IEA/AMF

Research Report

IEA/AMF Annex XXVII

“Standardization of alternative fuels”

Atrax Energi AB

Innas BV

This report is the result of an International Energy Agency`s, Implementing Agreement on Advanced Motor Fuels (IEA/AMF) project concerning standardization of alternative fuels. The project has been carried out as an IEA/AMF annex, number XXVII, with financial support from Canada, Finland, France, Japan (LEVO), Sweden and The USA. Annex XXVII is prolonged in a second phase planed to be reported spring 2004. The second phase of annex XXVII has financial support from Canada, Japan (LEVO), Sweden and the USA. This report is open to public and can, as long as copies are available, be ordered from IEA/AMF`s secretariat, Atrax Energi AB or from the financial contributors as mentioned above.

ABSTRACT

There are different interpretations of the term “alternative fuels”, depending on the part of the world in which the definition is used. In this report, alternative fuels mainly stand for fuels that can replace gasoline and diesel oil and at the same time contribute to lowered emissions with impact on health, environment and climate.

The use of alternative vehicle fuels has increased during the last 30 years. However, the increase has developed slowly and today the use is very limited, compared to the use of conventional fuels. Although, the use in some special applications, often in rather small geographical areas, can be somewhat larger.

The main interest for alternative fuels has for a long time been driven by supply security issues and the possibility to reduce emissions with a negative impact on health and environment. However, the development of reformulated gasoline and low sulphur diesel oil has contributed to substantially decreased emissions from these fuels without using any alternative fuel. This has reduced the environmental impact driving force for the introduction of alternative fuels.

In line with the increased interest for climate effects and the connections between these effects and the emission of greenhouse gases, and then primarily carbon dioxide, the interest for biomass based alternative fuels has increased during the 1990s.

Even though one of the driving forces for alternative fuels is small today, alternative fuels are more commonly accepted than ever before. The European Commission has for example in May 2003 agreed on a directive for the promotion of the use of bio fuels. In the directive there are goals for the coming 7 years that will increase the use of alternative fuels in Europe rather dramatically, from below 1 percent now up to almost 6 percent of the total vehicle fuel consumption in 2010.

The increased use of alternative fuels in Europe and the rest of the world will create a need for a common interpretation of what we mean with a specific alternative fuel; a standard for the fuel. Since we today live in a global society with international trade, the work with standards has to be carried out by international standardization organizations such as CEN and ISO.

In the work on standardization of alternative fuels, it is of course important that all existing knowledge and experiences on production, distribution and use of alternative fuels are taken into account to avoid duplication of work and to limit the time and resources needed to produce standards.

The International Energy Agency’s Implementing Agreement on Advanced Motor Fuels, (IEA/AMF) is an organization with competence and more than 20 years of experience on alternative fuels. In April 2002 IEA/AMF’s Executive Committee decided to start a new Annex, Annex XXVII on “Standardization of alternative fuels”. This report is the result of phase one of Annex XXVII.

The first phase of Annex XXVII have been financed by Canada, Finland, France, Japan (LEVO), Sweden and the USA.

This report should be considered as a state of the art report on existing and planned work on standardization of alternative fuels in the participating countries/regions and in the international standardization organizations CEN and ISO.

The result of phase one of Annex XXVII as reported is to serve as a platform for IEA/AMF's further discussions with CEN and ISO. These discussions have the goal to establish a form of cooperation between IEA/AMF and CEN and between IEA/AMF and ISO on how IEA/AMF with their competence and experience in the field of alternative fuels could contribute to CEN and ISO's work in this field. This work will be carried out in a second phase of Annex XXVII during the autumn of 2003 and the beginning of 2004 with the goal to be reported to IEA/AMF's Executive Committee in the beginning of 2004.

One of the thoughts behind Annex XXVII is to look for possibilities to broaden the scope of IEA/AMF to become more market oriented.

The results of phase one are based on information obtained from sources like websites and literature, but predominantly they are based on information received from relevant people in the participating countries and in CEN and ISO. These people have been interviewed about the situation for alternative fuels, and then specifically the standardization of alternative fuels, in the countries and organizations where they live and work.

The results of the interviews give a good picture of ongoing and planned activities in the field of standardization of alternative fuels. The interviews have also indicated a common positive and open attitude toward IEA/AMF's thoughts about contributing to the standardization of alternative fuels.

The result for each participating country and also for CEN and ISO are reported in separate chapters. Based on that information, an analysis is carried out and conclusions are drawn concerning alternative fuels and their standardization.

The conclusions can very shortly be summarized as follows:

- An introduction of alternative fuels on the consumer market requires acceptance of both vehicle manufactures and the vehicle users.
- Acceptance from vehicle manufactures and users will require fuel standards.
- To begin with, international standards could be decided on regional international level, as for example in Europe.
- In the long term, there might also be a need for global standards for vehicle fuels, alternative fuels as well as conventional fuels.
- Worldwide, standards on specification and properties of conventional vehicle fuels are scarce. Such standards on alternative fuels are lacking, except for an ISO standard on hydrogen.
- Blending of small quantities of an alternative fuel in conventional fuels (low blending) will lead to a much faster growth in market share, with an associated growth in production demand, than the use of a neat alternative fuel in adapted vehicles.
- Low blending will soon demand such production volumes that the use of the fuel in neat form very well could gain a part of the total production volume.
- If there have to be different standards for a fuel used for low blending and the same fuel to be used in neat form, it is more urgent to have a specification and standard for the use of the fuel for low blending.

- Today, the transport sector contributes to a very high extent (about a quarter) of the total manmade emissions of carbon dioxide. Because of that, the transport sector also influences the possibility for different nations to fulfil international commitments as for example in the Kyoto protocol.
- Today, the main reason to replace conventional fossil fuels with biomass based/renewable/carbon dioxide neutral fuels, is to contribute to the reduction of the net emissions of carbon dioxide, and in association with that the impact on the climate.
- Since the use of bio based alternative fuels such as FAME and ethanol, but also to some extent natural gas, contributes to the reduction of the net emissions of carbon dioxide, and consequently reduces the impact on the climate, it seems reasonable to give priority to the work on standardization on alternative fuels to this kind of fuels.
- International standards are best produced by standardization organizations like CEN and ISO.
- CEN and ISO have shown to be interested in using IEA/AMF's competences, knowledge and experience on alternative fuels.
- The form of such a co-operation has to be discussed.
- Among people engaged in the standardization of vehicle fuels, there is also an interest to have a kind of informal discussion forum where issues related to standardization of alternative fuels could be discussed, free from formal negotiations and in advance of such negotiations. These informal discussions could be the starting point of further discussions in the standardization organizations' technical committees and working groups.
- Such informal discussions could preferably be arranged/organized annually, in the form of workshops headed by an organization independent from CEN and ISO.
- IEA/AMF has good prerequisites of organizing such workshops. This could be done at the request of CEN or ISO.

For detailed information about the conclusions please see Chapter 13.

The results of the interviews and also the conclusions from the information collected through interviews, websites and literature are similar, even though coming from all over the world. Of course there are local differences, but these are smaller than might have been expected.

The organizational forms for standardization do not differ much between the different countries examined, except for the USA. The USA seems to be such a big country that the system looks more likes the system for the whole of Europe than for individual countries. The National Standardization Institute in the USA is for example engaged in the procedural forms for standardization and not in the production of detailed specification standards. In the USA, many organizations are engaged in and certified for the production of standards, compared to the other countries examined.

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1 BACKGROUND

Alternative fuels and related issues, like supply of raw material, production technology, distribution technology and engine technology have been analysed and discussed for more than three decades. During this time several production and engine technology tests have been performed, with a broad range of alternative fuels, fossils as well as bio based. Different alternative fuels have also been used in fleet tests, ranging from a couple up to several hundred vehicles. In some countries, the use of primarily methane (natural gas and biogas), LPG/Motor gas, ethanol and bio-diesel has been introduced on the commercial market, even if the total consumption is still just a small percentage of the total volume of vehicle fuels used.

During this time of exploration, the need of specifications has been highlighted. Not at least producers of engines and vehicles have more and more emphasized the importance of specifications, or rather standards. To some extent, national specifications have been set up and occasionally these have also been brought forward to national standards. Some work has also been done with standards on an international level (for example the ongoing work in CEN with fatty acid methyl esters FAME/bio-diesel).

Even though the producers of engines and vehicles often are prepared to accept the use of alternative fuels in their engines and vehicles when they take part in laboratory tests and fleet tests, they have severe problems to accept alternative fuels on the open consumer market without having standards. An introduction on the open consumer market would substantially increase the total number of vehicles. Without standards the producers might for example not be prepared to keep up with such important issues as guarantee obligation concerning vehicles performance and exhaust gas catalytic cleaner performance (emission levels). Already today, the lack of standards is a serious obstacle when acting for an increased use of common accepted alternative fuels, as for example methane, LPG, FAME and ethanol.

Since the mid 1990s, as an effect of the climate change and its connection to emission of greenhouse gases, the main interest of alternative fuels has been concentrated on bio based or rather carbon dioxide neutral fuels. In the autumn of 2001 the European Commission presented a draft communication, as well as two directive proposals concerning promotion of the use of bio fuels and the taxation of bio fuels. In May 2003 a decision was taken on the directive for promotion of alternative fuels. The aim of the communication and the directives is to enlarge the use of alternative fuels to certain levels. For example in the directive concerning the promotion of alternative fuels, 5,75 percent of the total volume of used vehicle fuels is set up as a voluntary minimum level for the use of alternative fuels, mainly ethanol, bio-diesel and methane by the year 2010, see Appendix 1.

If we really want to increase the use of alternative fuels up to a level of approximately 5 percent, and maybe even more than that, during the coming 5 to 10 years, sole use in vehicle fleets is not a successful way forward. The use of fuels has, so to speak, to be taken out from fleet tests and introduced into the normal market much more than today. It will probably also be necessary to broaden the range of alternative fuels from ethanol and MTBE and bio-diesel to other alcohols such as for example methanol and dimethyl ether (DME) and in the long run also hydrogen. The need for standards will in that case be of even higher importance than today.

However, national standards will not be enough to solve this problem. 50 years ago it might have been sufficient with nationally decided standards, but today transportation is often crossing borders. Without international standards it will be difficult to drive from one country to another, since one cannot be sure that the fuel in one country is of the same quality as in another country. Vehicle manufacturers produce vehicles not for use in one country, but for worldwide use. Without international standards these vehicle manufactures probably will have to produce several national adapted versions of each of their vehicle models.

Because of what has been said above, one of the most important issues to deal with, and to deal with prompt in the frame of the promotion of alternative fuels, is the development of negotiations concerning and decisions on international standards.

Until today, probably almost every OECD state to some extent has been and often still is engaged in development of specifications and standards for alternative fuels. Instead of continuing this work mainly on a national level, much could be gained if at least parts of the work could be coordinated on an international level. EU and CEN have the responsibility for that on a European level and ISO on a global level. However, these international organizations often have so much to deal with concerning standards for fossil fuels, fulfilling their duties in existing and coming EU directives, that the resources for alternative fuels might be rather small. Even if international stakeholders and national representatives in CEN and ISO will bring up these issues for discussion, it might be a very long process to establish proposals for standards for alternative fuels, since this is a somewhat new kind of item for the standardization organizations. Alternative fuels to some extent will bring in new issues, not dealt with before in the standardization procedure, like for example how to define the fuels' origin or degree of renewability, or how to analyse and define properties as cetane index/number or octane number for alternative fuels.

It is also not unlikely that limited resources for standardization of alternative fuels may result in discussions and decisions concerning how to choose between different alternatives, when deciding which alternative fuel the market introduction is closest and therefore the need of the standard most important at the moment. Taking an incorrect decision in this issue might result in slowing down the introduction of alternative fuels on the consumer market. If the available resources, are not put primarily on the alternative fuel closest to a market introduction, or rather with the highest consumer demand, the risk for creation of bottlenecks is obvious.

IEA and especially IEA/AMF have unique competences and a very long experience concerning issues related to the production and the use of alternative fuels. Because of that IEA/AMF could contribute to the upcoming work with standardization of alternative fuels and related issues. Certainly, standards finally have to be worked out by CEN and/or ISO and the formal decisions have to be taken in these forum, but the decision concerning which alternative fuels should be prioritised, and also some of the more fundamental conclusions on which decisions should be based, might be analysed and proposed with help from IEA/AMF.

International cooperation is often a slow process, sometimes with a yearly cycle. One reason for this is that the delegates are not able to meet more than two to three times a year. Another important reason is that the delegates at these meetings often have restrictions concerning what to say or decide. Before taking a decision they have to go back home and get acceptance for the proposal that has been brought up on the agenda. Even if the delegates have had time to read a proposal prior to the meeting, proposals often change during a meeting, before they finally will be taken to a formal decision. During this process the proposal often has changed

too much to make it possible for the civil servants to take the decision on his/her own. First they have to go back home for consultation and then maybe they come back with a further change or maybe even a new proposal to present at the next meeting, resulting in that other participants have to go back home for consultation and so on “for ever”.

One possibility to decrease the time and number of meetings/negotiations before a decision will be taken, might be to meet and discuss the issue in a quite informal way, without having the feeling of being quoted or making a too binding statement for the country or organization that one represents. This kind of informal discussions could be a positive start of a process concerning for example the need of new standards for alternative fuels and how these should be designed, as well as a kind of informal expert discussion forum performed parallel to the formal discussions and negotiations within the framework of the forum in which the decision finally will be made. Sometimes it facilitates the process and the negotiations if one knows the other participants’ reasons for their acting, reasons that might be difficult to bring forward and express at a formal meeting/negotiation.

Obtaining a successful result concerning standardization of alternative fuels without spending too much time at formal discussions might, as said above, require a combination of informal and formal discussions. The formal discussions have to be performed within the framework of organizations such as CEN and ISO, but this solution does not necessarily suit the informal discussions. The informal discussions could preferably be performed under the auspices of a body with experience and knowledge about alternative fuels, but without any specific bindings to the international standardization organizations. For example IEA/AMF, which has this experience and knowledge, could serve as an informal expert body for preparatory coordination of international standardization efforts concerning alternative fuels. These efforts could be performed as workshops and seminars arranged by IEA/AMF, but on the request of for example CEN or ISO.

To be able to act as a forum for informal discussions about standardization of alternative fuels, IEA/AMF has to establish a common view concerning the need for standardization and, if so is decided, a common view concerning how to work with standardization of alternative fuels.

To be able to decide on this, IEA/AMF needs a kind of state of the art investigation to analyse what has already been done, what is going on for the moment, what will come and what are the preferences in the IEA/AMF member countries. With the result of this state of the art investigation, areas and needs, as well as working principles for the work with standardization of alternative fuels could be proposed and decided on by IEA/AMF’s executive committee.

A proposal to establish a new IEA/AMF Annex about standardization of alternative fuels, in line with what has been discussed above, was presented to the IEA/AMF delegates in March 2002.

At the IEA/AMF’s executive committee (ExCo) meeting in April 2002, IEA/AMF decided to establish a new IEA/AMF Annex (XXVII) on the standardization of alternative fuels with Atrax Energi AB as operating agent.

It was also decided to carry out the Annex in different phases and with new decisions taken for each phase.

Phase one of the Annex, with participation of Canada, Finland, Japan, Sweden, the USA and France, was decided to concentrate on a state of the art investigation and then mainly the following issues:

- Existing national and international standards for alternative fuels. National ongoing work on standardization of alternative fuels.
- Ongoing and planned/discussed international work on standardization of alternative fuels (CEN, ISO and EU).
- The participating countries' opinions concerning their needs for new and re-examined alternative fuel standards as well as their priority list among such standards.
- Conclusions concerning a possible common opinion between the participating countries about the need for new, re-examined international alternative fuel standards and a common priority list among such standards.
- Preliminary proposals concerning how IEA/AMF best could work on the international arena offering CEN and ISO its knowledge and competence.
- Preliminary proposal concerning how IEA/AMF might work as an forum for international informal discussions about standardization of alternative fuels, in parallel to the formal discussion being performed in CEN and ISO.
- Preliminary proposal for a continued work in a phase two.

The work in phase one was to be based on existing public information available on websites etc., plus new information from contacts with people handling and also in charge of standardization of fuels and other relevant areas in the participating countries, authorities as well as institutes and industry, and relevant organizations as CEN and ISO and when suitable the EU Commission.

To be able to carry out the work in phase one it was clearly stated that Atrax Energi AB would need relevant information from the participating countries concerning their national work with standards for alternative fuels. It was also stated that this implicates that Atrax Energi AB from each participating country request to have such information and on an initial level at least information about people handling fuel standardization issues and that these persons had to be informed about the ongoing IEA/AMF work, and that they also had to be prepared to deliver this kind of information.

