

# IMPLEMENTING AGREEMENT FOR ADVANCED MOTOR FUELS STRATEGIC PLAN 2015–2019





# Strategic Plan 2015–2019

## Foreword

This document is the fifth Strategic Plan for the Implementing Agreement (IA) for Advanced Motor Fuels (AMF). Its purpose is to provide direction and focus for AMF during its next 5-year term: March 1, 2015–February 28, 2020. The Plan should be considered in association with AMF’s End of Term Report for the period 2010–2014 (Implementing Agreement for Advanced Motor Fuels End of Term Report 2010-2014).

The AMF IA is a long-standing, yet dynamic, agreement on transportation fuels. It started in 1984 as “Alcohols as Motor Fuels.” In 1990, the scope was widened and the name was changed to “Alternative Motor Fuels.” Since 1999, AMF has stood for “Advanced Motor Fuels.” The title of our IA has always reflected trends within fuels and technology development. Being at the forefront of important fuel-, vehicle-, and transportation-related issues is also well demonstrated by our 38 completed Annexes (projects) (see <http://www.iea-amf.org/>).

The number of participating countries increased from 4 to 16 in 2013, which shows our attractiveness in nearly all continents of the world.

This Strategic Plan was prepared by the Strategy Group with contributions from, and under the direction of, the AMF Executive Committee (ExCo), and it was unanimously accepted by the ExCo on May 23, 2014. The AMF ExCo would like to thank the publications team at Argonne National Laboratory ([www.anl.gov](http://www.anl.gov)) for support in the editing, design, and document production of this report.

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**Dr. Sandra Hermle**

*AMF ExCo Chairperson*

sandra.hermle@bfe.admin.ch

**Dina Bacovsky**

*AMF Secretary*

dina.bacovsky@bioenergy2020.eu



## **Need for Advanced Motor Fuels**

Because internal combustion engines will be the prime movers for the transport of goods and passengers for many years to come, there is a clear need for fuels delivering:

- Lower greenhouse gas emissions,
- Lower local pollution,
- Enhanced efficiency, and
- A wider supply base for transportation fuels.

It is also necessary to understand the full impact of alternative energy solutions from a well-to-wheel perspective, and to use solid data for decision making.

## **Our Approach**

We have established a strong international network that serves to foster collaborative research, development, and deployment (RD&D) and to provide unbiased information on clean, energy-efficient, and sustainable fuels and related vehicle technology.

AMF intends to:

1. Build on this network and to continue its fruitful contributions to R&D,
2. Strengthen the collaboration with other topically closely related Implementing Agreements (IAs), and
3. Involve industry better in its work.

By verifying and generating data, we are able to provide decision makers at all levels with a solid foundation for turning mobility toward sustainability.

## **Benefits**

We bring stakeholders from different continents together to pool and leverage their knowledge and research capabilities in advanced and sustainable transportation fuels. Our cooperation enables the exchange of best practices. With our broad geographical representation, we are able to take regional and local conditions into consideration when facilitating the deployment of new fuel and vehicle technologies.

## **Competition**

Internationally, there are several fuels-related organizations. However, without exception, these organizations are working for a specific fuel or group of fuels — for example, alcohols, natural gas, liquid petroleum gas, and synthetic fuels. In addition, there are organizations promoting electromobility. In the field of transportation fuels, AMF is the only internationally recognized, technology-neutral clearinghouse for fuels-related information.

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## NOTATION

2DS	2 degree scenario
AFC	Advanced Fuel Cells
AMF	Advanced Motor Fuels
CO <sub>2</sub>	carbon dioxide
DME	di-methyl ether
ERTRAC	European Road Transport Research Advisory Council
ETN	Energy Technology Network
EUWP	End-Use Working Party
ExCo	Executive Committee
GHG	greenhouse gas
GOT	Gas and Oil Technologies
HEV	Hybrid and Electric Vehicles
IA	Implementing Agreement
ICE	internal combustion engine
IEA	International Energy Agency
LCA	life-cycle analysis
OECD	Organisation for Economic Co-operation and Development
P2G	power to gas
R&D	research and development
RD&D	research, development, and deployment
WEF	World Economic Forum

## 1. INTRODUCTION

This document is the fifth Strategic Plan for the Advanced Motor Fuels (AMF) Implementing Agreement (IA); it covers the period 2015–2019. The Plan takes into consideration the changing and challenging world situation regarding transportation fuels, together with continuing concerns for local and global environment and energy security. AMF membership has grown in recent years and includes International Energy Agency (IEA) countries, as well as IEA partner countries. This Strategic Plan includes consideration of the wide range of fuel requirements represented by the diversity of AMF member countries. The strategic objectives of the End-Use Working Party (EUWP), as they relate to individual IAs, have also been factored into this document to make it consistent with the EUWP's goals.

AMF has established a strong international network that serves to foster collaborative research, development, and deployment (RD&D) and to provide unbiased information on clean, energy-efficient, and sustainable fuels and related vehicle technology. AMF

intends to (1) build on this network and to continue its fruitful contributions to R&D, (2) strengthen collaboration with other topically closely related IAs, and (3) involve industry better in its work. This fifth Strategic Plan was developed stepwise with the involvement of different groups and stakeholders within AMF. The IA started with an online survey among all Executive Committee (ExCo) members to obtain an overview of the various fuels used in the different countries; fuels supported by national governments in terms of subsidies and mandates, but also with regard to R&D. Furthermore, and most importantly, the survey asked for research gaps in the respective countries that could be closed through collaboration with other AMF countries. It also asked who AMF's target audience is, how industry could be more involved, and which other IAs it would be desirable to have closer collaboration.

