathy (BSE) in cattle in Europe and now Canada, there is strong interest within government and industry in assessing new methods to dispose of high-risk materials in value-added applications.

Objectives

The study will determine what risks, if any, are present to animal and human health, and to ascertain what key knowledge gaps may exist that need to be addressed through experimental work.

Content of Work

The project is divided into two key areas of investigation. The first area addresses prions (BSE) and whether rendering practices and processes such as esterification (biodiesel production) and engine combustion are effective at deactivating prions and whether there is any prion carry-over into tallow. The second area deals with emerging issues in animal tallow; these include heat resistant bacteria, the presence of heavy metals, antibiotics, pesticides and dioxins.

Financial Status

A total of four countries, Canada, Finland, Switzerland and the United States of America are supporting the project and contributing a total of $ 600 000 CAD to the work program.

Time Schedule

The project which started in November 2003 will be completed in spring of 2005 with the study reports to be publicly released in June, 2005.

Results and Reports:

The results of the study will be published as 3 separate stand alone reports. The primary study report will be a qualitative risk assessment which will address the use of animal fat including those from high-risk materials such as dead stock animals, specified risk materials (SRMs), and animals that have bovine spongiform encephalopathy, to produce biodiesel. The second report will be a review of current diagnostic techniques for detecting pathogenic prions (TSE diseases) in animals and the current physical limitations. The third report will look at new and emerging issues in animal fat such as the solubility of pharmaceuticals, pesticides, mineral supplements etc. and the potential concern these materials could pose if these materials are present in animal tallow which is then used to produce biodiesel.

An experts' workshop to discuss the study reports will be organized for June 21, 2005 in Ottawa, Canada.

Future Plans

A second and third phase experimental work program to build on the activities of the original project is being planned. The second phase will address the majority of key technical knowledge gaps that currently exist with respect to understanding the prion deactivation potential of the biodiesel transesterfication processes, the constituent components found in the insoluble fraction in animal tallow, and the ability of a diesel engine to incinerate prions. These knowledge gaps need to be covered off if a thorough quantitative risk assessment is to be carried out in the future. The second phase work program is being proposed for 2005 to 2006 and will be overseen by an international panel of experts. The third phase work program will be comprised of a set of bio-assay experiments and will examine the transesterfication processes to determine more precisely the ability of the processes to deactivate prion materials. This third phase which would involve mice and possibly hamster colonies would run from 2005 to 2007.

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

Operating Agent	Atrax Energi AB, Sweden
Assistants	DTU, Denmark TFK, Sweden
Decision to start	October 2004 (ExCo 30)
Project Duration	Nov 2004 – Jan 2006 (1,5 years)
Participants	DK, FIN, and USA (3 countries)
Total Budget	€ 130 000 (FIN 30 000 +DK 40 000 + USA 60 000)
Project Leadership	Mr. Björn Rehnlund Atrax Energi AB Box 30192 SE-104 24 Stockholm Sweden Phone: +46 73 384 24 46 E-mail: bjorn.rehnlund@atrax.se

Background

Synthetic fuels for vehicle use, as paraffins (synthetic diesel oil) and alkylates (synthetic gasoline) are more and more being regarded as sustainable future alternative fuels for the transport sector. The main reasons are that they can be produced from natural gas as well as from almost all types of gasified biomass including garbage and sewage sludge and that the possibility to adjust them by the use of FT technique to different types of engine requirements are very good. FT-fuels are also most promising with regard to emissions and engines performance. However, for the moment the knowledge of FT-fuels, their production and use is spread among many different sources like companies and universities and not always in a form that is easy to read and understand for policy and decision makers in government and industry.