Atrax Energi AB also stated that Innas BV, The Netherlands, was to be engaged as sub contractor for phase one of the Annex.

The work with phase one started in the beginning of September 2002 and the result of the work under phase one of Annex XXVII is the report you now have in your hand.

The preliminary result has also been presented at the IEA/AMF ExCo meeting in March 2003.

2 INTRODUCTION AND METHODOLOGY

Alternative fuel is a word with many interpretations. That might have been one reason for IEA/AMF to change the name of the Implementing Agreement so that the A in the abbreviation AMF now stands for "Advanced" instead of "Alternative". In the USA an alternative fuel is every fuel that can replace oil products as gasoline and diesel oil. When

using the word alternative in the USA they do it from a supply point of view. In parallel to alternative, in the USA, they also use the wording Clean Fuels for fuels that compared to normal qualities of gasoline and diesel oil have substantial reduced emissions with impact on environment and health. Clean fuels in the USA could because of that include reformulated gasoline and reformulated diesel oil. In Sweden, the expression “alternative fuels” is somewhat unclear: Alternative fuels often means bio based fuels or rather carbon dioxide neutral fuels, but sometimes it also includes fossil methane. In Finland, alternative fuels include bio based fuels, as well as methane and LPG. It is more a matter of who is using the word alternative fuel, than a clear and logic meaning of it.

In this Appendix we use the words “alternative fuels” for all fuels that can replace gasoline or diesel oil. Reformulated quality of gasoline and diesel oil is not included in the Annex. The same goes for electricity. Even if electricity can be, and in for example USA is, regarded as a fuel we mere see it as an energy carrier. Then, what is the difference between a fuel and an energy carrier? Is it a question of how the energy is transformed to motive (kinetic) energy, a question to consider but maybe not to include in this Annex.

Finally, Annex XXVII, at least phase one, is only about standards on fuel composition and fuel specifications. Other types of standards, like for example refuelling nozzles for gas vehicles, are not included.

In mid September 2002, the operational part of phase one of IEA/AMF Annex XXVII ”Standardization of alternative Fuels” started. A draft time schedule and a draft work plan were decided on and sent out to the participating countries.

As mentioned in Chapter 1 (Background) the work in phase one had to be based on existing public information available on websites etc., plus new information from contacts with people handling and also in charge of standardization of fuels and other relevant areas in the participating countries, authorities as well as institutes and industry, and relevant organizations as CEN and ISO and when suitable the EU Commission. Also as mentioned in Chapter 1, Atrax Energi AB, to be able to carry out the work in phase one, needed relevant information from the participating countries concerning their national work with standards for alternative fuels.

In September, October and November 2002, Atrax Energi AB and Innas BV, based on information from the participating countries, as far as possible established contacts with relevant people in the participating countries.

In October, November, December 2002 and January and May 2003, telephone interviews were carried out with the people contacted, while supplementary information. Parallel to these interviews, information was also searched for in literature, on websites etc..

A list of examples of issues that were brought up during the interviews, is enclosed to this report, see Appendix 2.

Information gained from the interviews as well as information found on websites and otherwise, is summarized and reported in Chapters 3 to 8, one chapter for each country.

Names and address of people interviewed, as well as web addresses etc., can be found in the end of each chapter under the headline References.

- In November 2002, Björn Rehnlund, Atrax Energi AB, and Martijn van Walwijk, Innas BV, visited and interviewed the secretary of CEN's technical committee 19, CEN/TC 19 "Petroleum products, lubricants and related products", Mr Ortwin Costonoble at NEN Centre of Standardization, in Delft, The Netherlands.
- In January 2003, a telephone interview was also carried out with CEN/TC 19's chairman Carel Stapel, ExxonMobil, Breda, The Netherlands.
- In December 2002, Björn Rehnlund also carried out a telephone interview with the secretary of ISO's technical committee 28, ISO/TC 28 "Petroleum products and lubricants", Mrs Paula Watkins, API, Washington, USA.

Since the ISO/TC 28 secretary Paula Watkins, as well as the CEN/TC 19 secretary Ortwin Costonoble and CEN/TC 19 chairman are employed by API, NEN and ExxonMobil respectively, it is important to emphasize that during the interviews they have given their answers solely as represents for ISO and CEN and not API, NEN or ExxonMobil

Information gained from the interviews, as well as information found on websites and otherwise, is summarized and reported in Chapter 10 and 11, one chapter for each organization.

Information concerning the joint publication of European Automobile Manufacturers Association (ACEA), Alliance of Automobile Manufacturers (Alliance), Engine Manufacturers Association (EMA) and Japan Automobile Manufacturers Association (JAMA), "The world-wide fuel charter", is shortly summarized and reported in Chapter 9.

The information summarized and reported in the country chapters as well as the chapters for CEN, ISO and "The world-wide fuel charter" has been further summarized, analysed and reported in Chapter 12.

Based on that summarized information some conclusions have been drawn and a preliminary proposal has been put forward concerning how IEA/AMF in the future might work and contribute to the international standardization work on alternative fuels, see Chapter 13.

Finally in Chapter 13 the subjects for a second phase of Annex XXVII are presented.

The proceeding of phase one of Annex XXVII has in intervals of two months been reported to the participants. Late December a first draft of Chapters 4 (Finland), 11 (CEN) and 10 (ISO) were sent to the participants as a short medial report of the work with the Annex.

In the beginning of February 2003, 4 weeks in advance of the IEA/AMF ExCo meeting, a first draft of the whole report was sent out to the participants as information to the coming IEA/AMF ExCo meeting and for comment etc.

The result of the Appendix as described in the report was also orally presented at the IEA/AMF ExCo meeting in the beginning of March 2003.

After discussion at the IEA/AMF ExCo meeting and further interviews as well as collection and processing of comments, the final report was prepared and printed. In September 2003 the final report for phase one was distributed to the participating countries in Annex XXVII.

3 CANADA

3.1 Introduction and background

The Standards Council of Canada (SCC) observes that at an international level, standards are of increasing importance to the global trade system, because trade barriers are eliminated and technologies continue to evolve. Standards also play a role in international codes and guidelines on health, safety and environmental issues. On a Canadian level, standards can help in reducing administrative procedures and costs. For these reasons, Canada is an active player in the international standards arena by participating in ISO and IEC work. Because the USA is an important trade partner, Canada also participates in forums that establish US standards. World wide, many parties working on standardization are also aiming at a system under which a product has to be tested or certified only once, to be accepted anywhere in the world. Canada is a major player in developing a global accreditation regime. Bilateral and multilateral agreements such as Mutual Recognition Agreements between accreditors can help in reducing redundant testing and certification procedures. This helps in lowering costs, reducing delays and expanding trade opportunities. SCC participates in the work of the international accreditation Forum (IAF), the international Laboratory Accreditation Cooperation (ILAC), the European cooperation for Accreditation (EA), the pacific Accreditation Cooperation (PAC), the Asia Pacific Laboratory Accreditation Cooperation (APLAC), the North American Calibration Cooperation (NACC and the interamerican Accreditation) Cooperation (IAAC) [SC1, SC2].

The Standards Council of Canada does not develop standards, but it accredits the organizations that do develop standards. The accredited standards development organizations in Canada are:

- Canadian General Standards Board (CGSB).
- Canadian Standards Association (CSA), also known as CSA International.
- Underwriters Laboratories of Canada (ULC).
- Bureau de Normalisation de Québec (BNQ).
  BNQ is managing the activities on standardization of hydrogen in Canada.

Detailed information on these organizations can be obtained from their respective websites. The Internet addresses of these websites are mentioned in the references to this chapter.

In the process of producing a standard, the final step is that SSC approves the National Standards of Canada [SC3].

3.2 Alternative fuels in Canada

The automotive fuel market in Canada is dominated by gasoline and diesel fuel. The number of alternatively fuelled vehicles in Canada is low and their share in the total vehicle fleet is small. Natural gas dominates the alternative fuel vehicle fleet in Canada. Since the early 1980s, tax exemptions have been provided for alternative fuels in Canada.

Ethanol is blended in about 5 percent to 10 percent of Canadian gasoline. Gasoline with 5-10 percent ethanol content is marketed in Ontario, Québec, the Western provinces and Yukon, through approximately 1 000 outlets [gre]. This ethanol is predominantly produced from biomass. Mid 2002, Saskatchewan became the first province in Canada that has established a legal framework to allow for mandating blending ethanol in gasoline [Sas]. The Canadian government invests in research to improve fuel ethanol from biomass [agr, ren]. Compared to the USA, fuel ethanol use in Canada is less.

Organizations like the Canadian Renewable Fuels Organization (CRFA), the Ontario Corn Producers' Association and the Saskatchewan Canola Development Commission are promoting the use of alternative and/or renewable fuels.

3.3 Standardization of alternative vehicle fuels in Canada

Standardization of (alternative) fuels is important for Canada because of international trade, health, safety and environmental issues. For road vehicles it is important that they are compatible with the standards in neighbouring USA, to enable to cross the border.

Petroleum fuels predominantly propel the current fleet and activities on the standardization of alternative vehicle fuels in Canada are low. Hydrogen is an exception. Canada is actively participating in the ISO technical committee on hydrogen technologies. The different alternative vehicle fuels are addressed in more detail below.

Bio fuels

Fuels from biomass receive some attention in Canada. Ideas on the standardization of these fuels are developing slowly. In case such standards would be developed in the future, a first activity would be to make an inventory of the standards that already exist in Europe. So far, these are only ideas. There are no concrete activities yet [Cha].

Hydrogen

The work on hydrogen standardization in Canada is allocated to the Bureau de Normalisation de Québec (BNQ), which is part of the Centre de Recherche Industrielle du Québec (CRIQ). Although its name might suggest otherwise, BNQ produces standards that are valid on a national level, not only in Québec. The role of BNQ in the production of hydrogen standards is supplying the secretary to ISO/TC 197 on hydrogen technologies. Ms S. Gingras is performing this task. There are no other activities on a national level on the standardization of hydrogen. However, different Canadian industries and organizations, including the Canadian government, take part in the ISO work [Gin, N23]. When ISO has produced a standard, Canada will adopt it as a Canadian standard. The scope of work of ISO/TC 197 is not limited to vehicle related issues; it covers all hydrogen technologies. In the year 2002, ISO/TC 197 has signed a cooperation agreement with ISO/TC 22, which is working on road vehicles. They operate joint working groups on issues that are related to hydrogen and road vehicles, like on board storage tanks. A proposal for a standard will undergo parallel voting in both Technical Committees.

In 1999, the standard ISO-14687 ”Hydrogen fuel - Product specification” was published and it was updated in 2001. This standard is currently in the procedure to become adopted as a Canadian standard. The fuel quality specified in this standard generally is suitable for the application as a vehicle fuel. For hydrogen use in fuel cells, this standard may need revision because fuel cells need a high purity fuel. However, Ms Gingras expects that such modifications would only be minor. So far, the fuel cell industry has not asked for such a revision [Gin].

ISO/TC 197 is currently working on two other issues that are related to hydrogen use in vehicles. These standards are not finished yet. They currently have the status of a draft standard (DIS). The subjects are:

- Liquid hydrogen - Land vehicle fuel tanks (ISO/DIS 13985).
- Gaseous hydrogen and hydrogen blends - Land vehicle fuel tanks (ISO/DIS 15869).

ISO/TC 197 also started working on refuelling connectors for land vehicles.

Methanol

There is a Canadian standard on M85 (methanol that contains 15 percent unleaded gasoline), CAN/CGSB-3.514-98 ”Fuel methanol (M85) for automotive engines”. This standard was published in April 1998 and it has been reaffirmed in 1999 [SC4].

Currently, no activities on the standardization of methanol are ongoing. Canada is planning to adopt ISO standards on methanol, when these come out [Gin].

Natural gas

Natural gas is the most important alternative vehicle fuel in Canada, although its share in the total fleet is small (about 20 000 vehicles are running on natural gas [Wh3]. Canada has established natural gas installation codes, which are enforced by provincial authorities. Canadian standards for natural gas vehicle equipment are harmonised with those of the USA, because vehicles regularly cross the border. In the standardization process a document is accredited through both Standards Council of Canada and American National Standards Institute procedures, so that the document is recognised in both countries [Wh1, Wh4]

Natural gas composition is important because it affects engine behaviour. Every different gas composition requires its own settings of the engine management, for maximum energy efficiency and minimum harmful exhaust gases. According to Mr N. White, who chairs the CSA International NGV Strategic Steering Committee and who has been involved in standardization of natural gas composition for use as a vehicle fuel, natural gas composition is very consistent over Canada [Wh1]. However C. Webster has reported that the natural gas is not available in the Eastern provinces of Canada [Web]. While Canadian natural gas composition is consistent, it may differ from that provided in some regions of the USA.

In the late 1980s and the early 1990s when the first lean burn natural gas engines were introduced in Canada, there was considerable natural gas research, including the standardization of natural gas composition [Wh2]. About six years ago, activities on

standardization of natural gas composition faded away [Cha, Wh1]. These activities have not resulted in a published standard. A draft standard was produced, but this document has no formal status. The draft includes requirements on composition (for example the content of methane, other hydrocarbons, nitrogen and water), odourisation and sample points [DNG]. The most important reason to stop working on a natural gas specification standard is that natural gas composition is constant in Canada [Wh1]. Piped natural gas is presently not available in many areas in the Eastern provinces, although there are plans to expand the network using offshore natural gas from the Atlantic [Wh4]. In case Atlantic natural gas composition is significantly different from Canadian gas, standards on natural gas composition for vehicle use may gain importance. Vehicle manufacturers and fuel suppliers are currently discussing sulphur limits and oil ranges in natural gas, but there is no relation to a possible standard yet [Wh2, Wh3].

Canada is a voting member in ISO TC 22-SC25 ”Road vehicles using natural gas” and provides technical expertise to the working groups of this sub-committee. In recent years, there has been no cooperation with CEN [Wh3].

Table <Can.1> Overview of activities on standards for alternative vehicle fuels in Canada.

Bio fuels	Some preliminary discussions are ongoing. No activities on standardization yet.
DME	No activities on dimethyl ether have been found.
Hydrogen	Canada is actively involved in ISO/TC 197 ”hydrogen technologies”. The ISO-14687 ”Hydrogen fuel - Product specification” standard is currently in a procedure to become a Canadian standard.
LPG	There is a Canadian standard on LPG composition, but this is meant for generating heat and not for use as a vehicle fuel.
Methanol	There is a standard on M85 (methanol containing 15 percent gasoline).
Natural gas	Work on a standard for natural gas properties has been stopped, before any formal document was published.

3.4 Need for international informal discussions and the role of IEA/AMF

Ms Gingras (secretary of ISO/TC 197 on hydrogen technologies) informs that ISO is always looking for international organizations to exchange information with. IEA/AMF could for example have a liaison agreement with ISO/TC 197 to exchange information. Under a liaison agreement, one receives all the TC documents, one can participate in establishing standards and one can comment on draft standards. In such a form of cooperation, setting priorities in standards can be discussed between IEA/AMF and ISO [Gin].

Mr White (chairman of the CSA International NGV Strategic Steering Committee) is interested in participating in discussions to investigate the role that IEA/AMF can play in the arena with organizations like ISO and CEN [Wh3].

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- Canadian Standards Association (CSA), also known as CSA International Internet:
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- Underwriters Laboratories of Canada (ULC)
  Internet: http://www.ulc.ca
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  Internet: http://www.criq.qc.ca/bnq

4 FINLAND

4.1 Introduction and background

The Finnish Standards Association SFS is an independent, non-profit body, responsible for standards in Finland. SFS cooperates for example with industry, research institutes, consumer organizations and governmental and local authorities. On many subjects, including automotive fuels, European standards produced by organizations like CEN are implemented as national Finnish standards. SFS is the organization that publishes the Finnish standards [SFS].

The Finnish Oil and Gas Association is the branch organization for the oil and gas companies that operate in Finland. The Finnish Oil and Gas Association co-operates with SFS on the contents of automotive fuel standards. This work includes conventional and alternative automotive fuels. Within the Finnish Oil and Gas Association, the Technical Department is doing the work on standards. Mr H. Koskinen is the head of the Technical Department. He is involved in CEN work on standard EN 589, which addresses LPG. Mr Koskinen has been interviewed for this chapter [Kos].