Out of this survey, a draft Strategic Plan was developed. The draft was discussed in a 2-day strategy group meeting in autumn 2013 and incorporated input from the technology group. Before discussing and voting for the strategic direction and the scope of the Strategic Plan at ExCo 46 in November 2013, all ExCo members were asked to provide input to the document. For the strategy group, it was extremely important to receive feedback and input from all regions where AMF members are located (Asia, Europe, and North America). After incorporating all inputs, the Strategic Plan was unanimously approved at ExCo 47 in May 2014.

**This Strategic Plan serves to outline how AMF intends to further contribute to research, development, and deployment of advanced motor fuels and fuel-efficient vehicles, vessels, crafts, and machinery.**

## 2. STRATEGIC DIRECTION

*AMF is one of the actors in putting transport on track to sustainability and reducing its environmental impacts. Simultaneously, we are striving to broaden the supply base of transportation energy.*

This new Strategic Plan must be framed in the context of world events, the constantly changing scene with regard to energy supplies, transportation fuels, local environmental conditions, and global challenges. This section provides a brief synopsis of the framework in which AMF must operate for the next 5 years and a look forward in terms of the evolution of sustainable new fuels that might be expected in the marketplace within the next several years. This will help to set the agenda for AMF R&D activities.

The new strategic direction was extensively discussed among the group of Chairs and with the entire AMF ExCo. Yet, the resulting strategy remains largely in line and congruent with the strategies of earlier working periods. Therefore, AMF is building upon acquired experience but also foresees reacting to major societal changes that will affect transportation for decades.

### 2.1. BACKGROUND

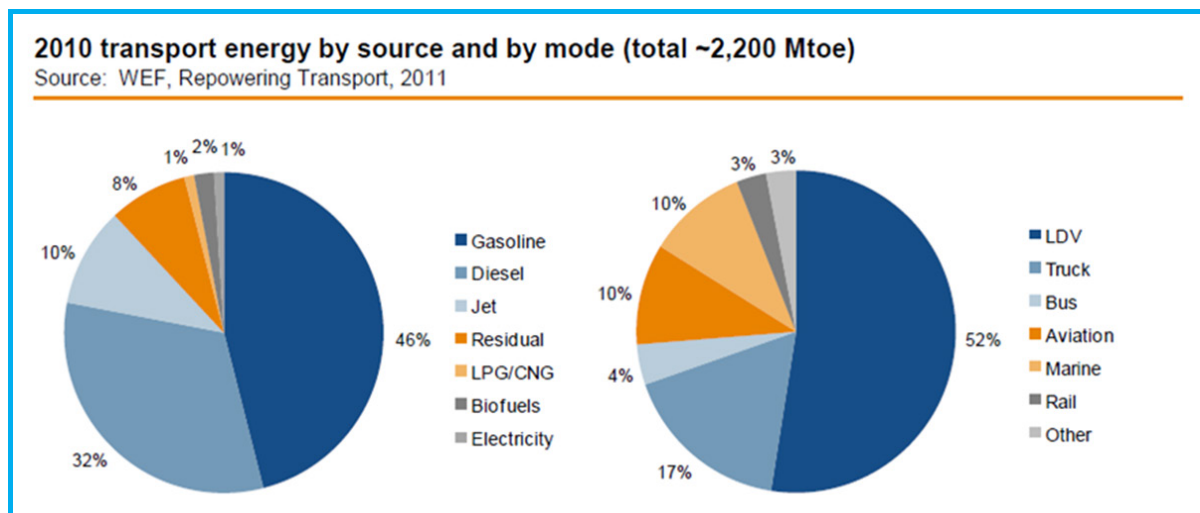
Transport is a major consumer of energy (Figure 1) and a major source of greenhouse gas (GHG) emissions and pollution. Globally, local pollutants are increasing steadily as a result of urbanization and high traffic volumes in urban areas.

To reduce GHG emissions from the transport sector and to secure a long-term supply of energy requires a true transition of the transport sector and its energy system. The main ingredients to realizing such a transition are:

- Curbing the growth of transport demand;
- Shifting toward a more energy-efficient and less carbon-intensive mode of transport;
- Reducing the energy demand of vehicles; and
- Shifting toward less carbon-intensive and carbon-neutral, sustainable energy carriers.

While the IEA Energy Technology Network (ETN) is addressing all of these bullets, AMF is addressing the last two bullets.



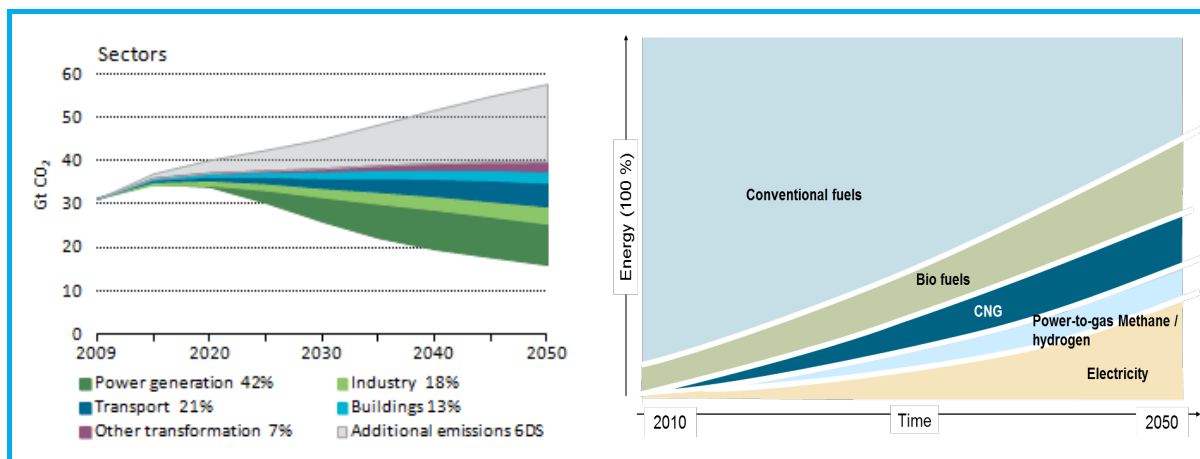


**Fig. 1 Global Transport Energy Consumption 2010 (WEF 2011)**

The transport sector contributes a substantial share of global carbon dioxide (CO<sub>2</sub>) emissions (22% of global CO<sub>2</sub> emissions in 2011) (IEA 2013). Reaching the 2°C climate target will require contributions from all sectors, as seen in Figure 2. The reduction of transport-related CO<sub>2</sub> emissions requires a change in the energy resources used for transportation as well as increased efficiency.