Objectives

The main objective is to present an analysis of the FT-Fuels role in the future transportation system in an easy accessible way for politicians and other decision makers for example in the industry

Content of Work

- Collect and analyse data concerning production and use of FT-fuels for vehicle purpose.
- Carry out vehicle dynamometer tests with different FT-fuels with the purpose to measure engine performance as well as tail pipe emissions.
- Carry out life cycle analysis concerning production and use of FT-fuels produced from different raw materials in USA and the Scandinavian countries
- Analyse FT-fuels´ possible role in a future transport system

Financial Status

Total budget € 130 000. A first invoice has been sent out in February 2005 A final invoice will be sent out in December 2005/January 2006 when the annex is finally reported

Time Schedule

The work of the annex will be carried out during 2005.

Results and Reports

The result will be preliminary reported at the ExCo meeting in September 2005 and a final written report is planned for December 2005.

Future Plans

If there is an interest among the annex participants and/or other IEA/AMF participants the work of the annex can be prolonged in a second phase concerning LCA-scenarios for other regions as for example southern Europe, Japan, and India. A second phase could also include an economical study on the possibility of FT-Fuels future to be established on the fuel market.

5.6 Annex XXXII Future Fuels for Road Transport

Operating Agent	Atrax Energi AB, Sweden
Assistant	Martijn van Walwijk, France
Decision to start	October 2004 (ExCo 30)
Project Duration	Phase 1: Nov 2004 –Dec 2005 (1 year)
Participants	FR?, I, J (LEVO & NEDO), and USA (3-4 countries, to be confirmed)
Total Budget	€ 260 000 ca, of which € 187 000 for Phase 1
Project Leadership	Mr. Björn Rehnlund Atrax Energi AB Box 30192 SE-104 24 Stockholm Sweden Phone: +46 73 384 24 46 E-mail: bjorn.rehnlund@atrax.se Martijn van Walwijk: m.van.walwijk@wanadoo.fr

Background

Today there is a growing demand for new alternative vehicle fuels, fuels to replace conventional fuels as diesel oil and gasoline and alternative fuels more and more becoming an accepted part of the total vehicle fuel supply. However for the moment almost all alternative fuels are more expansive to produce than today's conventional fuels. At the same time the conventional fuels are steadily being improved and new reformulated, low-sulphur, low-benzene, low-aromatic qualities are possible to use resulting in low total emissions and low impact on environment and health. Also the engine technology is being developed resulting in reduced consumption of fuels and reduced emissions and low impact on environment and health. To summarize: Policy and decision makers are facing many dilemmas regarding the development and introduction of conventional as well as alternative fuels

Objectives

- Identify new engine concepts and improvements of today's engine technologies
- Identify which demands that have to be put on the fuels to be used in these new engine concepts
- Examine which fuels of today that can be used in these new engine concepts and which fuels that have to be regarded as dead end streets
- Carry out a first economical assessment of production, distribution and use of the fuels that will have a possibility to be used in today's as well as tomorrow's engines.

Content of Work

To carry out a first short literature survey focusing on articles and statements from experts and high-level decision makers within

- Vehicle and engine manufactures
- Governments
- Universities
- International organizations
- Relevant national and international branch organizations

Interview the most relevant decision makers and analyse and summarize their answers concerning what they regard as the most promising and hopeful future in the fields of engine technology and fuels adapted for such new or developed engine technology

Financial Status

To be discussed.

Time Schedule

To be further discussed.

Results and Reports

- Presentation of preliminary results at IEA/AMF ExCo September 2005.
- Written interim report for Phase 1 (se below) in December 2005

Future Plans

The work is planed to be carried out in three phases. In the first phase interviews will be carried out with relevant people from the car and engine manufacturing industries. The result will be summarized and reported to IEA/AMF in an interim report.

In a second phase the same kind of interviews will be carried out with people from the oil industry. The second phase will also include a workshop with people from the car and engine industry as well as the oil industry. The results of Phase 2 and the results from the workshop will be reported to IEA/AMF in a second interim report.