Fortum is one of the larger Nordic energy companies. It's field of work covers the production of oil, natural gas (as a shareholder in Gasum), power and heat, it includes refining, distribution and marketing and they do energy related engineering, operation and maintenance [For, Mik]. Automotive fuels are part of the activities of Fortum. Mr Mikkonen is working on fuel specifications at Fortum, currently mainly concentrating on gasoline and diesel. He has been involved in the CEN committee that has developed a standard for bio-diesel. Fortum contributes to the content of European standards in cooperation with the Finnish Oil and Gas Association, of which Fortum is a member. Mr Mikkonen has been interviewed for this chapter [Mik].

Although Fortum and the Finnish Oil and Gas Association have their background in fossil oil and natural gas, they are also the organizations that are working on standards for alternative motor fuels. Long term environmental and political targets for promoting bio fuels and other alternative fuels are recognised.

4.2 Alternative fuels in Finland

In this Section, first some general remarks on the alternative vehicle fuel situation in Finland are made. Next is a discussion per fuel.

Alternative vehicle fuels are not considered very important in Finland. The main reason is that Finland is a large and thinly populated country. This has two consequences:

- In most areas pollution levels are low and are not considered to be a problem, and
- Building an infrastructure for a new fuel is not economically viable.

However, looking for options to reduce oil dependency makes organizations in Finland monitor worldwide developments on alternative vehicle fuels. If alternative fuels are introduced in Finland, it is expected that they will be blended with conventional fuels, so the existing refining and distribution infrastructure can be used. Natural gas buses in Helsinki are an exception; they are a viable option because they run in a densely populated region and need a limited number of refuelling stations.

Temperatures in Northern Finland can be extremely low, down to - 40 ºC, during winter. In southern Finland and the Helsinki area, temperatures can still go down below - 30 ºC. Such low temperatures put special demands on automotive fuels. Because Northern Finland is very thinly populated, alternative fuels are not expected to play a role there, so their very low temperature characteristics are not relevant. This may be different for the south

Currently, there are no legislative standards for alternative motor fuels in Finland. The only regulation for non-standard conventional fuels is a tax incentive for reformulated gasoline and diesel fuels

Alternative fuels that are monitored or considered in Finland are (in alphabetic order) bio-diesel, ethanol, hydrogen, LPG and natural gas. These fuels are addressed subsequently below. Additional, the blending component ETBE is being monitored.

4.2.1 Bio-diesel

Bio-diesel is a popular name for Fatty Acid Methyl Esters (FAME) of vegetable oils. Fortum (Mr Mikkonen) has been involved in the CEN committee that has developed a European standard for FAME (EN 590). This committee has completed its work about two years ago. Now the EN 590 standard is in a procedure to become a EU directive [Mik]. FAME is only expected to play a role as a blending component in conventional diesel fuel, although 100 percent FAME could be used for fleets during summertime. Tax incentives are considered essential to get FAME to the market.

4.2.2 Ethanol

Ethanol receives attention because it can be produced from biomass and thus has the potential of reducing well-to-wheel CO_2 emissions. A well-to-wheel study has been performed on ethanol for vehicle use, produced from grain that is grown under Finnish conditions. It was found that the energy consumed in the whole process is significant compared to the energy content of the ethanol that is produced. It was concluded that bio fuels are more suitable for power and heating purposes, because they need less refining and consequently have lower energy consumption of the total fuel chain [Mik]. Under ”other fuels” below, some more information on bio fuels can be found.

If ethanol will be used in Finland, using it as a blending component in gasoline is the most obvious application [Koc, Kos, Mik]. In fact, this has already started at a small scale, promoted by a temporary tax incentive. Gasoline containing 5 percent bio-ethanol is used in parts of Southern Finland. The total amount of bio-ethanol used in the year 2002 is approximately 1 000 tons, while the total amount of gasoline used in Finland that year mounted to about 2 million tons [Nob2]. The current European gasoline standard (EN 228)

allows an ethanol content of maximum 5 percent. Finland has adopted this European standard [Mik].

4.2.3 Hydrogen

In Finland, there is only minor interest in hydrogen as a fuel. The main barriers for hydrogen are the high price, the costs of setting up a distribution infrastructure and uncertainties about sustainable and environmental sound production routes [Mik]. Still, worldwide developments on hydrogen are monitored.

4.2.4 LPG

LPG is used for cooking in summerhouses and for industrial applications in Finland. LPG is only used as an automotive fuel on a very small scale in Finland. The city of Helsinki has acquired four LPG trucks and under the European ZEUS project five diesel buses have been converted to run on LPG. Currently, about 10 LPG buses are on the road in Helsinki [Kos, Mik, Nob].

4.2.5 Natural gas

All natural gas that is used in Finland is imported from the Western Siberia region in Russia [Ass]. The natural gas grid in Finland is limited to densely populated areas and industrial zones. Using compressed natural gas (CNG), or liquefied natural gas (LNG) as an automotive fuel would require a new distribution infrastructure. To build such an infrastructure is not economically feasible in the thinly populated regions of Finland. About 70 natural gas buses are running in Helsinki [Nob]. Because these buses operate in a limited region, only a limited number of refuelling stations in necessary [Kos, Mik].

Using blending components that are produced from natural gas may be a feasible way of using natural gas for vehicle propulsion, because no new distribution infrastructure needs to be build and existing refineries can use the natural gas based feedstock. MTBE is an example of a natural gas product that can be blended in gasoline as an octane improver. Gas-to-liquid (GTL) fuels are another option. Liquid fuels can be produced from natural gas using processes like Fischer-Tropsch synthesis or SMDS (Shell Middle Distillate Synthesis). These fuels are free from impurities like sulphur or heavy metals. GTL diesel can be blended in conventional diesel, for example [Mik].

4.2.6 Other fuels

Besides bio-diesel and ethanol, other fuels can also be produced from biomass. Gasification of biomass gives synthesis gas, of which for example methanol or dimethyl ether (DME) can be produced. Another option is to produce pyrolysis oil form biomass. In Finland, biomass for fuels predominantly stems from forests. Producing fuels from this feedstock that meet the specifications required for automotive use is energy intensive. Therefore, it is considered more efficient to produce fuels with a somewhat lower quality (having a higher water content for example) that are suitable for heat and power generation. These fuels can be used in large,

stationary internal combustion engines. Fortum has built a pilot plant that produces pyrolysis oil for heat and power generation, using wood chips as feedstock. This plant is now operating under almost commercially viable conditions [Mik].

Finland is following the EU programme to use bio fuels in Europe, and will comply with its provisions if it becomes a directive. The introduction of bio fuels in Finland is expected to be as blending in gasoline and diesel (Koc). For example existing MTBE production facilities could be converted to produce ETBE. For all bio fuels holds that tax incentives are necessary to get them to the market (Mik2).

4.3 Standardization of alternative vehicle fuels in Finland

Finland follows European legislation on alternative vehicle fuel standards. This legislation is based on European (CEN) standards. Therefore, Finnish parties participate in CEN activities. Finnish participation in developing ISO standards on alternative vehicle fuels is limited to hydrogen.

The Finnish Oil and Gas Federation contributes to the development of technical standards via the Finnish Standards Association (SFS). Regarding automotive fuels, the Federation is responsible for standardization work on petroleum products including LPG and also for alternative energy carriers. Therefore, the Federation is in continuous dialogue with the relevant national and international bodies. Finland does not produce separate fuel standard on it's own. It implements the European CEN standards on automotive fuels. So far, only standards on gasoline and diesel fuel have been implemented. The status of standards for alternative fuels is presented in table <Fi.1>. Finland is not a leading country in international fuel standardization. They contribute to fuel standards for safeguarding the Finnish industry's interest and to avoid that fuel standards are unsuitable for cold climate regions [Ass, Kos].

Table <Fi.1> Standards for alternative vehicle fuels in Finland [Kos, Mik, Mik2].

Bio-diesel	Finland (Fortum) was involved in the development and now has adopted EN 590 (a CEN standard on FAME). Now Finland is waiting until it becomes European legislation.
DME	No activities on dimethyl ether have been reported.
Ethanol	In European standards, ethanol may be blended up to 5 percent in gasoline. Fortum is involved in CEN TC 19 on gasoline and diesel fuel. In south and southeast Finland there is field trial using 5 percent ethanol in 98 octane gasoline
Hydrogen	Finland is involved in developing an ISO standard. There is a scientific forum that discusses the issues that are associated with the use of hydrogen.
LPG	The Finnish Oil and Gas Federation (Koskinen) participate in CEN activities on producing a standard, EN589.
Natural gas	Currently, there is no standard. Work on a European standard is ongoing. Finland monitors these activities.

In Section 4.2 was described that except for natural gas buses in Helsinki, there is not much Finnish interest in alternative vehicle fuels. This limited interest results from cost-benefit considerations and it is not related to the standardization of alternative fuels. The international work on standardization is followed and if considered important, Finland contributes to such work.

4.4 Need for international informal discussions and the role of IEA/AMF

The need for international and informal discussions and the role that IEA/AMF could play in standardization of alternative vehicle fuels were discussed with the people that have been interviewed for this report.

Mr H. Koskinen (Finnish Oil and Gas Federation) shared the following thoughts:

- In ISO and CEN standardization work, lack of budget for research is a common problem. Therefore, the costs are shared between different parties. IEA/AMF could be one of the parties that contribute through research.
- In standardization work, people produce technical standards. The next step is that these standards are promoted to become a basis for (European) legislation. IEA/AMF could assist in the promotion process, helping to remove obstacles.

Mr S. Mikkonen (Fortum) brought up the following issues:

- In principle, standards are more or less a technical description, but they can have non-technical side effects. The European standard for FAME can serve as an example of what can happen. This standard seems to be written too much towards RME. The standard excludes that ethanol (from biomass) can be used for esterification of bio oil; it must be methanol (from natural gas). The standard excludes esters from sunflower oil, fish oil, etc. So only current RME meets the standard.
- There is much discussion on standardization of fuel blends. The discussions address the question if each component or just the end product should be standardised. From his fuel producers point of view, Mr Mikkonen is in favour of the last option, because it leaves the manufacturer room on how to produce the fuel, as long as the final product meets the requirements set by engine manufacturers, safety, customer needs, etcetera. He also observes an inconsistency on this issue. Currently, MTBE and ETBE are not standardised but may be blended with gasoline. On the other hand, the discussion if ethanol from biomass for blending with gasoline should be standardised separately is still ongoing.
- Mr Mikkonen does not see a role for AMF in CEN, because that work is ongoing and produces standards that address the relevant topics. However, he recognises that standards more or less describe history and that the current situation, not the future. Standards now only describe a minimum quality level and do not address advanced fuels. Mr Mikkonen is in favour of research to define future fuel quality and he in his opinion defining different quality levels would be useful. In Finland, high quality fuels are produced and used but customers are not always aware of that. A standardised quality label could show it and would help customers in choosing a fuel.

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5 FRANCE

5.1 Introduction and background

AFNOR (Association Française de Normalisation) and the Standards Bureaux (BN) are the organizations that are responsible for establishing and publishing French standards [Afn]. AFNOR has delegated the work on fuel standards to the Bureau de Normalisation du Pétrole (BNPé). It involves all fuel related standards, so BNPé is working on standards for products (fuels) and also on standards for installations and equipment. Examples of subjects that BNPé is currently working on are asphalt, LPG, oil and refining [Cha].

BNPé is actually managing the work on producing standards; they do not have specialists in their staff. Specialists from oil companies, the automotive industry and other relevant parties are invited to attend CEN and ISO meetings. BNPé conducts the national position of France in international standardization work [Cha].

In the international arena, BNPé is involved in CEN/TC 19 and ISO/TC 28 (TC is Technical Committee). The scope of CEN/TC 19 is broader than just petroleum products; it also includes alternative vehicle fuels. ISO/TC 28 works on petroleum products and lubricants. France chairs ISO/TC 28 SC 4 on classification and specification of fuels (SC is Sub Committee). The most important reasons to participate in international work on standards are for national interest and for the French industry. Another BNPé aim is to avoid duplication in work on standards. Currently, BNPé participates in establishing a memorandum to gear all work to one another within CEN, ISO and the USA [Cha]. Mr Luc Chatin, director of the Bureau de Normalisation du Pétrole (BNPé), has been interviewed for this project.

At Gaz de France, a group of about 20 people is working on natural gas standards. They work on topics like filling stations and high-pressure components. At the moment, there is no activity on the standardization of natural gas composition and/or properties. Gaz de France is involved in CEN and ISO standardization work. Mr Philippe Ankri who is working for Gaz de France has been interviewed for this report [Ank].

Gaz de France is a member of CEN/TC 326, the technical committee that is working on ”Gas supply for natural gas vehicles (NGV)”. This committee is working on two standards: prEN 13638 NGV filling stations (approved) and prEN 13945 Vehicle refueling appliances (under discussion) [An2, CEN]. In ISO, Gaz de France is a member of ISO/TC 22/SC 25, working on ”Road vehicles using natural gas”. This sub committee (SC) has three working groups (WG) [AN2, ISO]:

WG1 Compressed natural gas refuelling connector,

WG2 Design principles and installation of vehicle fuel systems (the secretariat of this working group is at AFNOR),

WG3 NGV fuel system components.

Being a CEN member, France replaces its own national standards by CEN standards without modification, as soon as a CEN standard is published [Afn]. Currently, France is using the European standards (specifications) for gasoline, diesel fuel and LPG.

5.2 Alternative fuels in France

In this section, first some general remarks on the alternative vehicle fuel situation in France are made. Next is a discussion per fuel.

Reducing CO_2 emissions and improving local air quality are the most important reasons for promoting the use of alternative vehicle fuels in France [Wal].

According to Mr Chatin, people are only interested in using alternative fuels if it is at least not more expensive than using conventional fuels. Car manufacturers only produce vehicles they can sell, so cars are predominantly powered by gasoline and diesel engines. In France, LPG is the only alternative vehicle fuel that has gained a significant market share. This market share could only develop because there is a tax advantage for using LPG [Cha]. Bio fuels are used as a blending component in French gasoline and diesel fuels. More details are given below.

5.2.1 Bio fuels

The initial support for bio fuels in France had the objective to reduce the amount of set aside agricultural land. Later, also the environmental benefits (predominantly reducing well-to-wheel greenhouse gas emissions) became an argument for the authorities to support the use of bio fuels. In 1997, ETBE and FAME produced from biomass accounted for 0.9 percent of the total fuel consumption. Bio fuels are exempt from petroleum tax in France [Ade, CFR, Wal] For bio-diesel (RME) this holds only for vegetable esters originating from European countries [Ch2]

Bio-diesel is a popular name for methyl esters produced from vegetable oils. In Europe, rapeseed oil is the most commonly used feedstock for bio-diesel. However, for example sunflower-, coconut- and fish-oil can also be used as base materials to produce bio-diesel. In France, an unmarked use of 1.2 percent ester (RME, rapeseed methyl ester) blended in diesel fuels is allowed [Ade]. Also in France, rapeseed is the main feedstock for bio-diesel. Research on bio-diesel specifications currently concentrates on iodine content [Gru].

Another group of bio fuels consists of ethanol and ethanol derived products, as long as biomass is the feedstock for their production. They are addressed below in the ”ethanol” subsection.

5.2.2 DME

There is some activity on DME as an automotive fuel in France. IFP, PSA and Renault have participated in Appendix XIV ”DME as fuel I” of the IEA Implementing Agreement on Advanced Motor Fuels. Renault and Air Liquid are members of the International DME Association [DME]. The current vision is that DME will first be introduced on some markets for stationary applications like heating and cooking. In a later phase, when a distribution infrastructure has been established, the DME market can be extended to the use as an automotive fuel. Before the year 2010, DME is not expected to play a significant role in vehicle propulsion.

5.2.3 Emulsions

The former French oil company Elf Aquitane has introduced a stable diesel-water emulsion (Aquazole) in 1995. On a weight basis, the fuel contains about one unit of water per six units of diesel oil. The emulsion is developed for use in heavy duty diesel engines; it is not intended for use in passenger cars. Today, TotalFinaElf markets Aquazole. The water in the fuel improves the dispersion of the diesel and therewith improves the efficiency of the combustion. Using Aquazole in diesel engines leads to a significant reduction of harmful emissions. NO_x emission reductions between 15 percent and 30 percent are claimed and the emissions of particulate matter are lowered by 30 percent - 80 percent, compared to low sulphur diesel fuel. Additionally, using an exhaust catalyst will lead to further emission reductions. Late 2001, over 1 000 heavy duty vehicles in France were running on Aquazole. Currently, 314 Paris city buses are using Aquazole [Aqu, Len, RAT].