A possible scenario for supplying energy to the transportation sector is depicted in Figure 3. Biofuels, including liquid and gaseous biofuels, will provide an important contribution; however, the share is limited to the availability of sustainable biomass. The decarbonization goals can only be fulfilled by high shares of “green electricity” — directly used and stored, for example, by power to gas (P2G)<sup>1</sup> or liquid technology. Methane, first from fossil sources and later increasingly also from biomass, waste, or from P2G technology, will provide a relevant share (ERTRAC 2014).

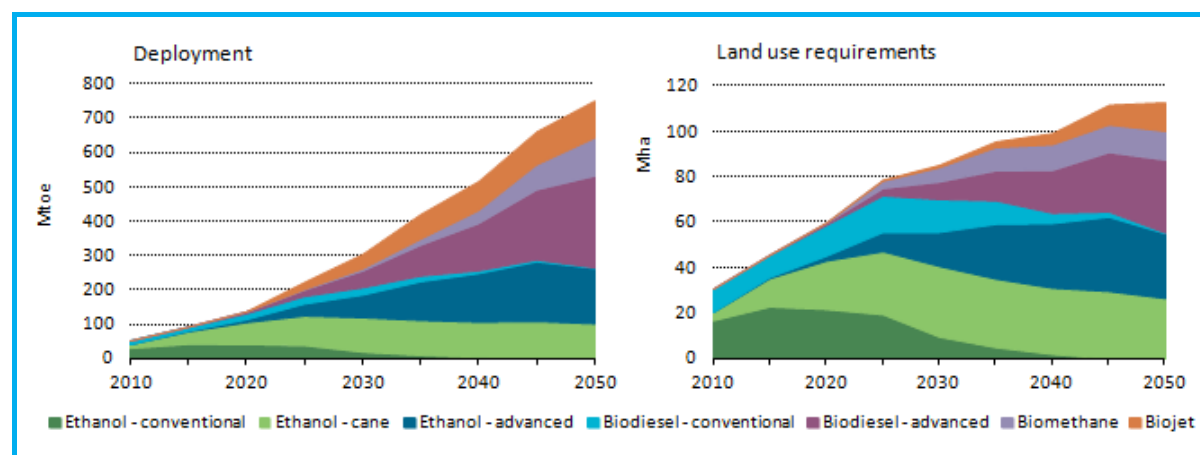
<sup>1</sup> Power to gas is a pathway envisioned to balance the electricity production and demand by conversion of electric power to a gaseous fuel, through electrolysis production of hydrogen and oxygen. The hydrogen could be then fed into the natural gas system or used in a fuel cell (in a FCV for mobility); it could be also combined with CO<sub>2</sub> from various origins (e.g., biogas) to produce methane, which is added to the natural gas system. All related technologies are available, but cost is still an issue.



**Fig. 2 Contributions to Emissions Reductions in the 2DS (2 degree scenario) (IEA 2012)**

**Fig. 3 The Indicative Evolution of Passenger Road Transport Energy Source and Propulsion Technology toward 2050 (ERTRAC 2014)**

Focusing on biofuels, Figure 4 depicts that up to 2050, a big share of advanced biofuels are expected to penetrate the market. There are several segments where electrification is not feasible — for example, aviation, marine, and long-haul heavy-duty road transport. Aviation will need liquid fuels, whereas ships and heavy-duty road vehicles can use either liquid fuels or liquefied methane.



**Fig. 4 Biofuels Deployment and Land Use Requirements 2010–2050 (IEA 2012)**

The challenge to realize the transition to a lower energy demand and lower emissions in the transport sector has to be seen in the light of different megatrends worldwide, which could be counterproductive to the envisioned efforts.

#### MEGATRENDS VISIBLE WORLDWIDE

- Increasing number of vehicles
- Air quality problems due to urbanization
- More unconventional fossil energy sources (shale gas and oil)
- Turning away from nuclear energy

- Growing demand for middle distillates (road, aviation, and shipping)
- Increasing interest in advanced biofuels
- Advancement in engine and after-treatment technologies
- Focus on energy-efficient vehicles
- Mobility as a service

Some megatrends are directly affecting the transport sector, while others have to be seen in the context of the general topic of energy provision. Mobility is a basic societal need, not only for individuals but also for our whole society, which relies on transportation — especially for goods and services. Therefore, it is not surprising that vehicle numbers are increasing especially in non-Organisation for Economic Co-operation and Development (OECD) countries, which causes massive air quality problems, especially in agglomerations. The need for mobility fosters the search for new energy sources, such as unconventional fossil energy sources that fit in the existing production and distribution infrastructure. Although there are still inexpensive fossil fuel resources available, interest in advanced biofuels is increasing. In addition to the use of less carbon-intensive fuels, advances in engine and after-treatment technologies will help to reduce energy consumption and pollutant emissions.