In Phase 3 an economical assessment of the most probable scenarios will be carried out. The overall result of this assessment and the results of Phase 1 & 2 will be put together in a draft final report which will be presented at a international IEA/AMF seminar with invited people from industry, government, etc - not only from the IEA countries but also from developing countries.

5.7 Annex XXXIII Particle Emissions of 2-S Scooters

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 – June 2006 (2 years)
Participants	CDN, CH, DK, F, FIN, I, and JRC EU Laboratories (4-6 countries, to be confirmed)
Total Budget	No AMF budget. Task-sharing. Total costs € 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 32 331 64 26 Fax: +41 32 331 59 34 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 without recirculation of the lubricant cannot be neglected any more, or simplified by the substituting measurements of CO and HC.

A particular concern is about the 2-S scooters, 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

1. 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
2. Preparations of the Finish activities under leadership of VTT
3. Analytical works at the JRC EU Laboratories, Ispra
4. Preparations of the joint activities with the French toxicity network
5. Preparations of activities with Indian authorities
6. 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 (Mai 2005 official version)
- Meeting Zurich, June 15, 2005
- 1st information report for Annex XXXIII (August 2005)
- Further technical reports from the Swiss Network
- Meeting Zurich, February 2006
- 2nd information report for Annex XXXIII (March/April 2006)

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.

Future Plans

- Further research of:
  - influences of oils and fuels
  - influences of catalyst technology
  - special wire mesh filter - catalyst (WFC)
- Adaptation of the results to the engine/vehicle technology, oils and fuels from other markets
- Further studies of health effect
- Support by legal authorities

Appendix 1

COMPLETED PROJECTS/ANNEXES

(Status February 2005)

Main Results of Earlier Projects

Some more spectacular results of now completed projects are summarised here. Information about participating countries and their contributions is found in the following Tables 3 and 4.

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

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

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

Operating Agent: TNO (NL)

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

- *Trade-off fuel quality versus costs:* Haldor Topsoe (DK) and Statoil (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)

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

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

Annex XIX New Fuels for New Engines

Operating Agent: Innas (NL)

The final report was published in January 2001 as volume 6 in the Automotive Fuels Survey series of IEA AMF/AFIS under the title "Fuels for HCCI engines". It describes homogeneous charge compression ignition (HCCI) operation in four-stroke, two-stroke and free piston engines. The relation between fuel characteristics and HCCI operation is discussed. The report contains an extensive list of references and also lists organisations 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-portfuel-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 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.

Table 3a. Completed Projects (Annex I – XV)

The following 15 projects/annexes have been completed during the period 1984-2004.

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 3b. Completed Projects (Annex XVII - XXVII)

The following 10 projects/annexes have been completed during the period 1997-2004.

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 XXVII	Standardization of Alternate Fuels	2000 – 2004	Atrax (S)	4-6

*) 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 4a. Completed Projects (Annex I-X)

Participation and financial commitments are shown in the following table.

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

Table 4b. Completed Projects (Annex XI-XXVII)

Participation and financial commitments are shown in the following table.

Annex	Participating Countries and their Contributions Œ denotes the Operating Agent. Amounts are given in 1 000 USD.												
	B	**CDN**	**DK**	**ES**	**FIN**	**FR**	**I**	**J**	**NL**	**S**	**UK**	**US**	**Total**
XI Forecasting and Planning Tools		15			10							Œ 50	75
XII Particulate Emissions	22.7	22.7			22.7				22.7		Œ 22.7	22.7	136
XIII Biodiesel Fuels	32	32			Œ 75			39.7	32	42		95	348
XIV DME as Fuel I		110	90		20			40	Œ 85	180		80	787*
XV Implementation Barriers					13			13	Œ 13	13		13	66
XVI Biodegradable Lubricants			Œ ?		?		?	?		?		?	199
XVII Heavy-Duty Vehicles	Œ 80				40		0**	40	40	40		40	280
XVIII Future Greener Diesel Fuels		5			10	10		10	10	10		Œ 10	65
XIX New Fuels for New Engines		8			8				Œ 8	8		8	40
XX DME as Fuel II			10		10	30	10	10	Œ 20	10		10	150***
XXII Low Temperature Particles		?			Œ ?		?	?		?		?	210
XXIV Information Exchange IEA AMF/AFIS		X	X	X	X	X	X	X	Œ X	X	X	X	58
XXV Non-Road Engines					Œ ?	?				?		?	120
XXVII Standardization of Alternate Fuels		24			10	15		27		Œ 30		27	133
TOTAL													**5 781**

*) 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.