5.2.4 Ethanol

Pure ethanol is not used as a fuel or as a blending component in France. However, the French oil industry does buy ethanol (produced from biomass) to produce ETBE (Ethyl Tertiary Butyl Ether). ETBE is a blending component that improves the anti-knock characteristics of gasoline. Gasoline containing ETBE is not separately marked in France [Ade, Cha].

5.2.5 Hydrogen

Many parties in France are working on hydrogen technology and its introduction. Just some examples of organizations that are involved are AFH2 (the French association on hydrogen), ALPHEA, Réseau APCo (a network on fuel cells and hydrogen), IFP, PSA, Renault, TotalFinaElf and Air Liquide. ADEME is involved through its programme on stimulating renewable energies and new energy technologies. Compared to all other energy carriers, activities on hydrogen are relatively small. Part of this hydrogen activities focus on (fuel cell) vehicles [Ad2, All, APC].

5.2.6 LPG

Around the year 1980, the French government successfully promoted the use of LPG as a vehicle fuel. This has resulted in an LPG consumption of 70 000 tons in 1983. However, a change in legislation that allowed the use of dual fuel cars reduced the use of LPG and by 1995 it had dropped to 26 000 tons. In 1996, the tax on LPG was reduced, so on a per litre basis it became the cheapest vehicle fuel [Len]. This contributed to a rise in LPG consumption. In 1999 it was already 293 000 tons and industry aims for 500 000 tons in 2003 [Gro, Wor]. France is currently one of Europe's fastest growing LPG markets [Alt]. LPG is the largest alternative vehicle fuel in France [An2]. Today, French car manufacturers like Renault produce vehicles that are originally equipped with an LPG fuel system.

5.2.7 Natural gas

Natural gas was first used as a vehicle fuel in France in 1943. However, interest in natural gas vehicles declined during the sixties. New public policies motivated by reducing air pollution from the transport sector again increased interest in natural gas vehicles in the nineties [Cou]. Using home vehicle refuelling compressors should break the chicken and egg dilemma for the introduction of natural gas vehicles in France [An2]. Natural gas in France (Lacq) has relatively high nitrogen content. It is between 15 and 16 volume percent [Cou, Dub]. The Dutch (Groningen) natural gas field is the only other location in Europe where nitrogen content is similar. For all other European locations, nitrogen content is (mostly far) below 10 volume percent.

In France, natural gas is only used as a fuel in some vehicles fleets. Because there is no refuelling infrastructure, natural gas is not used on a large scale [Cha]. In October 2000, there were 2 440 natural gas vehicles and 105 natural gas refuelling stations in France [IAN]. In March 2003, the natural gas fleet had increased to approximately 1 000 buses and 5 000 light duty vehicles [An2].

5.3 Standardization of alternative vehicle fuels in France

Bio-diesel

France has adapted the CEN standard on FAME.

Emulsions

Different French national standards on diesel-water emulsions have been produced. Properties like density, viscosity and sulphur content are addressed in these standards. A list of French national standards on diesel/water emulsions is included in the ”References” section of this chapter. The national standards may be taken to a European level, according to Mr Chatin [Afn, Cha].

DME

Within the International DME Association, there is a standard specification for automotive DME. However, it does not have the formal status of a standard in France, CEN and ISO.

Ethanol

There is no separate standard for ethanol as a vehicle fuel in France. However, the ethanol ester ETBE is allowed as a gasoline constituent.

Hydrogen

One French supplier of hydrogen and seven French hydrogen users are participating in ISO/TC 197 on hydrogen technologies. France is a member of the editing committee of ISO/TC 197 [N23].

LPG

France has adapted the CEN standard on LPG.

Natural gas

Natural gas composition is not constant over Europe. For natural gas engines, it is important that the Wobbe index of the gas is constant. Therefore, a European standard for natural gas specifications could help deployment of natural gas vehicles (NGVs). There is no such European standard yet neither does France have a national standard. However, French law gives maximum levels for components like CO_2 and H_2S for natural gas in general. The natural gas industry is not very interested in changing gas composition, and engine manufacturers are hesitant to develop engines that are fuel flexible regarding natural gas properties. Additionally, as long as there is no demand for natural gas vehicles, the automotive industry will not bring such vehicles on the market [Ank, An2 Cha].

Overview

Table <Fr.1> presents an overview of the activities on the standardization of alternative vehicle fuels in France.

Table <Fr.1> Standards for alternative vehicle fuels in France.

Bio-diesel	The CEN standard on FAME is being adopted.
DME	No activities on standardization.
Emulsions	National standards on miscellaneous properties of diesel-water emulsions exist.
Ethanol	No activities on standardization.
Hydrogen	France is a member of ISO/TC 197.
LPG	The European CEN standard on LPG is adopted.
Natural gas	No activities on standardization of fuel properties.

5.4 Need for international informal discussions and the role of IEA/AMF

Mr Chatin (BNPé) is not following the IEA activities on automotive fuels. He is not interested in participating in informal discussions with IEA/AMF. However, he would appreciate to be kept informed about IEA/AMF activities (on the standardization of fuels).

Through the IEA Implementing Agreement on Advanced Motor Fuels (AMF), ADEME and IFP participate in the international discussions on standards for alternative vehicle fuels. The AMF Executive Committee meeting that was held at the IFP premises on 10 - 12 March 2003 started with a mini seminar on alternative vehicle fuel standards. Besides a general overview, also CEN and the Swedish activities in this field were presented.

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- NF M07-098 Octobre 2000
  Émulsions eau dans gazole - Action corrosive sur le cuivre - Essai à la lame de cuivre
- NF M07-099 Octobre 2000
  Émulsions eau dans gazole - Détermination de la température limite de filtrabilité
- NF M07-100 Octobre 2000
  Émulsions eau dans gazole - Dosage du soufre - Méthode par combustion et détection par fluorescence ultraviolette
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6 JAPAN

6.1 Introduction and background

Governmental committees belonging to The Ministry Economy Trade and Industry (METI) carry out the main work with standardization, including standardization of conventional and alternatives fuels, in Japan.

In Japan, industrial standardization is promoted on national level, on industrial level and at a company level. Japanese standards (JIS) are national standards of which adoption can be decided voluntarily. JIS covers industrial mineral products comparable to standards established by various industrial associations for their specific needs, or standards established by many companies, the so-called company standards (operational manuals and products specifications) (jisic).

The 1997 amendment of the Industrial Standardization Law introduced two accreditation systems.

The Japan Accreditation System for Product Certification Bodies of JIS is an accreditation system of the certification bodies, in the private sector under system of and operated based on ISO/IEC Guide 65 and 61 (JASAC). An accredited certification body (JIS Mark Certification Body) is able to issue JIS Mark certificate (JNLA).

The Japan National Laboratory Accreditation system (JNLA) is a laboratory accreditation system based on ISO/IEC Guide 58 and ISO/IEC 17025. An accredited testing laboratory is able to issue test reports with a logo of JNLA within the scope of accredited testing fields.

The Japanese Industrial Standards Committee (JISC) consists of many national committees such as a Committee on ISO, a Committee on IEC, a Technical committee on environment and recycling, a committee on JIS marketing and several other specific technical committees. JISC plays a central role in standardization activities in Japan. In essence, the task of JISC can be summarized as follows:

- Establishment and maintenance of JIS
- Administration of accreditation and certification
- Participation and contribution in international Standardization activities
- Development of measurement standards and technical infrastructure standardization.

JISC represents Japan in ISO including ISO/TC 28 “Petroleum products and lubricants”.

The Japanese Standards Association (JSA) is an organization formed through the merger of the Dai Nihon Aerial Technology Association and the Japan Management Association. It was authorized to incorporate by the Minister of Trade and Industry in1945. The objective of the association is to educate the public regarding the standardization and unification of industrial standards, and thereby to contribute to the improvement of technology and the enhancement of production efficiency.

Nippon Oil Corporation is Japans largest Oil Corporation. The main products are different kind of oil products. Nippon Oil is the leading Oil Company in the Japanese market regarding total volume as well as sales of oil products. Even if Nippon Oils main interest is in oil products, it also has an interest in alternative fuels and the introduction of alternative fuels on the consumer market.

Nippon Oil is represented in several governmental committees engaged in standardization and policymaking about fuels. Representatives of Nippon Oil also chair some of these committees. In its work concerning standardization, Nippon Oil cooperates with other corporations and industries. Still the main work is done in the governmental committees.

Mr Masaki Ikematsu is General Manager at The Fuel Cell Development group, The Fuel Cell Research and Development Department, Nippon Oil.

Mr Iwao Takata, who was interviewed, is project coordinator at The Fuel Cell Development group, The Fuel Cell Research and Development Department, Nippon Oil.

The Japan DME Forum (JDF) is a Japanese Association with 113 members. JDF organize seminars for their members. The seminars address dimethyl ether (DME) related research and development in the area of production technology, transportation (ocean and inland), storage, applications, conversion of existing LPG facilities, study of suitable elastomers/seals to DME, safety regulations and standardization of DME. The work in JDF is aiming at a fast dissemination of DME fuel in the Japanese market.

Mr Tasuku Matsuda, president of TM Consultants LTD, who was interviewed, is an international representative of JDF. TM Consultants LTD is a consulting company in Tokyo,

Japan, covering new clean energy technology such as DME, GTL methanol etc. Mr Matsuda is also senior advisor of The International DME Association (IDA).

LEVO is a Japanese organization for the promotion of low emissions vehicles. Mr Yutaka Takada, who was interviewed, is general manager at LEVO's Research and Survey Division

6.2 Alternative fuels

Alternative fuels are considered important in Japan as long as they, in a cost efficient way, contribute to the reduction of emissions of greenhouse gases [IT]. This includes not only the combustion in the engine but also the production and distribution of the fuels. Even if alternative fuels can contribute to reduce emissions with impact on environment and health, the interviewed people mentioned above state that without any doubt the reduction of greenhouse gases, with the purpose to fulfil international targets in this area, is the main reason for the introduction of alternative fuels.

In the short term it is important in Japan that alternative fuels can be used in existing vehicles, without any adjustment of the engine [IT]. This is one of the reasons that the main interest concerning liquid alternative fuels is focused on low blending with conventional fuels. Low blending (for example lower than 5 percent of ethanol in gasoline) often enables production and use of the alternative fuel on a large scale, without having to produce and use vehicles that are specially adapted to use these fuels. Adapted vehicles would head very large numbers if the fuel consumption would correspond to the produced volume of the fuel [IT].

Even if the production of liquid alternative fuels will increase substantially still the total production volume for at least ten years probably will be just a small percentage of the total used volume of vehicle fuel. Thus for a rather long period, there will always be a possibility to blend the production of alternative fuels with conventional fuels. Parallel to the increased production and use of the alternative fuel, the development and an increased production of adapted vehicles using the alternative fuel in neat form can continue. Since blending enables increased production and use, even in the short term it will also quickly contribute to the reduction of greenhouse gases [IT, YT].

The main options for liquid alternative fuels in Japan today are primarily compressed natural gas (CNG), methanol and to a lesser part Liquid natural gas (LNG). For gaseous alternative fuels dimethyl ether (DME) tends to be the most important option.

Recently the ministry of Economy, trade and Industry (METI), the Ministry of Education, Culture, Sports, Science and Technology (MEXT), the ministry of Agriculture, Forestry and Fisheries (MAFF) and the Ministry of Land, Infrastructure and Transport (MILT) jointly have developed a strategy for the utilization of biomass. In this strategy the government aims to promote the production and use of biomass. The cabinet formally approved the strategy in December 2002. As for biomass for automotive fuel use the strategy includes the following items:

- Evaluation on advantage/disadvantage of the introduction of bio-diesel, from fiscal year 2003.
- Evaluation on quality, safety and environmental benefit of bio-diesel vehicles, from fiscal year 2002.

- Evaluation on advantage/disadvantage of the introduction of biomass derived fuels in order to discuss schedule for the development of standardization and supply of infrastructure, from fiscal year 2003.
- Demonstration of a certain system to evaluate on safety, quality etc of biomass derived fuels, from fiscal year 2003

6.2.1 Methanol

The alcohol methanol can easily be blended into gasoline and it can also be used as a neat fuel in adapted otto engines (spark ignition engines). Methanol can be produced from fossil raw material such as natural gas and gasified coal, but it can also be produced from gasified biomass. The production technique of methanol from synthesis gas is well known in Japan and commonly used in chemical industries today. The same goes for gasification of coal. Gasification of biomass still needs to be improved before commercial production is feasible.

The possibility to produce methanol from actually available fossil resources makes it possible to start production of methanol more or less immediately. When the technique for gasification of biomass is mature enough for the commercial market, it is possible to change from fossil methanol to biomass-based methanol.

6.2.2 Dimethyl ether (DME)

DME is at ambient pressure a gas similar to LPG/Motor gas. Slightly pressurised at 6 to 8 bar, DME is a liquid. DME is an excellent fuel for diesel engines and can to some extent be blended in diesel oil. The main interest in Japan concerning DME is to use it as neat fuel (TM). Use of neat DME as diesel engine fuel requires a new fuel injection system.

The production technique for DME is well known and similar to the production technique for methanol. However, as for methanol, the production of DME from biomass, or rather the gasification process, is not mature yet and form a barrier to its introduction on the fuel market Producing DME from natural gas or gasified coal is since long time in use and may help in the transition to production from biomass in the long run.

6.2.3 Compressed natural gas (CNG)

The use of CNG contributes to both lowered net emissions of carbon dioxide as well as emissions with impact on health and environment.

The interest for CNG as a vehicle fuel has increased substantially in Japan in later years. CNG vehicles are rather widely used in different applications and there is already rather large use in different kind of fleets. Examples of applications are buses and garbage trucks but also business use in mini cars and forklifts.

The use of NGV’s has also been extent from so to speak corporate users as local governments and public transport companies to private transportation companies.

Today there are approximately 12 000 CNG vehicles in use in Japan.

6.2.4 Other fuels

Japan is well informed about other options of alternative fuels but is still somewhat reluctant to use for example ethanol and bio-diesel. Other options that might be of interest are liquefied natural gas (LNG) and maybe LPG, but for the moment the interest is clearly focused on methanol, CNG and DME.

In the long term Japan sees hydrogen as the most promising fuel to replace today's conventional fuel, and as a fuel for fuel cells IT). Great efforts and financial funding are put into research and development of fuel cells in Japan.

The short time production perspective of alternative fuels in Japan seems much to be focused on production from natural gas or gasified coal. Methanol as well as DME can easily be produced from natural gas. Production of vehicle fuels from biomass seems to be an option for the long term.

6.3 Standardization of alternative fuels in Japan

Japan follows ISO's work concerning fuel standard issues for example in ISO/TC 28 "Petroleum products and lubricants" and ICO/TC 197(hydrogen). Japan is positive to international standards and will be prepared to accept and follow international standards on alternative fuels if they come. It is important for Japan to be part of the international society and to adopt international standards as far as possible [IT].

Today there are no existing standards on alternative fuels for commercial use in Japan. Some standards on natural gas for certification issues exists but no standards on natural gas for commercial use in vehicles seem to exist. However, there are discussions going on in Japan, mainly under the lead of METI, concerning how to deal with standards for alternative fuels. It is important that new standards do not intervene with cost efficiency for the alternative fuels and that the standards are designed in such a way that it will be possible for all producers/distributors to accept and follow them when they will go further with production, distribution and use of alternative fuels [IT].

In line with the interest for methanol and DME, the discussions concerning standards for alternative fuels are focused on these fuels. Currently, JDF's standardization study group works as a kind of operating agent in Japan keeping contact with other related organizations as METI The Ministry of Land, Infrastructure and Transport (MLIT), The Ministry of the environment (MOE), JSA, LEVO, The National Safety and Environment Laboratory (NTSEL), JARI, The National Institute of Advanced Industrial Science and Technology (AIST), The LPG center, The Japan National Oil Corp (JNOC), NEDO and The High Pressure Gas Safety Institute (HPGSI). There are plans to establish new DME standards at two different application fields i.e. two different standards for the following applications:

- Fuel for Vehicle use
- Fuels for power generation (GT/boiler/diesel engine/fuel cell), industrial and household use.

According to JDF's preliminary schedule, the study of standardization of DME should be completed in 2004. This should be followed by the acceptance of a JIS standard for DME and subsequently after full communication with IDA it will be forwarded to ISO (TM).

6.4 Need for international informal discussions and the role of IEA/AMF

The need for international and informal discussions and the role that IEA/AMF could play in standardization of alternative vehicle fuels were discussed with the people that have been interviewed for this report.