#### TRANSPORTATION NEEDS AND CHALLENGES

- Put transportation on track to sustainability
- Reduce GHG emissions globally and toxic pollutants locally
- Secure stable supply with transport services (resource base, energy efficiency)
- Make uptake of transport in developing countries clean and efficient
- Trade fuels globally to overcome lack of feedstock
- Encourage public transport over private transport
- Implement economically viable solutions without subsidies in the long term

Transportation challenges exist on different levels: locally, regionally, and globally. On a global level, there is clearly the need to reduce GHG emissions. Regionally, stable supply with transport services shall be secured. On a local level, there is the need to reduce toxic pollutant emissions.

Measures addressing these challenges, however, may conflict with each other, for example; increasing the supply base through unconventional oil will undermine efforts to reduce GHG emissions. Also, solutions need to be economically viable without subsidies in the long term. Developing countries need to install clean and efficient transport systems, and all countries need to encourage public transport over private transport. Vehicles need to be adapted to the use of new or unconventional fuels, and distribution infrastructure needs to be adapted to the increasing variety of fuels. As to overcoming the lack of feedstock supply, feedstock and fuels must be traded globally.

Despite all the transport challenges we are facing, in our opinion, liquid fuels will remain dominant for long haulage, marine, and aviation, and internal combustion engines (ICEs) will be

the dominant prime mover for many years to come. Electricity will take its share, primarily in urban areas, but the transition is likely to be slow. Thus, an aggressive transition to low-carbon fuels for ICEs is complementary to a transition to electricity. In fact, in applications such as plug-in hybrids, the two worlds or approaches meet nicely. In the case of a successful development of fuel cell cars, there can be synergies between fuels for ICEs and energy carriers for hydrogen for fuel cells.

### Sustainable Transport Systems

- ...Reduce GHG emissions globally
- ...Secure stable supply with transport services
- ...Reduce toxic pollutants emissions

### VISION

The vision of AMF is a sustainable transportation system that uses advanced, alternative, and renewable fuels; has reduced emissions of GHGs and air contaminants; and meets needs for personal mobility and the movement of goods on a local and global scale.

AMF contributes to the achievement of this vision by providing a solid basis for decision making (information and recommendations) and providing a forum for sharing best practices and pooling resources, internationally.

## MISSION

**The mission of AMF is to provide sound scientific information and technology assessments that allow citizens and policy makers to make informed and science-based decisions about options involving the use of advanced fuels for transportation systems. To provide such data to decision makers, AMF acts as a clearinghouse, by:**

- Pooling resources and information on an international level;
- Identifying and addressing technology gaps and barriers to deployment;
- Performing cooperative research on advanced motor fuels;
- Demonstrating advanced motor fuels and related vehicle and after-treatment technologies; and
- Aggregating data and deriving key recommendations for decision makers within governments, municipalities, and industry

AMF fulfills its mission through international cooperation of academia, industries, governmental institutions, and nongovernment organizations. The Annexes in AMF are started to enable members to cooperate in groups that share common interests and to learn and grow as they interact and share different perspectives.



### 3. SCOPE

*AMF focuses on (but does not restrict itself to) end-use aspects that include the fuel, the engine, the lubricant, and the exhaust after-treatment systems as an interactive system. For some of the aspects related to fuels, AMF works in close cooperation with other IAs within the IEA ETN.*

The need for mobility is increasing on a global basis, and thus the transport sector is facing challenges from local pollution, climate threats, and resource constraints. The main drivers for AMF's work are energy security and reduction of the environmental impact.

AMF deals with fuels and technologies for use in combustion engines. Thus, AMF focuses on (but does not restrict itself to) end-use aspects, which include the fuel, the engine, the lubricant, and the exhaust after-treatment systems as an interactive system.

However, these end-use aspects have to be evaluated within a broad context, such as improved life-cycle efficiency, reduction of toxic emissions, reduction of GHG emissions, enabling fuels for new propulsion systems, sustainability in transportation, and security of supply. For this broad evaluation, next to academia, industry is a welcomed partner to become involved through the implementation of results, assistance with demonstration projects, and contributions to AMF-organized workshops.

IEA's four main areas of focus are energy security, economic development, environmental awareness, and engagement worldwide. As for transportation fuels, one more dimension has to be added: consumer needs and consumer acceptance. Market penetration and practicability are two essential factors to the success of new fuels and technologies.

#### **AMF Definition of Advanced Motor Fuels**

Advanced motor fuels are fuels that fulfill one or more of the following criteria:

- Reduces GHG emissions
- Improves life-cycle efficiency
- Has high energy efficiency
- Has low toxic emissions
- Enables fuels for new propulsion systems
- Contributes to security of supply

AMF supports IEA's initiative by providing sound information to all stakeholders. AMF understands its role in providing unbiased technology policy advice in order to help new technologies and fuels to get market access.

AMF's research focus will be road transport (with the highest share of transportation-related CO<sub>2</sub> emissions globally); however, off-road, maritime, and rail (non-electrified) transport will also be considered. High-speed diesel

engines and corresponding fuels are used both for road and off-road vehicles, thus knowledge from one sector can be transferred to the other. The maritime and rail transportation sectors also use similar engines and fuels, which allows for cross-comparisons. AMF has expertise in all of these sectors.

In aviation, the required fuels originate from the same middle distillates as the other sectors use; methane-derived aviation fuels are also under discussion. However, aviation engines are

very different in terms of technology. As a first step, AMF will monitor and provide a literature study on recent developments in the aviation sector without actively performing research on this topic.

Because advanced fuels are not the only building blocks for sustainable transport, we fully understand the need for cooperation within IEA's ETN. AMF works in close collaboration with different transportation-related IAs for covering the entire value chain, from production of the fuel to end-use aspects, and also for making cross-comparisons between different power trains. AMF provides sound data for performing life-cycle analysis (LCA) of fuels and technology options, to illustrate potential emission reductions.