Appendix 2

WORKSHOPS

(Status February 2005)

The following Workshops have been arranged during recent years.

- Heavy-Duty Vehicles on Alternative Fuels, Annex VIII
  Organized by: VITO (B) in Brussels, 5 December 1996

- 1st DME Workshop: DME as Fuel, Annex XIV
  Organized by: TNO (NL) in Delft, 14-15 November 1996

- 2nd DME Workshop: DME as Fuel, Annex XIV
  Organized by: TNO (NL) in Delft, 26-27 June 1997

- 3rd DME Workshop: DME as Fuel, Annex XIV
  Organized by: TNO (NL) in Naperville, Illinois, USA, 26-27 February 1998

- 4th DME Workshop: DME as Fuel, Annex XIV
  Organized by: TNO (NL) in Delft, 1-2 October 1998

- Clean Energy Vehicle Forum to discuss clean energy vehicle programmes in Japan and EU
  Organized by: NEDO, LEVO and JARI in Tsukuba, Japan, 21 October 1998

- 5th DME Workshop: DME as Fuel, Annex XIV
  Organized by: AVL (Austria) in Graz, 24-26 March 1999

- 6th DME Workshop: DME as Fuel, Annex XIV
  Organized by: Volvo (Sweden) in Göteborg, 2-3 December 1999

- Kick-off Workshop: Deployment Strategies, Annex XXI
  Organized by: Muntwyler (Switzerland) in Glattbrugg, 24-25 February 2000

- 7th DME Workshop: Dimethyl-ether as an automotive fuel II, Annex XX
  Organized by: AVL PTI (USA) in Plymouth [MI], 1-2 June 2000

- 8th DME Workshop: Dimethyl-ether as an automotive fuel II, Annex XX
  Organized by: The community of Växjö (Sweden), 17-18 January 2001

- Deployment Strategies, Annex XXI
  Workshop to discuss advanced vehicle programmes in Japan and the progress of Annex XXI
  Organized by: LEVO and NEDO in Kyoto, Japan, 6-7 June 2001

- IEA Information Centres Meeting
  Organized by: IEA, IEA HQ in Paris, 3 May 2002

- Deployment Strategies, Annex XXI
  Workshop to discuss 'Evaluation as a key to learning lessons/Defining goals of government promotion' and the progress of Annex XXI
  Organized by: Muntwyler in Vancouver, Canada, 10-11 June 2002

- Clean City Vehicles
  Workshop on "Clean City Vehicles with a special focus on Developing Countries"
  Organized by: T Månsson, EnEN, IEA HQ in Paris, 24-26 September 2002

- Clean City Vehicles
  Working meeting
  Organized by: T Månsson, EnEN, IEA HQ in Paris, 9 December 2002

Appendix 3

LIST OF REPORTS

(Status February 2005)

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**)

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 AMFs - 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.*

1. Raw Materials and Conversion (Dec 1996)
2. Distribution and Use (Dec 1996)
3. Comparison and Selection (Jan 1998)
4. Innovations or Illusions (Jan 1999)
5. 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:

Title : ***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:

Title : ***Toxicity aspects of Dimethylether in comparison with automotive fuels currently in use***

Number : TNO-MEP-R99/015 Date: January 1998

Title : ***Proposal for safety provisions for DME fuelling systems and their installation in vehicles***