Mr Iwao Takata from Nippon Oil Corporation was positive to international standards and international cooperation. His and Nippon Oils knowledge about IEA/AMF was mainly general, but he was positive concerning IEA/AMF's possibility to contribute to the international work on standards for alternative fuels.

Concerning some kind of informal discussion forum, Mr Takata could see some advantages and Nippon Oil would probably be prepared to participate, but not as company but on behalf of METI or some of METI's committees

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7 SWEDEN

7.1 Introduction and background

The Swedish Standards Institute (SIS) is an independent, non-profit body, which constitutes of members from the private as well as the public sector. The needs and desires of the members are the goals for SIS' activities. As a member of CEN and ISO, SIS is the Swedish part of the European and global network that produces international standards.

The operational work with standards is accomplished in projects covering almost every sector in the society. Examples are building and construction, healthcare, consumer products, management systems and fuels for heating and for vehicles, both in solid and liquid form.

Mrs Ana Olaru, who is one of the persons that has been interviewed for this chapter, is project manager at SIS in the area of fuels and energy systems.

The Swedish energy authority, STEM, is the central Swedish body for matters relating to the supply and use of energy in Sweden. The Swedish goal for the energy system is to achieve an economic and environmental sustainable energy system largely based on renewable energy sources. To obtain such a system, STEM, as one of several actions, supports production and introduction of different alternative fuels for vehicles on the consumer market. As an important part of that work STEM participates in SIS projects with focus on the production of standards for alternative fuels. Mrs Alice Kempe, who has been interviewed for this chapter, is project manager at STEM's department for industry, transport and non-residential Buildings and also Swedish delegate to IEA/AMF.

The Swedish Environmental Protection Agency (EPA) is the central environmental authority under the Swedish government with the task to coordinate and drive forward environmental work national and on international level. This includes *inter alia* actions to replace today's fossil fuels with new renewable alternative fuels, still have a low impact on health and environment. As a part of that work the Swedish EPA takes part in SIS standardization projects concerning fuels. Mr Anders Björsell, also interviewed for this chapter, is senior administrative officer at The Swedish EPA's department of legal affairs.

Volvo Technology Corporation AB is R&D company within the Volvo Group, a vehicle manufacturing company with production facilities in Sweden and abroad. Being a vehicle producer, Volvo has a strong interest in market fuel quality and in appropriate market fuel standardization. Mr Anders Röj, interviewed for this chapter is manager and co-ordinator fuels and lubricants at the fuels and lubricants department.

7.2 Alternative fuels in Sweden

Alternative fuels, or rather carbon dioxide (CO_2) neutral fuels, are being considered important in Sweden. The main reason is that the transportation sector in Sweden causes almost 50 percent of the total emissions of CO_2 in Sweden even, if just somewhat more than 20 percent of the total energy use is related to the transport sector. One reason for this is that Sweden has introduced central heating to a large extent and often this central heating is based on bio fuels. Another reason is that a large part of the Swedish production of electricity comes from hydropower and nuclear power.

For more than 30 years, Sweden has spent a lot of resources on research, development and demonstration of production and use of alternative fuels. Today there are approximately 350 buses in Sweden running on neat ethanol, 2 000 to 3 000 Flexible Fuel Vehicles (FFV) capable of running on "neat" (E85) ethanol (85 percent ethanol+15 percent gasoline) as well as neat gasoline, 10 000 vehicles, including machines used in farming, road building etc running on neat rapeseed methyl ester (RME), 80 000 vehicles (including machines) running on a mix of RME and diesel oil and 3 000 vehicles running on methane (natural gas or biogas).

Alternative fuels today are rather well accepted in Sweden. In Stockholm and the whole Stockholm region, gasoline today is blended with up to 5 percent ethanol. From the figures

above it is also clear that alternative fuels are used in relatively large fleets. These fleets have also increased obviously during the last 5 to 10 years. Even if the supply of raw material, production technology, engine technology, distribution technology, lack of specification and/or standards and EU directives (maximum 5 percent ethanol in gasoline) limit the increased use of alternative fuels in Sweden the real obstacles, or rather restrictions, are the high production costs and the relatively limited possibility for national tax redemption. As long as today's EU mineral oil directive, see Appendix 12, is in force, it will be difficult for the government to reduce the tax for alternative fuels in a flexible and logic way. If the discussions and negotiation on a new EU directive for the promotion of alternative fuels will come through, and if the mineral oil directive will be changed so that it will be possible to reduce the tax for alternative fuels in general with up to 100 percent, only then it might be possible to really speed up the increased use of alternative fuels.

7.2.1 Ethanol and RME

The first really commercial breakthrough for the use of alternative fuels in Sweden came in the 1980s, when the local transportation company in Stockholm decided to change from diesel oil to ethanol as fuel for their city busses. The original reason for using ethanol was to reduce the emissions with impact on health and environment, such as NO_x, CO, particulates and HC. However, during these 20 years, when the Stockholm city busses have been running on ethanol, the possibility to reduce the emissions from buses running on diesel oil have also increased. During these 20 years improved engine technology as well as introduced and improved after treatment technology have had a high and positive impact on the emissions, either you look at the quantity or the emissions hazardous properties. A second important reason is that today diesel oil (environmental class 1, MK1) in Sweden is of a very high environmental quality. Because of that, today the difference in emissions from buses running on ethanol and best technique buses running on diesel oil is relatively small. The difference is so small that it would not be economically reasonable to invest in ethanol busses just for the somewhat lower emissions. Instead, today the reason to continue using ethanol is mainly the reduced emissions of CO_2 and as an effect of that the reduced impact on the climate.

For the coming 5 to 10 years an increased use of alternative fuels in Sweden will be focused on low blending (up to 5 percent) of ethanol in gasoline and to some extent alcohols and RME in diesel oil might also come. One reason is that the EU directive for gasoline does not allow more than 5 percent ethanol in gasoline. Another more important reason is that low blending is possible in the existing vehicle fleet without introducing any new otto or diesel engine technology, neither does the low blending of ethanol and RME demand any obvious change in the distribution systems [MB, AK]. Since use in existing vehicle fleets is possible, it is not necessary to blend gasoline or diesel oil with ethanol or RME/ethanol to an exact percentage, or to blend all Swedish gasoline and/or diesel oil. Instead, one can start from a very low blending level and a rather small part of the country. Depending on the supply, it is then possible to admit the blending to grow up to the maximum allowable/recommendable level in the whole country. This makes it possible to adjust the use/blending to a growing production capacity, which in turn facilitates the building–up of the production capacity of raw material and the production- and distribution capacity of the alternative fuel. Parallel to the increasing production it is also possible to allow supply of alternative fuels to small but growing fleets of vehicles for use of the neat alternative fuel. This way of introducing alternative fuels makes it possible to allow fleets running on a neat alternative fuel, fleets that on their own cannot justify the erection of a production plant in an economical acceptable scale for many years.

Another important area where resources will be spent is on the production of ethanol from cellulose, as for example from woodchips or straw. A research and development project financed by the government is running since the beginning the 1990s. In a 10 years period the hydrolysis and fermentation technology will probably be mature enough to build a large demonstration plant. However, the big obstacle, which requires further research, is how to ferment 5-carbon sugars (heptoses) and how to avoid toxification of the fermentation process (the yeast) by natural components in the woodchips that are set free by the hydrolysis process. If these obstacles can be avoided it will probably be possible to produce ethanol from wood chips with a rather high energy efficiency and to a price that might be in the same magnitude as for ethanol from crops. The main reason in Sweden to spend time and resources on the production of ethanol from cellulose is that the Swedish supply of agriculture products for the production of fuel ethanol is limited, but that the Swedish supply of cellulose from for example forest harvesting is rather "unlimited". In a rather long term perspective it might also be possible to reduce the production cost for ethanol from cellulose to such an extent that they would fall below the production cost for ethanol from agriculture products.

7.2.2 DME, methanol and F-T fuels

For the moment the interest for alternative fuels production technology has been focused on production from synthesis gas. DME, as already mentioned, is one example. Other examples are methanol and so-called Fischer-Tropsch fuels, sometimes also called synthetic diesel oil or paraffin and synthetic gasoline or alkylate. The main reason for going this way is that almost all kinds of carbon containing raw material could be used to produce the synthesis gas by gasification and shifting processes, and that a lot of different fuels then could be produced from the synthesis gas. It is so to speak a flexible way of producing fuels since one has great freedom to choose raw material for the production as well as what final product to go for. The gasification process is still not yet commercially feasible [AK]. More research and development work has to be done before one can take that process to the market, but in the mean time it is possible to produce synthesis gas from methane. This gives an opportunity to start the production of a wide range of fuels from for example natural gas while the technology for gasification of biomass is further developed and taken into production, replacing natural gas when possible.

7.2.3 Methane

Fossil methane (natural gas) is mainly used on the Swedish west coast where it exist a distribution pipeline system for natural gas. On the west coast as well as in other parts of Sweden methane is also produced from biomass (biogas). Biogas produced from sewage sludge has mostly been used for heating purposes but more and more this biogas is also being used as vehicle fuel. The production capacity from sewage sludge is limited but recent years there have also been investments in the erection of biogas production plants using other types of waste as for example stable manure as raw material for the process. This has lead to an increasing production capacity as well as an increasing use of biogas for vehicle purpose. Still the use of biogas is principally restricted to captive fleets such as buss companies and taxi companies, but in a couple of years the introduction on the open consumer market probably will come through. Even if being used more or less only in captive fleets it has to be mentioned that these fleets can be rather big ones. For example a couple of municipalities in

Sweden, including Malmö (Sweden's third city, counting on habitants) is running all of their city buses on biogas.

7.2.4 LPG/LPG

Motor gas or LPG was about a rather widely used alternative vehicle fuel in Sweden 15 years ago. Because of, over night, highly increased taxes for LPG as vehicle fuel, the interest totally collapsed and LPG cars were converted back to conventional fuels. Some minor use of LPG still exists but then to such a low extent that it might not be worth mentioning.

7.3 Standardization of alternative fuels in Sweden

Since alternative fuels are, and for a long time have been, an important issue in Sweden, the need for standards has come up on the agenda and on request of its members SIS has taken responsibility for the production of such national standards.

The first national alternative fuel standard was a standard for alcohol to be used in diesel engines. Obviously it was quite natural to start the national work with standards for alternative fuels with a standard on alcohols for diesel engines, since the breakthrough for alternative fuels in Sweden was the use of ethanol in the city busses in Stockholm. Secondly, a national standard for biogas was produced under the auspice of SIS and third there has also been produced a national standard for RME.

SS 15 54 36	Automotive fuels – Vegetable fatty acid methyl esters – Requirements and test methods
SS 15 54 37	Motor fuels – Fuel alcohols for high-speed diesel engines
SS 15 54 38	Motor fuels – Biogas as a fuel in high-speed otto engines

However, the task about standards for alternative fuels is not only an issue of designing/producing standards. It is also of great importance how to prioritise among the need for standards on alternative fuels, and to decide when to start the work with these standards, in case it is not possible to work with all of them at once and at the same time. This kind of overarching tasks has more and more become of interest for Swedish stakeholders when the use of alternative fuels increased, as well as the number of alternative fuels to use. An increased use of "old" as well as "new" alternative fuels, and then not at least an introduction of these alternatives on the open consumer market, requires standards.

Because of that, SIS has set up a national initiative concerning general issues about standards for alternative fuels and propellants in the year 2 000 (AO). An analysis group with participants representing producers of alternative fuels/propellants as well as conventional fuels/propellants, combustion equipment manufactures, branch institutes and authorities as the

Swedish Environmental Protection Agency and the Swedish Energy Authority, was set up. The Analysis Group was given the task to identify the Swedish, and also international, need for standards for alternative fuels within the coming 3 – 5 years and also to analyse how this work best could be carried out. The Analysis Group submitted a draft report for consultation in spring 2001. The Analysis Group had also taken into account the response from consultation, to the best of its ability.

The conclusions of the report can briefly be summarized as follows:

- All alternative fuels will need to be standardized eventually. At first and for the coming 3 – 5 years ethanol, Fatty Acid Methyl Ester (FAME) and methane (fossil as well as bio generated) should be prioritised. For the next 5 years, methanol and dimethyl ether (DME) could be included in the standardization work.
- Standards for alternative fuels may be required within at least three different areas:
  a) for use in pure form
  b) as a component in a blend
  c) for the actual blended fuel.
- In a perspective beyond 10 years, there will almost certainly be an increase in the use of fuel cells and thereby in the use of hydrogen in gaseous form. While waiting for methods to be developed for storing and using hydrogen gas at economically reasonable costs, methanol and DME can act as effective carriers of bound hydrogen. When technology allows the use of hydrogen in the form of hydrogen gas the need will then arise for a standard regarding hydrogen gas, as a fuel.
- The standardization process should include terminology, classification systems, requirement specifications and relevant methods for sampling, sample preparation and testing.
- The standardization should be synchronized as much as possible between current fossil fuels and new fossil or bio based alternative fuels, since the various types of fuels and blends are often used in the same combustion equipment/engines. Another reason is that the comprehensive regulatory and laboratory activities associated with fuels would be more effective and less expensive if a common standard was available.
- When there are parameters specific to alternative fuels, and in certain cases specific to bio fuels (e.g. the renew ability requirement and Life Cycle Analysis (LCA)) separate standards or at least specifications will be required for these parameters.
- The standards for alternative fuels should be combined with a system for environmental labelling of alternative fuels, if possible.
- The actual work of drawing up standards should be carried out in the first instance by/within CEN and ISO.
- CEN/TC 19 and ISO/TC 28 should include standardization of both liquid fossil fuels and liquid bio fuels for use either in their pure form, as components in blends or as actual blended fuels.
- ISO/TC 193 should include standardization of gaseous fossil fuels, gaseous bio fuels and blends. In parallel, these ISO standards are converted to CEN standards via CEN/MC

In the report is a list (spring 2001) of existing standards for liquid and gaseous alternative fuels and work in progress on new standards for alternative fuels, in Sweden as well as some other countries, see Appendix 3.

As a result of the conclusions in the report, SIS has continued the initiated work concerning standardization of alternative fuels and spring 2002 a new standardization project concerning alternative fuels was started [AO]. A reference group of stakeholders is associated to this project. This group is almost the same as for the analysis group, but it is also including representatives of car manufacturing industries.

However, as SIS regards it, an increased use of alternative fuels demands international trade and not at least the possibility to buy alternative fuels with the same quality and specification everywhere in Europe, and in the long-term perspective maybe the whole world. Because of that, perhaps the most important starting point for the new SIS project was that European standardization, and perhaps also global standardization, is essential in the promotion of increased trade and use under controlled forms. So the actual work of drawing up standards should be carried out preferably by/within CEN and ISO.

As a first action in the new project SIS contacted CEN for a discussion about the issue of standardization of alternative fuels, to try to find out if it might be of interest for CEN to support an European project along the same lines as already done for Sweden. One possibility could be that CEN would commission SIS to take the lead for such a European project, with the purpose to find a common European line for coming activities in the area of standardization of alternative fuels.

After a preliminary positive reaction from CEN concerning the proposed idea, SIS in late autumn 2002 sent in a formal proposal for a new project, or rather working group (WG), to CEN with the title “New technical Board working group on alternative fuels”.

The proposed scope of the WG was to:

- Initiate a European collective view for a general strategy for improvement of standardization on alternative fuels.
- To set an agreement between all European stakeholders on the objectives.

This meant that the new WG would:

- Act as a forum for dialog between the stakeholders.
- Investigate the need of European (and global) standards for liquid and gaseous alternative fuels over the next five to ten (or longer) years.

Acting as a forum for dialogue, the WG would primarily aim at:

- Delineating a European standardization strategy for supporting the increase of production, distribution and use of alternative fuels, to be approved by CEN’s Technical Board (CEN/BT)
- Strengthening the relation with European stakeholders (i.e. CEC, ACEA, Europia) and international stakeholders as for example IEA.
- Allowing CEN members and others to express their view on the current national, European and global situation, and on the foreseeable impact of the European standardization.

Acting as an investigation group, the WG would primarily aim at:

- Analysing and listing the need of European and global standards regarding specifications. Classification systems, test methods etc. for fuels that have been prioritised.
- Making an inventory of which specifications, classification systems, test methods, etc. already exist in CEN, ISO, and national standardization bodies and other international and national organizations and industry.
- Analysing from this inventory the possibility to wholly or partially use specifications, test methods, etc.
- Analysing and listing the need of future research regarding test methods, and proposing how to solve this need.