### 3.1 DYNAMIC OPERATIONS

The AMF ExCo has established three working groups, so called subcommittees, that are well established and that will continue to the next period. The **Outreach Subcommittee** will focus on new membership, especially with regard to countries with a rapidly increasing transportation demand in the near future. The **Strategy Subcommittee** will be responsible for bringing new mobility trends/needs up to the ExCo. The **Technology Subcommittee** will initiate new Annexes according to urgent technical questions and needs identified by its members.

Unlike some other IAs, AMF does not allow its Annexes to become institutions. AMF Annexes are real projects with a defined timeline (typically 2–3 years). One exception is the Information Service Annex (Annex 28).

The exact work program will be defined continuously by the AMF ExCo (as done in the past), in consultation with the Outreach, Strategy, and Technology Subcommittees. Wherever technology



gaps or barriers to deployment are identified, the ExCo will seek to set up a related Annex to address these (top-down approach). The method of starting Annexes within AMF enables cooperation in groups with common interests but different perspectives. AMF can also accept bottom-up initiatives, meaning ideas coming, for example, from one

single AMF member. As Annexes can be set up cost-shared, task-shared, or a combination of both, there is sufficient flexibility to react quickly to changing markets and urgent questions arising from members. This working arrangement has worked well over the past years, has been appreciated as being an efficient one, and will therefore be continued.

Recent members appreciate today's working system of the IA as a result of different factors. The IA helps to obtain broad insight into the development of fuels and vehicles in different countries, which fosters learning from each other and sharing best practices. Members are able to leverage resources by either initiating or participating in Annexes. Another important point is the fact that AMF generates and synthesizes information that is of primary importance for R&D and decision-making bodies. Members appreciate AMF as being a flexible platform with effective

tools. AMF will further build on these benefits by reacting adequately to the requests of its members.

### 3.2 CONTINUATION OF EXISTING ACTIVITIES

Some Annexes that were started in the 2010–2014 working period of AMF will continue into the next period. These Annexes are:

- Annex 28: Information Service & AMF Website (AMFI)
- Annex 46: Alcohol Application in Compression Ignition (CI) Engines
- Annex 48: Value Proposition Study on Natural Gas Pathways for Road Vehicles
- Annex 49: COMVEC – Fuel and Technology Alternatives for Commercial Vehicles
- Annex 50: Fuel and Technology Alternatives in Non-Road Engines
- Annex 51: Methane Emission Control

For the new period, AMF envisions undertaking the following activities, as a continuation of previous activities:

- Describing and comparing available technology options in terms of fuel efficiency, local pollutants, and GHG emissions, and taking into account different market areas and applications;
- In particular, investigating cleaner and more efficient technologies for the turnover of bus fleets in Latin American Cities;
- Making use of “Life-Cycle Analysis” for classifying advanced fuels in terms of their environmental performance;
- Addressing barriers to market deployment, together with the public sector and industry;
- Increasing the resource base for transport (e.g., biofuels, methane, di-methyl ether [DME], and methanol);
- Assessing the adaptation of engines and drivetrains for clean and efficient combustion;
- Reaching out to those countries that are forecast to rapidly increase transport demand in the future; and
- Monitoring the fuel needs of the airborne transport sector.

Some of these activities will be actively undertaken in collaboration with other related IAs, for example, Bioenergy, Combustion, and Hybrid and Electric Vehicle (HEV).

### 3.3 FUTURE ACTIVITIES

Our international survey among AMF members helped us identify future topics that are of interest to the majority of countries. The survey results showed that the following overarching topics should be addressed in the upcoming period:

- Contributing to a smart balance of fuel supply and market needs (making the best use of available fuels).
- Evaluating the infrastructure needs for alternative energy carriers by covering all transport sectors (in response to a request by AMF's Desk Officer); this topic will be addressed in close collaboration with other IAs (e.g., Hydrogen, Gas and Oil Technologies [GOT], and HEV). Also industry should be closely involved.
- Investigating durability issues (engine, lubricant, etc.) related to alternative motor fuels.
- Including retrofitting options into the studies where new technologies and fuels can offer higher security of supply and/or lower toxic emissions.
- Investigating the P2G concept and its implication on the mobility sector; this topic will be addressed in close collaboration with other IAs (e.g., Hydrogen, Advanced Fuel Cells [AFC]).
- Investigating the effect of fuel chemistry on advanced engine performance, including recognizing that the petroleum component, or the synergy of the petroleum and alternative fuel component, is as important to ultimate engine performance as the alternative component alone; this topic will be addressed in close collaboration with other IAs (e.g., Combustion).

With regard to different fuels, the survey results showed that fuels like biomass-to-liquid (BTL), hydrotreated vegetable oil (HVO), and 85% ethanol/15% gasoline fuel blend (E85) are seen as prospective and are gaining more and more interest in research, although they are not widely used yet. According to AMF members, there is a need to focus on these fuels.

The survey also revealed, however, that in order to accelerate the widespread use of alternative fuels, one should consider a portfolio of fuels rather than a single fuel. With regard to synthetic fuels, the survey showed that it is important to evaluate the end-use potential and the economic and environmental performance of these fuels in order to estimate their market penetration realistically. Another fuel that could become more important in the future is methane (as natural gas or biogas.) The best use of methane in transportation has to be evaluated, especially in the context of more and more unconventional resources. Annex 48 was initiated to investigate this topic, and related work will be undertaken in close collaboration with other IAs (e.g., GOT, Bioenergy, and Combustion).

Other fuels that could become more important in the future include methanol and DME. Both of these can be derived either from natural gas or from renewable sources. There are still technical and toxicity (methanol) issues to be resolved that could be addressed in collaboration with other IAs (e.g., Bioenergy, Combustion).