Number : 98.OR.VM.051.1/JV Date: September 1998

Title : ***Failure mode and effect analysis DME vehicle storage tank systems***

Number : TNO-MEP-R98/449 Date: November 1998

Title : ***Conversion of lPG distribution guidelines into DME distribution guidelines***

Number : TNO-MEP-R99/050 Date: February 1999

Task 3:

Title : ***Dimethylether as an Automotive fuel Annex XIV***

Number : BE 0472 (AVL) Date: March 1999

Task 4:

Title : ***DME from Biomass***

Number : (Atrax) Date: February 1999

Task 5:

Title : ***Environmental effects of DME compared to other automotive fuels***

Number : (Innas) Date: June 1999

Task 6:

Title : ***Automotive DME distribution infrastructure costs***

Number : (Innas) Date: July 1999

Task 7:

Title	: ***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

Title : ***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 p*ublicly available through SAE and VTT.*

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

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

Annex XXIV

Information Exchange IEA AMF/AFIS

Operating Agent: Innas (NL)

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

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

Annex XXV

Fuel Effects on Emissions from Non-Road Engines

Operating Agent: VTT Processes (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, Iterim Report, October 2002

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

Annex XXVI
Oxygenates in Diesel

Operating Agent: TEC (FIN)

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.

Annex XXX
Animal Fat in Biodiesel

Operating Agent: ATFCan (CDN)

The complete final report is pending, and will be provided to the participants of the Biosafety Workshop in Ottawa, Canada on June 21, 2005. Additional details of the final report and how to obtain copies will be available at ATFCan's website April 2005 (please visit www.atfcan.com).

Appendix 4

AMF ExCo Meetings

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

		Date	*Chairman*	*Secretary*
a	Madrid	80/3	Staffan Ulvönäs, S	Folke Schippel
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	"	"

Appendix 5

Executive Committee on Advanced Motor Fuels

(Status February 2005)

A. Delegates and Alternates

Canada

Mr. Andy Beregszaszy — *Delegate*
Natural Resources Canada
CANMET Energy Technology Centre
580 Booth Street, 13th floor
Ottawa, Ontario K1A OE4, Canada
Phone: +1 613 996 8557
Fax: +1 613 996 9416
Mail: aberegsz@nrcan.gc.ca

Mr. Nick R. Beck — *Alternate*
Natural Resources Canada
CANMET Energy Technology Centre
580 Booth Street, 13th floor
Ottawa, Ontario K1A OE4, Canada
Phone: +1 613 996 6022
Fax: +1 613 996 9416
Mail: nick.beck@nrcan.gc.ca

Denmark

Prof. Jesper Schramm — *Delegate*
Technical University of Denmark (DTU)
Bldg 403
DK-2800 Lyngby
Denmark
Phone: +45 4525 4179
Fax: +45 4593 0663
Mail: js@mek.dtu.dk

Mr. Kim Winther — *Alternate*
Danish Energy Authority
Amaliegade 44
DK-1256 Copenhagen K
Denmark
Phone: +45 3392 6728
Fax: +45 3311 4743
Mail: kwi@ens.dk

Finland

Dr. Nils-Olof Nylund — ***Vice Chairman***
VTT Processes — *Delegate*
P.O. Box 1601
FIN - 02044 VTT
Phone: +358 9 456 5518
Fax: +358 9 460 493
Mail: nils-olof.nylund@vtt.fi

Mr. Martti Korkiakoski — *Alternate*
National Technology Agency (TEKES)
P.O. Box 69
FIN – 00101 Helsinki
Phone: +358 10 521 5875
Mob : +358 50 5577 875
Fax: +358 10 521 5905
Mail: martti.korkiakoski@tekes.fi

France

Mr. Patrick Coroller — *Delegate*
ADEME
500 route de Lucioles
F-06560 Valbonne
Phone: +33 4 9395 7932
Fax: +33 4 9395 7986
Mail: patrick.coroller@ademe.fr