January 2003 CEN/BT agreed to create a Technical Board working group (BT/WG 149) on "Alternative fuels" and to allocate the convenorship and secretariat function to SIS. The aim of the BT/WG 149 is to initiate a European collective view of the general strategy for improvement of standardization on alternative fuels. BT/WG 149 shall according to CEN/BT's decision not establish CEN publications. A report with conclusions and recommendations shall be presented to CEN/BT, by mid 2004.

7.4 Need for informal discussions and the role of IEA/AMF

The need for international informal discussions and the role that IEA/AMF could play in standardization of alternative fuels were discussed with the people that have been interviewed for this report. See Section 1 (Background).

The common opinion among these people is that IEA/AMF's knowledge and experiences one way or another should be used in the international work with standardization of alternative fuels. One way could be to give IEA/AMF a position like liaison or affiliated member to international organizations as CEN and/or ISO. However, according to these people IEA/AMF should not primarily be engaged in work with the technical specifications for alternative fuels in general, but they see a role in management of the standardization work like how to prioritise among different alternative fuels (which of them are closest to market introduction and therefore the need of a standard). IEA/AMF could also be engaged in some for alternative fuels very specific technical issues as for example how to translate properties as cetane index for a diesel oil to a comparable parameter for an alternative fuel or how to guarantee bio origin of the raw material used for the production of a bio fuel.

The people interviewed have welcomed the possibility for IEA/AMF to act as an informal discussion forum. Even though it is possible to have rather open discussions in for example CEN and ISO's technical working groups, the issues discussed there are mostly technical issues when dealing with the production of a new standard and not so much issues about which alternative to prioritise as well as when and why. Besides that, even if acting as a free expert in the technical committee, the representatives are nominated by the member states and might have a strong wish to go back and check different issues "at home" before giving a too certain statement or comment. The size of CEN and ISO and the number of participants in their technical committees also restricts the possibility to have a rapid and not so formal conversation during meetings.

A discussion about the need of new or redrafted standards initiates by the members of CEN and ISO. It is of course possible to have bilateral contacts with other member states before

taking an initiative. Besides that there seem not to be many groups in CEN and ISO where the need for standards, not at least for alternative fuels, could be discussed among the member states on an informal basis and without having a feeling of making too conclusive statements. According to the people interviewed, IEA/AMF might be a forum for such informal and open discussions. IEA/AMF could for example arrange annual workshops in the area of standardization of alternative fuels and/or other issues closely related to that area. However, it is important not to start up too many workshops and seminars discussing these items (AK). Time is limited and if IEA/AMF wants to interest people for such workshops or seminars, it is important not to risk to duplicate work done by other forum and not to have to many annual gatherings. It seems to be much better to focus on a limited number of highly interesting issues and to limit the workshops/seminars to one or at the most two per year (AK). A good idea might be to have such workshops or seminars not at the same time but in good time before and in connection to for example the meetings of CEN's and ISO's technical committees.

7.5 References

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[MB], Mr Mats Björsell, Swedish Environmental Protection Agency, *Personal communication by Mr Björn Rehnlund on 6 December 2002*

[STEM], Swedish Energy Agency, *Website:* www.stem.se

[AK], Mrs Alice Kempe, Swedish Energy Agency, *Personal communication by Mr Björn Rehnlund on 26 November 200.*

[VV], Swedish National Road Administration, *website:* www.vv.se

[PG]. Mr Per Gustafsson, Swedish National Road Administration, *Mail interview by Mr Björn Rehnlund*

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8 USA

8.1 Introduction and background

The organization of standardization issues in the US is somewhat different from the rest of the countries being looked at and analysed in Annex XXVII. As can been seen from below, there are many different parties involved in the standardization process in the US and the role of the national standardization institute is more to coordinate the work and to set up rules for how standards are produced. Late in this chapter, the different situation compared to for example the European countries, will be somewhat more discussed.

The American Standards Institute

The American Standards Institute (ANSI) is a private, non-profit organization that administrates and coordinates the US voluntary standardization and a conformity assessment system.

ANSI's mission is to enhance both the global competitiveness and the US quality of life, by promoting and facilitating voluntary consensus standards and conformity assessment system, and ensuring their integrity.

Recently, ANSI together with representatives from both public- and private sectors, has developed a National Standards Strategy (NSS) for the US. This document establishes a framework that can be used by all interested parties, including companies, government, non governmental organizations (NGOs), standards developers and consumers, to further improve US competitiveness abroad, while continuing to provide strong support for domestic markets.

Although ANSI itself does not develop American Standards (ANSs), it provides all interested US parties with a neutral venue to come together and work towards common agreements. The process to create these voluntary standards is guided by ANSI's cardinal principles of consensus, due process and openness and depends heavily upon data gathering and compromises among a diverse range of stakeholders. ANSI ensures that, so to speak, access to the process, including an appeal mechanism, is made available to anyone directly or materially affected by a standard that is under development. ANSI has approximately 1 000 companies, organizations and government agencies, as well as institutional and international bodies as members.

ANSI currently provides a forum for over 270 ANSI-accredited standards developers representing approximately 200 distinct organizations in the private and public sectors. These groups work cooperatively to develop voluntary national consensus standards and American National Standards (ANS).

In order to maintain ANSI accreditation, developers of standards are required to consistently adhere to a set of requirements or procedures known as the "ANSI procedures for the development and coordination of American National Standards" that govern the consensus development process.

The hallmarks of the American Standards process include:

- Consensus on a proposed standard.
- Broad-based public review and comments on draft standards.
- Consideration of and response to comments submitted by voting members and by public review commenter.
- Incorporation of approved changes into a draft standard.
- Right to appeal by any participant.
- Consideration/incorporation of Governmental regulations.

In addition to facilitate the formation of standards in the US, ANSI also promotes the use of US standards internationally and advocates US policy and technical positions in international and regional standards organizations. ANSI also encourages the adoption of international standards as national standards where these meet the needs of the user community.

ANSI is among other things the official US representative to the International Organization for Standardization (ISO) and the International Accreditation Forum (IAF). Through ANSI, the US has immediate access to the ISO standards development process. ANSI participates in almost the entire technical program of ISO and administers many key committees and subgroups. In many instances, US standards are taken forward to ISO through ANSI where they are adopted in whole or in part as international standards.

ASTM

ASTM International, formerly known as The American Society for Testing and Materials, is a non-profit organization that provides a global forum for the development and publication of voluntary consensus standards for materials, products, systems and services. ASTM has over 30 000 members from 100 nations, representing producers, users, consumers and representatives of governments and academia.

ASTM standards serve as the basis for manufacturing, procurement and regulatory activities in over 130 different industry areas.

ASTM International provides standards that are accepted and used in research and development, product testing, quality systems and commercial transactions around the world.

ASTM's mission is to be the foremost developer and provider of voluntary consensus standards, related technical information, and services having internationally quality and applicability that:

- Promote public health and safety, and the overall quality of life.
- Contribute to the reliability of materials, products, system and services.
- Facilitate national, regional, and international commerce.

The operational work at ASTM International is carried out by Technical committees and related subcommittees. The number, as well as the diversification of such committees is high. ASTM Committee D02, "Petroleum Products and Lubricants", handles fuels for vehicles, aircrafts, the marine, and stationary engine systems. Committee D02 was already formed in 1904. Committee D02 has a current membership of approximately 1500 industry professionals and experts with jurisdiction over 580 ASTM standards.

The scope of ASTM Internationals committee D02 is to promote knowledge and promulgations of standard specifications, classifications, test methods, practices, guides and terminology in the following technical fields:

- Liquid fuels derived from petroleum products.
- Liquid and semi liquid lubricants.
- Hydraulic fluids.
- Gaseous or liquid hydrocarbons and mixture of hydrocarbons for chemical and special use.
- Petroleum coke.
- Petrolatum and petroleum waxes.
- Fuel and lubricants additives.

Also included in the scope of the committee shall be the promotion of knowledge and the promulgation of standards on the environmental persistence (biodegradation), eco-toxicity and bioaccumulation of the products above.

Specifically excluded from the scope of the committee are standards related to natural gas and manufactured gases as water gas.

Mr David Bradley, who is staff manager of ASTM Committee D02, and Mr Steve Howell, who is the chairman of ASTM Subcommittee D02.E2, taskforce on bio-diesel, have been interviewed for this report.

The SAE International

The SAE International (SAE) (formerly Society of Automotive Engineers) or rather its precursor was formed in the beginning of the 1900s.

SAE's vision is:

- Advancement of the mobility community to serve humanity.
- Improved processes and systems for mobility product life cycles, with a focus on total life cycles.
- A culture that foster innovation, creativity, timely response to change social responsibility and user satisfaction.

The main objective for SAE to reach its vision is to be a resource for technical information and expertise used in designing, building, maintaining and operating self-propelled vehicles for use on land or sea and in air or space. SAE disseminates information through its meetings, books, technical papers, magazines, standards, reports, professional development programs and electronic databases.

Today SAE has more than 83 000 engineers, business executives, educators and students from more than 97 countries in its network of membership, members that share information and exchange ideas for advancing the engineering of mobility systems.

The SAE Technical Standards Board develops through its technical committees probably more new aerospace and automotive engineering standards than any other standards developing organization in the world.

SAE's role in standardization of fuels, conventional as well as alternative, is very much to take the ASTM International standards and use them for the development of performance standards.

Mr Lew Gibbs, ChevronTexaco, who is the chairman of Technical Committee 7 Fuels of the SAE Fuels and Lubricant Council was interviewed for this report.

The Alliance of Automobile Manufacturers

The Alliance of Automobile Manufacturers Inc. is a US based trade association composed of ten car and light truck manufacturers. The alliance members account all together for more than 90 percent of the total vehicle sales volume in the US.

The Alliance is open to all car and light truck manufacturers and serves as an advocacy group for the vehicle industry concerning policy issues.

The members are:

- BMW group
- Mazda
- Nissan
- Daimler Chrysler
- Porsche
- Mitsubishi Motors
- General Motors
- Volkswagen
- Toyota
- Ford Motor Company

The Alliance has put up a number of goals for their activities. One of these goals is to seek harmonization of global standards.

The Alliance has shown interest in new clean fuels and has also taken the lead in calling for ultra low sulphur gasoline and diesel oil.

In the work on standardization on alternative fuels, the Alliance has, through some of its members, taken part in the work on a specification ASTM standard for bio-diesel, and also supported the work on a Worldwide Fuel Charter. The standardization is not a main issue for the Alliance, since the interest for alternative fuels mainly come from three (DaimlerChrysler, Ford and General Motors) of total ten members.

Mrs Ellen Shapiro, who works as expert for the Alliance, was interviewed for this report.

The American Petroleum Institute

The American Petroleum Institute (API) is the primary trade association of and a research institute for the oil and petroleum industry in the US. API represents more than 400 members, involved in different aspects of oil and natural gas industry.

API is also an accredited standards developing organization, that meets the process requirements of the American National Standards Institute (ANSI). API-standards are developed by the members, to be used by the members. The meetings on standards are open to all materially affected parties.

When ASTM works on fuel standards on gasoline, diesel oil or on alternative fuels, API does not participate as an association, but rather participates through it’s members. However, when the standard is required on a federal level and by regulation or law, for example on the authorization of EPA, API participates in the standardization work as an association.

Mr Jim Williams, who works as expert for API, has been interviewed for this report.

The Environmental Protection Agency

The Environmental Protection Agency (EPA) is typically involved in the standardization process in the USA when the standard is required by law or when the standard can be justified on the basis of improving air quality.

For example the Clean Air Act authorizes EPA to define "clean air", as well as emission standards and fuel standards necessary to achieve clean air. As a consequence, EPA has for example set a variety of US fuel standards over the years. For gasoline, these have included removal of lead, limits on fuel volatility, limits on sulphur content, requirements for and limits on the use of oxygenates, and requirements that gasoline components contain only carbon, hydrogen, nitrogen, oxygen and sulphur. For diesel fuel, these have included limits on the sulphur and aromatics content, and cetane specification.

EPA also specifies specific ASTM test methods for determining compliance.

EPA has been very involved over the years in the development and use of alternative fuels. However, while EPA has set specifications for some of the test fuels used in certifying alternative fuel vehicles (e.g., natural gas), EPA has not set specifications for in-use alternative fuels.

Fuel specifications related to engine performance and unrelated to emission performance are however left to industry standard setting bodies.

Mr Paul Machiele, who is centre director for regulatory development in EPA's Assessment and Standards Division of the Office of Transportation and Air Quality, was interviewed for this report.

The Department of Energy

Even if emissions of carbon dioxide and its effects on the climate are of interest for the Department of Energy (DOE), their major interest concerns issues about supply and security and because of that the possibility to reduce import of oil and oil products.

To facilitate and promote the introduction of alternatives to gasoline and diesel oil, DOE sometimes is engaged in the process of standardization of alternative fuels, especially when specification standards are required to get vehicle manufacturers acceptance.

DOE has the possibility to give economical support to the introduction/use of vehicles for alternative fuels within the framework of fleet tests and then especially economical support for the incremental costs. However, this kind of support is yet used rather limited and then often-focused on small bus fleets with up to approximately 10 vehicles. There is currently no financial support for huge fleets or fleet tests.

DOE also has the possibility to use the authorization in the Energy security act to enforce the number of alternative fuelled vehicles in State owned vehicle fleets.

Mrs Wendy Clark and Mr Robert McCormick which both works at DOE's National Renewable Energy Laboratory, NREL, in Golden Colorado have been interviewed for this report.

8.2 Alternative fuels in the US

Alternative fuels have a somewhat different meaning in the US than in many other countries, as for example in Sweden and other European countries. In the US the word alternative indicates that the fuels under discussion could replace gasoline or diesel oil. Alternative fuels are furthermore fuels that can be internally produced and because of that reduce the need of import and increase the supply security. When talking about fuels that could contribute to lowered emissions with reduced impact on the environment and/or health, the words "clean fuels" are used in the US. However, clean fuels could then also be used for the description of reformulated gasoline, since reformulated gasoline compared to conventional gasoline has substantially reduced amounts of emissions with impact on health and environment.

Along with the discussion of the possible effects on the climate and the connection between the emissions of greenhouse gases and the impact on the climate, the use of biomass based fuels, just because of their possibility to reduce the emissions of fossil carbon dioxide and then also the impact on the climate, have been brought up for discussion. Today the discussions about if and when which fuels to replace gasoline and diesel oil is very much focused on how they can contribute to the reduction of carbon dioxide and other greenhouse gases. In some parts of the US such as California, other problems as for example smog and smog related diseases are a strong driving force for the introduction of what in the US are called clean fuels, whatever the origin. But even there fuels to replace gasoline or diesel oil should preferably be of bio origin or at least what sometimes is called carbon dioxide neutral fuels, fuels with no net contribution to the carbon dioxide cycle.

8.2.1 Methanol, ethanol and ethers

Twenty years ago methanol was introduced in the US as a clean fuel but also as an alternative/nationally-produced fuel. The introduction was mainly focused on California even though methanol also has been used in other parts of the US. Also the methanol-ether, Methyl Tertiary-Butyl Ether (MTBE), was introduced as a fuel component, an component that can be produced nationally and with good properties such as a high octane number, for use in gasoline engines (otto engines) After the time required for the introduction, the use of methanol has heavily decreased and today there are only very few vehicles still running on methanol [PM]. Instead the use of ethanol has increased and replaced methanol as an alternative fuel [JW]. Some reasons for this change might be that methanol has low energy content and is both strongly corrosive as well as human toxic. However, it can be discussed if these properties are so different from other fuels properties and also so disadvantageous that it can justify a change from methanol to ethanol. Another explanation is that the farmers in the Corn Belt are a strong lobby group with connections in the government as well as the Congress. Since ethanol can be produced both from corn and from the remaining cob, it has without no doubt been in the interest of the corn producers to find a market for ethanol

produced initially from corncobs as one of their possible products. This might have had a strong influence on the decision on both federal as well as state level that have made it possible to not only replace methanol with ethanol but also to increase the use of alcohols as vehicle fuels substantially. Probably the truth, as many times before, is somewhat in between these both explanations.

The use of ethanol as vehicle fuel is today in the order of 2 billion gallons per year in the US The most is used for blending into gasoline up to a level of 10 volume percent ethanol, while the rest is the form as E85 (85 volume percent ethanol and 15 volume percent gasoline). For the moment there are discussion in the congress concerning how to increase the use of bio fuels up to a level of 5 billion gallons per year.