With respect to concerns related to pollutant emissions, research has been increasingly focusing on secondary aerosols. Secondary aerosols have a significant impact on human health, climate, and air quality. They are formed from fine atmospheric particulate matter (composed of a complex mixture of organic and inorganic materials) and oxidation of volatile precursors. AMF considers the evaluation of the impact of secondary aerosols on human lungs to be an important topic for the future. This is a challenging task, as expertise from very different scientific areas

has to be brought together. However, AMF already has preliminary proof of its abilities in this field.

Many of these issues should be dealt with in cooperation with other IAs. AMF already has good collaboration and exchange with different topically related IAs, which should be further strengthened in the next years.

### 3.4 COOPERATION WITH OTHER IAs

AMF, although sanctioned to work on the entire fuel chain, is concentrating on end-use aspects. Thus, for upstream issues, cooperation will be sought with Bioenergy and GOT; for optimizing the combustion process itself, with Combustion; and for deployment and infrastructure with HEV, Hydrogen, and AFC.

#### **Anticipated areas of cooperation include:**

- *Bioenergy*: biofuels production, matching fuel quality with vehicle requirements, LCA and sustainability of biofuels, and airborne transport
- *GOT*: oil and gas upstream (exploration, drilling, production, safety, and gas in energy mix)
- *Combustion*: fuels and combustion principles in ICEs
- *HEV*: fuels for plug-in hybrids and deployment of vehicles
- *Hydrogen and AFC*: fuel supply and infrastructure needs for fuel cell and ICE vehicles (methanol, methane, DME, hydrogen, and other energy carriers)
- *Possible new IA on transport system-level issues*: best-case examples for transport concepts
- *Cross-cutting IAs, for example, Energy Technology Systems Analysis Program (ETSAP) and Renewable Energy Technology Deployment (RETD)*: cooperation as appropriate



#### 4. CONTRACTUAL AND MANAGEMENT REQUIREMENTS

*AMF is managed in an effective way, fulfilling all requirements from its members as well as the IEA Secretariat.*

AMF already is a well-managed IA. It was founded in 1984 and has continuously evolved since. Fifty-one Annexes have been initiated so far (of which 2 never started), and the work program is jointly driven by 16 participating countries.

ExCo meetings are held twice a year, with high participation of national Delegates and Operating Agents. Three subcommittees have been set up (Strategy, Technology, and Outreach) to better address specific aspects of the work program.

The Outreach Subcommittee currently consists of eight members from six countries (Austria, Finland, Germany, Japan, Switzerland, and the United States). It has been active since ExCo 37 in Finland (May 2009). Tasks include contributions to the AMF website, production of a greatly enhanced annual report and other outreach materials, and activities to encourage the participation of new members.

The Strategy Subcommittee currently consists of eight members from seven countries (Denmark, Finland, France, Japan, Sweden, Switzerland, and the United States). It was started at ExCo 40 in Greece, with the purpose of developing and revising the AMF strategy on a regular basis. Given the heterogeneity of the group — for example, in terms of regions, drivers to advanced motor fuels, predominant transport systems, fuels in use, and R&D activities — finding a common focus is quite challenging. The continuous work of the Strategy Subcommittee, which included many discussions and a survey, provides an excellent base for determining the strategic direction for the upcoming working period.

The Technology Subcommittee aims to foresee and discuss game-changing trends, coordinate technical investigations in member countries, and check Annex proposals as to whether they are in line with the technology foresight. It was founded at ExCo 44 in China and currently comprises members from eight countries (Canada, China, Denmark, Finland, Sweden, Switzerland, Thailand, and the United States). The Technology Subcommittee usually meets for discussion ahead of AMF ExCo meetings and then reports during the informal ExCo meeting.

The Annual Report has been greatly enhanced during the current working period and now serves well to showcase AMF work. The IEA Framework is being well respected, and the AMF legal text is being adapted when deemed necessary (e.g., in 2013 to include terms and conditions for sponsors).

As the working principles of AMF management are well in place, no major changes are envisioned for the new working period.

## 5. CONTRIBUTION TO TECHNOLOGY EVOLUTION/PROGRESS AND TO TECHNOLOGY DEPLOYMENT/MARKET FACILITATION

*AMF is actively working on bringing new and better fuels to the market, from basic research to market facilitation. However, it is not AMF's task to perform competitive development work on fuels or vehicles, as this is the role of industrial players.*

AMF sees its activities covering the following type of actions:

- Basic pre-competitive research on engine-fuel-exhaust after-treatment interactions (in cooperation with other IAs);
- Generation of performance data on new fuels and vehicles;
- Development of tools to evaluate performance of fuels and new vehicle technologies, from exhaust gas characterization to complete well-to-wheel assessment of alternative energies in transport; and
- Facilitation of deployment of new technology by working on issues such as fuel standards, dissemination of information, and consumer acceptance.

The ICE has undergone extensive technological development in the past few decades, particularly in the field of road vehicle application. This tendency will undoubtedly continue for many years. Furthermore, radical development of ICEs for other transport sectors is anticipated in coming years. For road vehicles, the main focus has been on the reduction of regulated emissions (e.g., oxides of nitrogen and particulates). It is easy to foresee that from now on, energy efficiency and the ability to use alternative fuels will become increasingly important. The necessary transition to new and more sustainable fuels has been recognized worldwide.

The technological development of the ICE has, for example, led to the introduction of a wide range of new combustion principles supported by advanced electronic controls and innovative fuel systems.

Making use of the ExCo network (both on the national level and internationally), as well as of current and future Annexes, AMF will contribute to progress in the field of advanced motor fuels by the:

- Identification of technology gaps and market barriers in ExCo meetings, supported by the Technology and Strategy Subcommittees,
- Creation of Annexes to address the identified issues and to generate first-line data as required,
- Involvement of industry in the Annexes as appropriate,
- Aggregation of research and/or demonstration results in the Annex Report, and
- Publication of Annex Reports.