M. Jean-François Gruson — *Alternate*
Institut Français du Pétrole (IFP)
BP 311
F-92508 Rueil-Malmaison Cedex
Phone: +33 1 4752 6920
Fax: +33 1 4752 7014
Mail: j-francois.gruson@ifp.fr

Italy

Dr. Fulvio Giavazzi — *Delegate*
Agip Petroli Centro Ricerche EURON
Via F. Maritano 26
I-20097 San Donato Milanese (Mi)
Phone: +39 02 5205 6421
Fax: +39 02 5205 6333
Mail: fulvio.giavazzi@euron.eni.it

Dr. Felice Corcione — *Alternate*
Istituto Motori (IM)
Viale G. Maraconi 8
I-80125 Napoli
Phone: +39 81 717 7130
Fax: +39 81 239 6097
Mail: corcione@motori.im.na.cnr.it

Japan/NEDO

Mr. Shigeaki Tonomura — ***Vice Chairman***
New Energy & Industrial Technology — *Delegate*
Development Organization (NEDO)
Sunshine 60, 30F
1 - 1, 3-Chome Higashi-Ikebukuro
Toshima-Ku, Tokyo, 170-6028, Japan
Phone: +81 3 3987 9436
Fax: +81 3 5992 4870
Mail: tonomurasga@nedo.go.jp

Mr. Shozo Kinoshita — *Alternate*
New Energy and Industrial Technology
Development Organization (NEDO)
Sunshine 60, 30F
1 - 1, 3-Chome Higashi-Ikebukuro
Toshima-Ku, Tokyo, 170-6028, Japan
Phone: +81 3 3987 9436
Fax: +81 3 5922 4870
Mail: kinoshitashz@nedo.go.jp

Japan/LEVO

Mr. Kazuo Tanigawa — *Delegate*
Organization for the Promotion
of Low-Emission Vehicles (LEVO)
YPC Building 3F, 2-14-8 Yotsuya, Shinjuku-ku
Tokyo, 160-0004 Japan
Phone: +81 3 3359 8461
Fax: +81 3 3353 5430
Mail: tanigawa@levo.or.jp

Mr. Yutaka Takada — *Alternate*
Organization for the Promotion
of Low-Emission Vehicles (LEVO)
YPC Building 3F, 2-14-8 Yotsuya, Shinjuku-ku
Tokyo, 160-0004 Japan
Phone: +81 3 3359 9008
Fax: +81 3 3353 5430
Mail: y-takada@levo.or.jp

Spain

Mr. Carlos López-López — *Delegate*
IDAE
Madera 8
ES-28004 Madrid
Phone: +34 91 456 4994
Fax: +34 91 523 0414
E-mail: carlopez@idae.es

Mr. Carlos Garcia Barquero — *Alternate*
IDAE
Madera, 8
ES-28004 Madrid
Phone: +34 91 456 5032
Fax: +34 91 523 0414
Mail: cgbarquero@idae.es

Sweden

Mr. Olle Josefsson — *Delegate*
Swedish Energy Agency (STEM)
Box 310
SE - 631 04 Eskilstuna
Phone: +46 16 544 2138
Fax: +46 16 544 2261
Mail: olle.josefsson@stem.se

Dr. Lars Vallander — *Alternate*
Swedish Energy Agency (STEM)
Box 310
SE - 631 04 Eskilstuna
Phone: +46 16 544 2088
Fax: +46 16 544 2261
Mail: lars.vallander@stem.se

Switzerland

Prof. Jan Czerwinski — *Delegate*
University of Applied Sciences Bern
Lab. for Exhaust Emissions Control
Gwerdtstrasse 5
CH-2560 Nidau
Switzerland
Phone: +41 32 331 64 26
Fax: +41 32 331 59 34
Mail: jan.czerwinski@hti.bfh.ch