Today there are federal tax incentives in the order of 53 cent per gallon for the promotion of fuel ethanol in fuel blends with gasoline, up to 10 volume percent. In some states there might also be other special incentives for the promotion of ethanol as well as bio-diesel. The corporate Average Fuel Economy Standards are also designed to favour alternative fuels; for example, E85 vehicles generate many credits because their fuel economy is based solely upon the hydrocarbon part (i.e. 14 percent) of the finished fuel.

Parallel to the use of alcohols as such in neat or blended form, ethers produced from alcohols and then predominantly MTBE have been used as gasoline additive. In normal gasoline the MTBE content has been approximately 2 percent but in reformulated gasoline the level has been as high as 15 percent. MTBE is for example a good octane improver and that has made it possible to use MTBE to replace for example the carcinogenic gasoline compound benzene. Benzene once was introduced to replace the more dangerous gasoline additive lead. However, the use of MTBE have been strongly criticised the last years and today the situation is that MTBE on the federal level is on the way to be phased out [PM]. The same will probably follow on state level. The reason for this changed apprehension concerning the use of MTBE is that MTBE is soluble in water and when leakage sometimes occur, for example when storing gasoline containing MTBE in old tanks and leaking pipes at gasoline stations, the MTBE content rather easily can be washed out from the leaking gasoline and reach the groundwater and contaminate it. Even if there is no real evidence for severe health effects caused by MTBE, there is a very obvious problem with the taste and odour of MTBE. Also extremely low MTBE quantities that reach the groundwater influence the taste and odour and easily make it almost impossible to use the water for drinking purposes. Today it seems that MTBE at first might be replaced by ethanol but maybe also to some extent by the ethanol ether, Ethyl Tertiary-Butyl Ether (ETBE) [JW].

8.2.2 Bio-diesel

Bio-diesel is a relatively widely used alternative fuel in the US both in neat form and blended in diesel oil, although if not in parity with alcohols/ethanol. Bio-diesel is the common used expression for a fatty acid methyl ester (FAME). The raw material differs but most commonly used raw material in the US is soybean even though also rapeseed sometimes is used [SH]. From the bean or the seed, oil can bee produced that later can be methylated with methanol to a soybean- or rapeseed methyl ester (SME or RME)

Beside the fact that bio-diesel is a biomass based alternative fuel, it has very good performance data concerning lubrication is an improver of the cetane number (compression

ignition index) and significantly reduces the emissions of diesel engines which are of great importance for a diesel fuel [SH].

Some financial support already exists to stimulate the use of bio-diesel. The production of bio-diesel is also stimulated through agriculture subsides on the production of the raw material for bio-diesel. There is for the moment also a discussion in the congress to give bio-diesel similar tax incentives as on ethanol, as one way to increase the total use of bio fuels in the US to 5 billion gallons per year.

8.2.3 Natural gas

Methane in compressed form is on a small scale used for vehicle propulsion in the US. Although production of biogas/bio based methane through the anaerobic fermentation of biomass (primarily sewage sludge) exists the absolutely major part of the methane used for vehicle purposes comes from natural gas, in the form of compressed natural gas (CNG).

The use of CNG is concentrated in captive fleets and then often smaller bus fleets owned by public transportation companies. Some reason for the limited use and interest for CNG is probably the need for local dispensing sources, new distribution and storage systems, new fuel injection systems in the vehicles as well as the cost of engine conversion systems..

To some extent there are also an interest in the US for liquefied natural gas (LNG), but the interest for LNG was much greater 10 years ago and is still decreasing. Instead of using the methane in liquid form, today there are plans to convert it to other types of liquid fuels. See more about this below.

8.2.4 Gas to liquid fuels

There is a growing interest in so-called Fischer-Tropsch (FT) fuels in the US today [ES]. In the F-T process natural gas can be used as raw material while the final product is in liquid form and often within the standard specification for gasoline or diesel oil, which enables distribution and use in existing systems and vehicles.

For many years F-T products will probably not be used in neat form in the US but rather as an additive/polisher of fossil fuels [ES], [PM]. The reason is that the production capacity still will be rather limited and at the same time F-T fuels have so many valuable properties they can improve the conventional fuels even when blended in rather low concentration. For the moment there are some ideas being discussed *inter alia* by DOE about changing the laws to make is possible to look at not only nationally produced but also imported F-T products as alternative fuels [ES].

8.2.5 LPG and DME

Liquefied Petroleum Gas (LPG) and dimethyl ether (DME) are both gases that are liquid after slight compression and can be used for vehicle purposes. However, to be able to use LPG and DME as vehicle fuels, there is a need for a new fuel injection system.

The use of LPG as a vehicle fuel in the US is today very limited and when used this is almost always in captured fleets as for example small taxi fleets [ES]. Because of the origin of LPG as a "rest product" from refineries most of the LPG used is used in Texas, Colorado and Oklahoma [MC].

DME is an excellent diesel fuel that can be produced from natural gas and gasified biomass. However, for the moment there seems not to be any commercial market for DME or any kind of use of DME as a vehicle fuel in the US and there is not either much of discussions about the future for DME as a vehicle fuel [ES], [PM].

8.2.6 Hydrogen

There is a growing interest for hydrogen as a fuel in the US today. The interest for hydrogen as a vehicle fuels is however almost only concentrated on the use as a fuel for fuel cells, even if for example BMW and Ford are promoting the concept of use in internal combustion engines. Since the fuel cell technology is probably10 years in the future, at least if we talk about an introduction on the commercial market, the interest is more on a supervision level than on an operative use level, at least concerning the need for standardization.

8.2.7 Alternative fuels regulation

The introduction of alternative fuels and vehicles optimised for alternative fuels is often linked to the Environmental Protection Agency (EPA) or Department of Energy and their regulations on supply security or air quality requirements.

As new fuels are developed, they must undergo a large number of emission tests to validate their claims.

The following list of executive documents is taken from the SAE J1297 Information Report on Alternative Automotive Fuels. For more information about the documents please see Appendix 10.

- Energy Policy Act of 1992 (Public Law 102-486)
- Energy Conservation Reauthorization Act of 1998 (Public Law 105-388
- Executive Order 12759 Federal Energy Management
- Executive Order 12844 Federal Fleet Conversion Task
- Executive Order 13123 Greening the Government Through Efficient Energy Management
- Executive Order 13134 Developing and Promoting Bio based Products and Bio energy
- Bio-diesel Fuel Use Credit Interim Rule
- Executive Order 13149 Greening the Government Through Federal Fleet and Transportation Efficiency

8.3 Standardization of alternative fuels in the US

The work on standardization on alternative fuels in the US has been going on for a rather long period. As expected, the work on standards has also been concentrated on the alternative fuels close to, or already out on, the commercial market.

The work on national US standards on alternative fuels is perhaps best reflected by existing approved ASTM Standard Specifications currently in use.

The six existing ASTM standards, given in numerical order are:

- D 1835-97 Specification for Liquefied Petroleum (LP) Gases.
- D 4806-02 Specification for Denatured Fuel Ethanol for Blending with Gasoline for Use as Automotive Spark-Ignition Engine Fuel.
- D 5797-96 (2001) Specification for Fuel Methanol (M70-M85) for Automotive Spark-Ignition Engines.
- D 5798-99 Specification for Fuel Ethanol (Ed75-Ed85) for Automotive Spark-Ignition Engines.
- D 5983-97 (2002) Specification for Methyl Tertiary-Butyl Ether (MTBE) for Downstream Blending for Use in Automotive Spark-Ignition Engines.
- D 6751-02a Specification for Bio-diesel Fuel (B100) Blend Stock for Distillate Fuels.

Additionally, there are also two SAE documents that although not specifically a standard are nevertheless relevant concerning the discussions about standards on alternative fuels.

These documents are:

- SAE J1297 SEPT 2002 Information Report on Alternative Automotive Fuels
- SAE J1616 FEB94 SAE Recommended Practice for Compressed Natural Gas Vehicle Fuel.

Others standards are being developed. For the moment the standardization activities on alternative fuels seems to be concentrated on bio-diesel. For example ASTM has started a work on a new standard on bio-diesel (B100) but not for blending but for neat use in diesel engines. There seems also to be discussions and work on standards for blends of bio-diesel and conventional diesel oil on given intervals or a so to speak fill and go standard for fuels to diesel engines that makes it possible to blend today conventional diesel oil with FAME up to certain levels.

The general feeling among the people in the US being interviewed is that standards have an important role to play in the promotion of alternative fuels to increase the use of them. The numbers of approved standards also give a good idea of the importance that standards play when introducing new fuels on the open market. Compared to the interest for alternative fuels and the volumes that are being used today in the US the numbers of standards could perhaps have been expected to be higher. The reason that this is not the situation might be that the interest for alternative fuels in the US is very focused on ethanol and to some extent also bio-diesel while other alternative as LPG (even though having a ASTM standard) and methane play a very limited role while for example DME and F-T fuels is not brought up for discussion yet. One other explanation might be that the system, as described above, is huge

and complex with several actors that might slow down the consensus process and also to some extent might exclude small niche fuels from the discussion.

8.4 Need for international informal discussions and the role of IEA/AMF

The situation in the US is quite different from the situation in the other countries being analysed for this report. The size of the US both geographically and about number of vehicles and the consumption of fuels is comparable with almost whole Europe. Since the US also is a country based on a federation of relatively free states, often two levels exists concerning for example regulation on the promotion of alternative fuels.

As described above, the national standardization institute ANSI does not carry out standardization activities. Instead ANSI is mainly responsible for the format of the standardization procedure and also the accreditation of standardization organizations. The real operative standardization work is performed by different organizations like ASTM, API and SAE, depending on the issue for the standardization.

In comparison to Europe the US seems to have an, at least informal, system for discussions between the stakeholders and the different standardization organizations concerning what to do and who will do it. Since there are several organizations with experiences and knowledge in the fuels area it has obviously been of importance to have some kind of information exchange as well as agreements between the organizations to avoid duplication of work. One reason for good information exchange has also been the fact that often the same people work with standardization of fuels in different groups of the different organizations.

The knowledge of the International Energy Agency is often good, even if the detailed information about IEA's implementing agreement seems to be lacking. Because of what already has been said about the seize of the US and its activities on alternative fuels and maybe also the lack of knowledge about IEA/AMF, the interest for IEA/AMF to play a role on the international standardization arena has been somewhat lower then what has been possible to find out for the other participating countries. However, there has been an interest to learn more about IEA/AMF and maybe also to support a contribution from IEA/AMF to ISO's work on standardization of fuels.

8.5 References

[ANSI] The American Standards Institute, website: www.ansi.org

[ASTM] ASTM International, website: www.astm.org

[SAE] The Society of Automotive Engineers, website: www.sae.org

[AAM] The Alliance of Automobile Manufacturers, website: www.autoalliance.org

[API] The American Petroleum Institute, website: www.api.org

[EPA] The American Environmental Protection Agency, website: www.epa.gov

[DOE] The Department of Energy, website: www.doe.gov

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[WC] Mrs Wendy Clark, NREL, Telephone contact and mail correspondence May 2003
[BR] Mr Brian Rippon, Ford Motor Company, Mail correspondence June 2003
[WK] Mr Walt Kreucher. Ford Motor Company, Mail correspondence June 2003.
[ML] Mr Maurice E. Le Pera. Le Pera and Associates, Mail correspondence May 2003.
[DB] Mr David Bradley, ASTM Committee D02, Telephone contact May 2003

9 WORLD-WIDE FUEL CHARTER

The "World-wide fuel charter" describes automotive fuel specifications [ww1, ww2]. It is a joint publication of ACEA (European Automobile Manufacturers Association), Alliance (Alliance of Automobile Manufacturers), EMA (Engine Manufacturers Association) and JAMA (Japan Automobile Manufacturers Association). The charter focuses on mass-produced fuels for vehicles, being gasoline and diesel fuel. Alternative fuels are briefly mentioned in relation to the conventional fuels. The information on alternative fuel specification is summarised below.

Ethanol is mentioned as a blending component for gasoline and diesel fuel. It is used in gasoline to increase the octane number and to extend gasoline supplies. Impurities in ethanol have lead to degradation of fuel systems in the past. Therefore, fuel ethanol must now meet specifications to control pHe (acidity of ethanol) and its blending properties. These specifications are written down in the ASTM D 4806 document.

So far, manufacturers do not support ethanol as a diesel component, due to safety, performance and health problems that they expect. Ethanol in diesel fuel reduces the flashpoint, which causes concern for explosions in fuel handling, storage and use. The impacts on compatibility with vehicle technology and on health are not known yet.

From the oils under consideration (stemming from rapeseed, sunflower, palm, soy and also cooking oils and animal fats) to produce FAME (fatty acid methyl ester), using rapeseed oil results in a product of which the properties come closest to diesel fuel. Lubricity characteristics of methyl esters are suitable for diesel fuel systems. The charter mentions four disadvantages of methyl esters, some of which may be alleviated by using appropriate additives.

- At low temperatures, the viscosity increases.
- Methyl esters are hygroscopic, which brings a risk of corrosion.

- Deposit formation tends to be higher than for diesel fuel.
- Methyl esters attack seals and composite materials.

Based on its characteristics, the charter recommends limiting the FAME content in diesel fuel to maximum 5 percent [ww2]. However, pure FAME can be used in vehicles with adapted fuel systems. Companies like Volkswagen, Opel, Ford, Mercedes, MAN and Iveco equip their diesel vehicles now standard with FAME compatible fuel systems [Wor].

Methanol is not permitted as a gasoline component, because it may cause corrosion of metals and degrades plastics and elastomers, which are used in fuel systems.

9.1 References

[Wor] M. Wörgetter. *Standardization of Bio-diesel and approval of diesel engines.* Paper presented at the 2nd European motor bio fuels forum, Graz, Austria, 1996.

[ww1] *World-wide fuel charter.* Published by ACEA, Alliance, EMA, and JAMA. April 2000.

[ww2] *World-wide fuel charter.* Draft for comments. Published by ACEA, Alliance, EMA, and JAMA. June 2002.

10 THE EUROPEAN COMMITTEE FOR STANDARDIZATION - CEN

10.1 Introduction

The European Committee for Standardization (CEN) is the association responsible for the development of European standards.

The members of CEN are the national standardization institutes of twenty European countries

- Austria, ON
- Belgium, IBN/BIN
- Czech Republic, CSNI
- Denmark, DS
- Finland, SFS
- France, AFNOR
- Germany, DIN
- Greece. ELOT
- Hungary, MSZT
- Iceland, STRI
- Ireland, NSAI,
- Italy UNI
- Luxembourg, SEE
- Malta, MSA
- The Netherlands, NEN
- Norway, NSF

- Portugal, IPO
- Spain, AENOR
- Slovak Republic, SUTN
- Sweden, SIS
- Switzerland, SNV
- United Kingdom, BSI

CEN is the European counterpart of the International Organization for Standardization (ISO).

Even if the use of standards is voluntary, sometimes the European standards are related to European legislation (directives) and conformity to such standards may constitute a presumption of conformity to the legal requirements of the directives. With the purpose to support European legislation the European Commission sometimes gives mandates to CEN concerning production of European standards. A mandate usually consists of a sponsored assignment (often 50 percent of the total cost) to produce and write such standards asked for, supported by an inter-laboratory test.

The main deliverables of CEN are European standards (EN), which must be published by each national standardization institute as an identical national standard. Already existing national standards in conflict with the European standard must be withdrawn.

European standards shall guarantee the principles of global openness, transparency, consensus, technical coherence, and national commitment. These qualifications are safeguarded through the standards development in a CEN Technical Committee with representatives of all interested parties.

Recently, CEN has developed new type of deliverables, which can be published quicker or may precede further work. Examples are the CEN Technical report (TR) and the CEN Technical specification (TS). More recently, CEN has created the CEN workshop Agreement (CWA) as a deliverable, which aims to bridge the gap between the activities of consortia and the formal process of standardization represented by CEN and its national members. An important distinction is that CWA is developed by CEN workshops, comprising only participants with direct interest (not necessarily within a Technical Committee), and so it is not accorded that the status of a European standard.

10.2 Structure and management of CEN

CEN is headed by ithe president and the secretary general.

Professor Christian P. Beckervordersanddforth was autumn 2002 CEN's president and Mr Georg Hongler was secretary general.

CEN is governed by the general assembly of its National members and in accordance with its legal statutes. The assembly is responsible for the budget, membership and appointment of officers.

The administrative Board (BA) is the authorized agent of the assembly to direct CEN's operation, prepare the annual budget and membership applications.

Responsible to the administrative board is the Management Committee (MC) consisting of the president, secretary general and three vice presidents. The committee enforces decisions taken by the administrative board and the technical board and ensures the operational management of the CEN system.