Examples of successful contributions to technology progress and market facilitation are given in the End of Term Report and include basic research on particle emissions of small two-stroke engines, the impacts of high-level ethanol blends on particle emissions, measurement methodologies and standards for ethanol-fueled vehicles, performance evaluation of fuel and powertrain options for light-duty vehicles, commercial vehicles and city buses, and insight into the concept of LCA of transportation fuels.

## 6. POLICY RELEVANCE

*In relation to transport, AMF's work program addresses GHG emissions, local air pollutants, energy efficiency, and security of supply. These topics are relevant for all countries. An important issue is to balance the need for reducing GHG emissions and the worldwide growing demand for energy.*

The importance of alternative fuels is growing worldwide, as is the use of biofuels. Legislation is in place or under preparation for biofuels, fuel efficiency of vehicles, and related infrastructure in almost all countries. An even faster growth can be seen in the exploration of shale gas, mostly in North America.

Several Annexes have established overviews of existing and close-to-market technologies and thus provide a sound basis for policy decisions. Examples include Annex 34 (biodiesel, algae), 35 (ethanol), 40 (LCA), 41 (marine fuels), and 47 (DME). Performance evaluation of various fuel and powertrain options (Annexes 37, 43, and 49) also supports national policymaking. Furthermore, the AMF website — especially through the Fuel Information System — provides a wealth of information to decision makers.

Results from Annex work are presented and discussed at ExCo meetings and within the Strategy and Technology Subcommittees. National Delegates spread the knowledge and the related reports in their home countries. Several AMF ExCo members directly advise their governments on transport-related issues, with the effect that the results derived from Annex work are used for national and trans-national policymaking. Such success stories include:

- *Finland:* Annex 37 and Annex 43 results were used to set national objectives and recommendations for alternative energies in transport;
- *Japan:* Annex 38 results were used to prepare appropriate policy for introducing biodiesel fuel and vehicles into the Japanese market;
- *Sweden:* Annexes 38, 39, and 43 have been very important as background for the governmental investigation of possible pathways to make Swedish road transportation independent of fossil fuels;
- *European Commission:* Annex 36 results provided the basis for further investigation into ethanol blends and related standards; and
- *United Nations Economic Commission for Europe (UNECE):* Annex 39 results were used to enable the homologation of dual-fuel engines within the Euro VI regulation.

Summaries of ExCo meetings are provided to the Desk Officer, the EUWP, and related IAs. This forms the basis for feeding-in the results of Annex work and ExCo discussions into related IEA analysis.

AMF anticipates continuing to deliver results, reports, and advice of relevance to policy makers. To improve outreach to policy makers, in the next period, each Annex Report will include several paragraphs of key messages derived from the Annex work.

## 7. CONTRIBUTION TO ENVIRONMENTAL PROTECTION

*The ICE will be the prime mover in transport for many years to come. AMF will work to promote advanced motor fuels to reduce GHG emissions, as well as local emissions. AMF sees its role in providing information to emerging economies as extremely important.*

AMF contributes to environmental protection through the provision of sound scientific information and technology assessments, which allows citizens and policy makers to make informed and science-based decisions concerning advanced fuel options for transportation systems. Also, AMF contributes to the comparability of test results among different countries and to the harmonization of legislation and standards.

AMF addresses GHG emissions, as well as regulated and unregulated local emissions. The use of methane in diesel and otto engines can result in GHG emission reductions of up to 25% — the best biofuels deliver 70% to 80% reduction of GHG emissions. Local emissions can be reduced by using clean-burning fuels and through tailpipe measures; health risks due to changed exhaust emissions when switching to new fuels or blends also need to be carefully considered. Clean-burning fuels can also contribute to improved engine efficiency, thus lowering GHG emissions. AMF is working on these issues and will continue to provide solid data for environmental protection.



## 8. CONTRIBUTION TO INFORMATION DISSEMINATION

*AMF has an effective system for dissemination of information, comprising an up-to-date website, the Fuel Info Service, a quarterly newsletter, a comprehensive Annual Report, and free access to most of the reports produced by the Annexes.*

AMF is already efficient in disseminating information, as explained in the End of Term Report. Information dissemination tools and mechanisms include:

- Well-managed AMF website, including information on Annex work, member countries, and news available to the public in the publicly accessible parts of the website, as well as documentation and information available only to members in the members area of the website.
- Comprehensive information on advanced motor fuels properties on the website (Fuel Info).
- Quarterly e-mail newsletter, distributed to all National Delegates and Operating Agents and directly to the IEA Secretariat, related IAs, and other experts; AMF Delegates forward the newsletter to their own national networks; the IEA Secretariat feeds the newsletter into OPEN Bulletin.
- Annual Report with national overviews and detailed descriptions of ongoing Annexes; greatly enhanced as compared with the minimum requirements.
- USB drives containing the Annual Report and Annex Reports for distribution to parties interested in joining AMF.
- Workshops alongside ExCo meetings, sometimes in cooperation with other related IAs.
- Invitations to observers to participate in ExCo meetings.
- Contributions to international workshops and conferences.
- Printed Annex Reports for wide distribution.
- Following EUWP requirements, regular reporting to EUWP and participation in EUWP meetings and Transport Contact Group meetings, including the provision of ExCo summaries shortly after each ExCo meeting.

In the new working period, AMF will aim to enhance information dissemination through a couple of measures. These include enabling closer interaction with the IEA Secretariat; requesting Operating Agents to provide key messages from Annex work in the Executive Summaries of their final reports; and, wherever appropriate, producing technology policy briefs to allow for efficient dissemination of the results of Annex work.