	Dr. Joerg Loepfe SAFOSO Bremgartenstrasse 109A CH-3012 Bern Switzerland Phone: +41 31 631 29 37 Fax: +41 31 631 29 32 Mail: joerg.loepfe@safoso.unibe.ch	*Alternate*
UK	Mr. Chris Parkin Department for Transport, Local Government and the Regions (DTLR) Zone 4/19, Great Minster House 76 Marsham Street UK-London SW1P 4DR Phone: +44 20 7944 2958 Fax: +44 20 7944 2605 Mail: chris.parkin@dtlr.gsi.gov.uk	*Delegate*
	-	*Alternate*
USA	Dr. Stephen Goguen US Department of Energy (DOE) Forrestal Bldg, MS EE - 33 1000 Independence Avenue Washington, D.C. 20585, USA Phone: +1 202 586 8044 Fax: +1 202 586 1600 Mail: stephen.goguen@hq.doe.gov	***Chairman*** *Delegate*
	Dr. Ralph McGill Oak Ridge National Laboratory (ORNL) NTRC 2360 Cherahala Boulevard Knoxville, TN 37932, USA Phone: +1 865 946 1228 Fax: +1 865 946 1248 Mail: mcgillrn@ornl.gov	*Alternate*

B. Representatives of Operating Agents

Annex XXVI

Mr. Rolf Berg
Befri Konsult
Hantverkaregatan 25
SE-252 26 Helsingborg
Sweden
Phone: +46 70 634 63 71
Fax : +46 42 240 651
E-mail: befrikonsult@netscape.net

Dr. Nils-Olof Nylund
TEC TransEnergy Consulting Ltd
Teknikantie 14
FIN – 02150 Espoo
Phone: +358 9 2517 2360
Fax: +358 9 2517 2361
E-mail: nils-olof.nylund@teconsulting.fi

Annex XXVIII

Ms. Päivi Aakko
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

Annex XXIX

Dr. Nils-Olof Nylund
VTT Processes
P.O. Box 1601
FIN – 02044 VTT
Phone: +358 400 703 715
Fax: +358 9 460 493
E-mail: nils-olof.nylund@vtt.fi

Annex XXX Mr. Rodney Semotiuk
ATF Advanced Technologies & Fuels Canada Inc. (ATFCan)
80 Aberdeen Street
Suite 400
Ottawa, ON K1S 5R5
Canada
Phone: +1 613 231 3298
Fax: +1 613 231 4353
E-mail: semotiuk@atfcan.com

Annex XXXI & Annex XXXII Mr. Björn Rehnlund
Atrax Energi AB
Box 30192
SE-104 24 Stockholm
Sweden
Phone: +46 73 384 24 46
E-mail: bjorn.rehnlund@atrax.se

Annex XXXIII Prof. Jan Czerwinski
University of Applied Sciences Bern
Lab. for Exhaust Emissions Control
Gwerdtstrasse 5
CH-2560 Nidau
Switzerland
Phone: +41 32 331 64 26
Fax: +41 32 331 59 34
Mail: jan.czerwinski@hti.bfh.ch

C. Secretariat

IEA Paris

Mr. Jeppe Bjerg
International Energy Agency (IEA)
9, rue de la Fédération
F-75739 Paris Cedex 15
France
Phone: +33 1 4057 6677
Fax: +33 1 4057 6759
E-mail: jeppe.bjerg@iea.org

Ms. Manuela Caruso
Legal Office
International Energy Agency (IEA)
2, rue André Pascal
F-75775 Paris Cedex 16
France
Phone: +33 1 4057 6588
Fax: +33 1 4057 6539
E-mail: manuela.caruso@iea.org

IEA/AMF Secretariat

Lic.Eng. Claës Pilo
SDAB Transport & Environment
Karlavägen 93
SE-115 22 Stockholm
Phone: +46 8 15 11 90
Fax: +46 8 15 11 91
E-mail: pilo.sdab@swipnet.se