## 9. OUTREACH TO IEA NON-MEMBER COUNTRIES

*AMF has been very successful in outreach to partner countries (China, Israel, and Thailand) and activities to attract new countries continue. For the new period, special efforts will be directed toward South America.*

In line with IEA's ambitions to involve partner countries and in order to coordinate AMF's outreach to other countries, the AMF ExCo established an Outreach Subcommittee in 2009. This subcommittee actively seeks to attract new members to AMF. Focus is being given to countries that are predicted to experience rapidly increasing traffic volumes (e.g., China, India) or that experience severe problems with air pollution from transport (e.g., Mexico). There is significant congruence between IEA and AMF target countries.

The AMF Outreach Subcommittee actively contacts relevant ministries in the target countries, informs them about AMF goals and work program via e-mail, and invites them to participate in ExCo meetings as observers.

This is quite successful: China, Israel, and Thailand are already active members of AMF. A special focus has been on Latin America. Chile hosted an ExCo meeting in which Uruguay and Brazil attended as observers. Ongoing communication with other new member countries includes India, Indonesia, Russia, and most recently Kazakhstan.

Moreover, AMF also contributes to IEA outreach activities, such as the Network of Expertise in Energy Technology (NEET). The opportunity to present AMF by invitation of the IEA Secretariat at specific events, for example, at the Kazenergy Eurasian Forum, will open the door to the possible participation of new member countries.

## 10. ADDED VALUE

*AMF brings stakeholders from different continents together for pooling and leveraging of knowledge and research capabilities in the field of advanced and sustainable transportation fuels. Our cooperation enables an exchange of best practices. With our broad geographical representation, we are able to take regional and local conditions into consideration when facilitating deployment of new fuel and vehicle technologies.*

Added value arises from good, truly international cooperation. AMF is a neutral, and thus credible, platform for international cooperation on transportation fuels. Setting policies for future energy in transport is challenging. The robust data produced by AMF can be used as a basis for decision making by governments as well as private companies.

AMF has broad membership, currently 16 member countries from 3 different continents, namely Asia, Europe, and North America. Included are three non-IEA countries — China, Israel, and Thailand. As explained in Chapter 9, AMF is constantly seeking to increase its membership.

Local conditions for deployment of alternative motor fuels differ significantly. There are variations in available fuel feedstocks, processing capabilities, fuel standards, exhaust emission regulations, and alternative fuel-related policies. AMF takes into account regional conditions already in its structure. AMF's Cabinet (Chairman and Vice Chairmen) is set up so that all participating continents are represented. This arrangement secures a balanced approach to transportation fuels. IEA partner countries bring new fuel options and new aspects related to alternative fuel deployment to the table.

The ExCo, in addition to the Cabinet, is a valuable asset. The Delegates include representatives of governments, industry, and academia. Thus, the complex issue of future fuels can be tackled from different angles. Interaction among Delegates provides insight and enables the sharing of best practices. Discussions within the ExCo range from technical issues to overarching discussions in the field of transport, which gives Delegates the opportunity to take comprehensive information back to their countries. Furthermore, AMF-organized workshops on a specific topic facilitate the exchange of new ideas and concepts between AMF members and experts outside of AMF.

To enhance its operations, AMF has established subcommittees on Outreach (membership and adequate regional representation), Strategy (overarching issues), and Technology; Technology is the latest addition. The subcommittees enable discussions on specific subjects on a level of detail that would not be possible with the full ExCo. The ExCo is a very heterogeneous group, with members from academia, industry, and policy. The subcommittees are open to all interested AMF participants and allow the formation of smaller and more homogeneous groups of experts, with common backgrounds and objectives. All subcommittees contribute to the management and guidance of AMF, including inputs to End of Term Reports and Strategic Plans, such as the document at hand.

AMF's ExCo plays an important role in defining the work program of AMF. AMF operates in a unique mode of combining cost and task sharing. Many other IEA Technology Initiatives (IAs) rely solely on national research programs and information exchange regarding these.

AMF has the authority to initiate new activities and to generate new first-line IEA data, whether through cost sharing, task sharing, or a combination of these two modes. Cost-shared activities enable AMF to quickly react to new developments, if necessary.

New Annexes are basically generated in two different ways. The ExCo might define information gaps, technology gaps, or market barriers to be tackled, and conclude that a new activity is needed. If the three Contracting Parties support this activity, then it can be started. Alternatively, individual participants can bring a new proposal to the table, and if the subject is relevant and has a sufficient international dimension, the ExCo can decide to go ahead with the proposed activity. Both top-down and bottom-up approaches are therefore possible.

Industry can participate in several different ways. In the case of France, Italy, and Thailand, the national governments have designated companies to serve either as Delegates or Alternates to the ExCo. Another option for companies is to participate at the Annex (project) level. A third option for industry to participate would be as a sponsor.

Over the years, AMF has carried out several Annexes on the development of test methodology and assessment methods, as well as Annexes providing solid and unbiased data on vehicle and fuel performance. Recently, several research laboratories have teamed up in Annexes, producing performance data generated by using a common protocol — in doing so, these organizations bring added value to national activities by pooling test facilities and test data. Coordinated efforts make it possible to avoid useless duplication and enable a leveraging of investments into a certain topic.

AMF's work has had an impact on national policies on transportation fuels and on industrial decisions. This is true, for example, in Finland and Sweden. The comprehensive joint work on technology and fuel options for buses by AMF and the Bioenergy IA (AMF Annex 37, in which nine countries plus the European Commission participated) has guided procurements of buses and bus services in many places around the world.

For the upcoming work period, AMF is, along the lines requested by the EUWP, renewing its reporting requirements to the Annexes to be clearer in delivering key technology policy messages to decision makers. All current AMF members have contributed to this new Strategic Plan and are eager to continue this valuable international cooperation.

## 11. REFERENCES AND RESOURCES

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