The technical board (BT) controls the standard programme and promotes its execution by the management Centre, technical committee (TC) and other bodies. The technical board is also responsible for the development of technical policies and for the overall management of technical activities to guarantee coherence and consistency of the CEN standardization activities system-wise.

CEN's technical committees (CEN/TCs) are responsible for the programming and planning of the technical work in the form of a business plan for the monitoring and the execution of the work in accordance with the agreed Business plan. The technical committees are also responsible for the management of the standards making process, including the respect of CEN's policy and the consensus building among all interested parties represented through the CEN National members, the CEN Associates and the affiliates.

10.3 Structure and management of CEN/TC and standardization work

The operational work with CEN standards is guided by one of CEN's technical committees (TC).

Technical development work, with the purpose to prepare standards, is done by different working groups (WG) under the responsibility of CEN/TC.

The member states are represented in the WG by experts that have been nominated by the national representatives/standardization institutes participating in CEN.

When a proposal for a standard is completed by the WG, the secretary for the responsible TC if necessary redrafts the proposal to make it uniform and logic and forward it to CEN's central office in Brussels. The document is thereafter sent out for an inquiry to the national standards institutes of CEN member states. The document is often also sent out by the national institutes for national inquiries before the national representatives in the TC give their vote in favour of or against. This vote could however be supplemented with comments concerning the proposal. The comments will be used for the TC secretariat to redraft a final standard proposal.

After the redrafting, CEN's central office will send out the final proposal for a formal vote concerning the standard proposal. This vote could not be supplemented by comments. It is a majority vote system and the votes will be weighted following the same formula as for votes in the European Council.

10.3.1 Standardization of automotive fuels

The political and legal environment for standardization of automotive fuel specifications and test methods is given by the European Directive 98/70/EC of the European Parliament and of the Council relating to the quality of petrol and diesel fuels and amending Council directive

93/12/EEC, see Appendix 4 and 5. The quality parameters of petrol and diesel oil are laid down in these Directives and are incorporated in the corresponding specification standards (EN 228 and EN 590) This means that any change of European legislation on the requirement concerning the quality parameters (influencing the vehicles emission values) requires immediate revision of the corresponding specification standards. To overcome this problem CEN anticipates these changes of requirements by revising its standards on forehand and offering this to the EC for reference in the Fuels Directive. This means that EU legislation does not call up requirements, but call up specifications, laid down by CEN.

In relation to European Directive 98/70/EC, a fuel quality monitoring system has been establish through EN standards and is mandatory for the member states since 2002

10.4 TC 19 "Petroleum products, lubricants and related products"

TC 19 "Petroleum products, lubricants and related products" is for the moment the most relevant TC concerning standardization of alternative fuels.

Technical Committee 19 handle *inter alia* standardization of vehicle fuels and is also the European counterpart of ISO's technical committee nr 28 on Petroleum Products and Lubricant (ISO/TC 28).

CEN/TC 19 constitutes of representatives of all CEN member states.

Autumn 2002 TC 19 secretariat was held by NEN and TC 19 was chaired by:
Mr Carel A.F. Stapel, ExxonMobil

The secretary function was fulfilled by:
Mr Ortwin Costenoble, NEN

Autumn 2002, there were 17 active working groups (WGs) under the auspice of CEN/TC19, see Appendix 6.

WG with special interest for standardization of alternative fuels might be:

- WG 21Specifications for unleaded petrol
- WG 23 Specifications for automotive LPG
- Specifications for automotive diesel
- WG 25 Specifications for FAME used as fuel for heating oil
- WG 26 Fame related fuel test methods

Furthermore, CEN/TC 19 has two experts groups on a non-formal base, so-called watching groups. One is watching the industries activities on fuel cell vehicles. The reason is that the European needs for standardization on fuels for these applications can be initiated in time. A second group is a precision expert group, which assists in judging new precision data of test methods being called up in specifications and EU directives.

10.4.1 Scope and objective of TC 19

The Scope of CEN/TC 19 is defined as:

- Standardization of methods of measurement, sampling and test, terminology and specifications and classifications for petroleum products, and non-petroleum based fuels, lubricants and hydraulic fluids; specifically the standardization of automotive fuels and bio fuels, (fire resistant) hydraulic fluids and bitumen.
- Preparation and publication of standards for the downstream oil industry covering the naturally occurring materials as well as the products derived from processing of these natural materials. The standards include those for characterizing the product quality, for quantity measurement and for operational procedures, e.g. quality monitoring system for fuels.

10.4.2 Mission of CEN/TC 19

CEN/TC 19 has defined 5 activities for the next 5 years:

- To provide, for European parties, a platform for discussion on the standardization for every area of the sector as well as on the implementation and use of European standards.
- To elaborate any standards requested by the European Commission, or needed, without formal request in view EC directives, specifically specification standards for automotive fuels and bio fuels in relation to directive 98/70/EC and the anticipated revision of the directive for the year 2005.
- To elaborate standards eliminating commercial trading barriers between the European countries, also for non-petrol based products e.g. hydraulic fluids.
- To develop any European standard needed for reference in other European standards of CEN/TC19, specifically methods of sampling and testing.
- To develop any European standard for new European subjects (e.g. bio fluids for use as heating oil, fuel based on regenerated used oil etc.), when needed by enough CEN members to make it more efficient to draft an European standard rather than a national standard.

10.4.3 CEN/TC 19 and standardization of alternative automotive fuels

CEN has in October 2002 after more than 2 years work been able to finish a final draft document on a European standard of Automotive fuels for fatty acid methyl esters (FAME) for diesel engines, with focus on requirements and test methods. The standard was initiated by the European Commission by a mandate to CEN. The work with the FAME standard has *inter alia* been prolonged because of internal discussions in CEN/TC 19 and WGs about the need for separate quality for FAME used in vehicles or used as heating oil.

The result of the discussions and the work is two standards for both purposes: blending and 100 percent concentration use. Both standards are in line for most of the parameters, but additional stability requirements are set for heating oil purposes. These results is not completely in line with the wish of the European Commission, which would have preferred two standards with lower specification requirements for use as blend in fuel in comparison to 100 percent concentration use.

The standard specifies requirement and test methods for market and delivered fatty acid methyl esters (FAME) to be used as automotive fuel for diesel engines at 100 percent

concentration, or as extender for automotive fuel for diesel engines in accordance with the requirement of EN 590.

The document, prEN 14214:2002, has been prepared by CEN/TC 19 and has also been balloted within the member countries for a formal vote, see Appendix 7.

This proposal for a FAME standard is CEN's first project on standardization of bio fuels. New standards can be initiated by member countries or as in this case the European Commission.

CEN or rather NEN (where CEN's secretariat is situated) is for the moment also discussing a work on standardization on ethanol for automotive use. The need of ethanol standards has been initiated by the European Commission as a reaction on the EU communication and the EU directive for the promotion of the use of alternative fuels as well as the proposed amendment of the so-called mineral oil directive concerning *inter alia* the taxation of alternative fuels in a way to open up for general national solutions with tax redemption of alternative fuels. The procedure concerning the production of an ethanol standard is however not following the normal procedure with a EU mandate to CEN. Instead of this the EU Commission has this time advised NEN together with a consortium of three bio ethanol stakeholders to apply for funding from the EU ALTENER program. In the autumn of 2002 the project was discussed and still in January 2003 the project was not running because the signing of the contracts was not yet are finished. The ALTENER project will however concentrate on E85, plus a feasibility study on the remaining ethanol blends/fuels being performed as a so-called TC 19 workshop agreement.

A reason to choose this way of procedure and funding and not follow the usually one with a mandate seems to be that it still is unclear if European-wide standardization of several ethanol fuel-blends is feasible or that first other barriers (for instance legal ones) should be overcome. This might be the reason for EU to propose a project lead by NEN to solve this issue first before going into the specific standardization procedure, which implies that the ALTENER project will be followed by a mandate to CEN. But there seems also to be dissatisfaction among some of the member countries in CEN with that kind of solutions. Their reason to hesitate is that they fear that the ALTENER project also will deal with the standards itself and that the result of the project concerning specification for a standard will be placed on CEN/TC 19 table for a decision without possibility to follow the normal procedure in which the work mainly is done in a working group consisting of nominated national experts.

Representatives of the European car manufactures that have been invited to participate in the ALTENER project have declared that they only will be able to accept standards for E 5 (5 percent ethanol in petroleum), based on the actual EU regulations. The members of the consortium on the other hand seem to be more interested also in standards for other blends of ethanol and petroleum as well as in blending of ethanol in diesel oil. As a consequence of the discussions CEN/TC 19 has decided to establish a task force on ethanol. This is a task force belonging to CEN/TC 19's working group 21 (Gasoline specifications), with the task to draft a specification for ethanol (not only bio-ethanol) as a blending component in gasoline (EN 228). This E5 project has started without a EU mandate and it still is a part of the proposed ALTENER project

10.5 Liaisons

Example of other organizations outside CEN for which such liaisons are maintained and judge beneficial for either or preferably both parties are:

- ACEA
- AEGPL
- EUROPIA
- CONCAWE

With European NTB Network liaison is maintained in particular in view of work related to the automotive bio fuels specification and with CETOP liaison is maintained in relation to the work on hydraulic fluids.

10.6 CEN cooperation with ISO

CEN/TC 19 has a close cooperation with ISO TC 28. According to the Vienna agreement the both organizations shall contribute to avoid double work on standards. To fulfil the agreement is important that, in this case CEN/TC 19 and ISO/TC 28, follow each other's work and planning and take part in each other's meeting, this is done by the secretaries of TC 19 and TC 28. It is also not unusual that people from CEN/TC 19 take part in ISO/TC 28 working group and vice versa. ISO/TC 28 also produces standardized test methods for fuels that CEN sometimes adopts and/or refers to in its own standards.

10.7 Swedish Standards Institutes and CEN Technical Board (CEN/BT) initiative on alternative fuels

The Swedish standards institute (SIS) in late autumn 2002 sent in a formal proposal for a new project, or rather working group (WG), to CEN with the title "New technical Board working group on alternative fuels".

The proposed scope of the WG was to:

- Initiate a European collective view for a general strategy for improvement of standardization on alternative fuels.
- To set an agreement between all European stakeholders on the objectives.

January 2003 CEN/BT agreed to create a Technical Board working group (BT/WG 149) on "Alternative fuels" and to allocate the convenorship and secretariat function to SIS. The aim of the BT/WG 149 is to initiate a European collective view of the general strategy for improvement of standardization on alternative fuels. BT/WG 149 shall according to CEN/BT's decision not establish CEN publications. A report with conclusions and recommendations shall be presented to CEN/BT, by mid 2004.

10.8 CEN/TC 19 and IEA/AMF

CEN/TC 19 secretary Mr Ortwin Costenoble has been interviewed as a part of the work with Appendix XXVII and much of the information about CEN and TC 19 above is based on the information he has been so kind to contribute.

During the interview with Mr Costenoble the question about IEA/AMF's possibility to contribute with its competence and knowledge in the international work with standards for alternative fuels has been brought up. Mr Costenoble reaction was positive concerning the possibility to in some way engage IEA/AMF in the European work with standards for alternative fuels.

Since CEN does not take initiatives on its own to start work on standards it is not predictable what work that might come the next 5 years but it is very likely that member countries or EU will bring up new standardization issues. For this reason there might very soon be a possibility for IEA/AMF to offer its competence and knowledge to CEN. Even if the work with real standards might be a somewhat slow process, much can be done in advance of that. To begin with there might be a need for a watch group in the same way as for fuels for fuel cells to follow the development of techniques both for production and use of some alternative fuels and to remind CEN/TC 19 when it might be the right time to set up a WG. In the mean time, there might also be a need for CEN/TC 19 to have workshops about one or more alternative fuels and to disseminate the information via a CEN workshop agreement like mentioned before.

Mr Costenoble mentioned that a possible way for IEA/AMF to take part in the standardization work in CEN/TC 19, and then primarily in a watch group or in workshops, could be as an affiliated member of CEN. For this acceptance by the CEN Technical Board, based on the organizations background, and by CEN/TC19 itself is needed.

10.9 References

[CEN] CEN, website: www.cenorm.be

[OC1] Mr Ortwin Costonoble, CEN/TC 19, Personal communication by Mr Björn Rehnlund on 20 November 2002.

[OC2] Mr Ortwin Costonoble, Mail correspondence 3 February 2003

[CS] Mr Carel Stapel, CEN/TC 19, Telephone interview by Mr Björn Rehnlund 8 January 2003

[AO1] Mrs Ana Olaru, Swedish Standards Institute. Personal communication 18 November 2002.

11 THE INTERNATIONAL ORGANIZATION FOR STANDARDIZATION – ISO

11.1 Introduction

The International Organization for Standardization (ISO) is a worldwide federation and a non-governmental organization.

ISO is made up of its members. Autumn 2002 there were 143 members, one from each country.

The members are divided into three categories:

- A member body of ISO is the national body most representative for standardization in its country. Member bodies are entitled to participate and exercise full voting in any technical committee and policy committee of ISO.
- A correspondent member is usually an organization in a country, which not yet has fully developed national standards activity. Correspondent members do not take an active part

in the technical and policy decision work, but are entitled to be kept fully informed about the work of them.
- A subscriber member is a country with very small economy. Subscriber members pay reduced membership fees that nevertheless allow them to remain in contact with international standardization.

The mission of ISO is to promote the development of standardization and related activities in the world.

ISO's work results in international agreements, which are published as international standards. Standards that are market driven and include involvement of all interests in the market place. These standards are voluntary to implement.

11.1.1 ISO strategies

ISO has defined five major strategies for 2002-2004 expressed as commitments to:

- Increase ISO's market relevance.
- Strengthening ISO's international influence
- Promoting the ISO system and its standards
- Optimising the use of resources
- Supporting national standard bodies in developing countries

11.2 Structure and management of ISO

ISO is headed by the president and the secretary-general.

Mr Mario Cortopassi is 2002 ISO's president and Mr Christian J. Favrei is secretary general.

ISO is governed by the general assembly that is constituted by a meeting of the officers, delegates nominated by the member bodies. Correspondent – and subscriber members may attend as observers.

The operations of ISO are governed by the council, consisting of the officers and eighteen elected member bodies. The council appoints the treasure, the twelve members of the technical management board and the chairman of the policy development board. The council also decides on the annual budget of the central secretariat.

The 2002 member bodies of the council are:

- Spain, AENOR
- France, AFNOR
- USA, ANSI
- India, BIS
- United Kingdom, BSI
- Germany, DIN
- Denmark, DS

- Malaysia, DSM
- Jamaica, JBS
- Japan, JISC
- Rep. Of Korea, KATS
- Kenya, KEBS
- Saudi Arabia, SASO
- Canada, SCC
- Israel, SII
- Sweden, SIS
- New Zealand, SNZ
- Viet Nam, TCVN

The council has two committees;

- Standing committee on finance
- Standing committee on strategy

The technical work of ISO is highly decentralized and carried out in about some 2850 technical committees (TC), subcommittees (SC) and working groups (WG). There are for the moment 186 active technical committees. These committees constitute of qualified representatives of industry, research, government authorities, consumer bodies and international organizations. The majority responsibility for administrating a standard technical committee is laid upon one of the national standard bodies that make up the ISO members.

The central secretariat of ISO, situated in Geneva, acts to ensure the flow of documentation in all directions, to clarify technical points with secretariats and chairmen and to ensure that the agreements approved by the technical committees are printed, submitted as draft international standards to ISO members for voting and finally published.

11.2.1 How ISO develops standards

ISO standards are developed according to the following principles:

- Consensus such that all interest are taken into account
- Industry –wide to find global solutions to satisfy industry and consumers worldwide
- Voluntary market driven involvement and implementation

The ISO standard development procedure can be divided into three phases.

First of all the need for a standard has to be expressed by a national member to ISO. Once the need for an international standard has been recognized and formally agreed by ISO, the first phase can start with the definition of the technical scope of the future standard. This phase is primarily carried out in working groups, which comprise technical experts nominated by interested National bodies.

When the technical aspects to cover have been agreed on, the second phase of the work can start. This phase includes negotiations concerning the detailed specifications within the standard. This is the consensus-building phase.

Finally and the third phase comprises the formal approval of the resulting Draft International standard (DIS). The acceptance criteria stipulate approval by two thirds of the ISO members that have participated actively in the standard development process and approval by 75 percent of all members that vote. After having approval of the standards the agreed text is published as an ISO international standard.

Since most standards require periodic revision, ISO has established the general rule that all ISO standards should be revised in intervals of not more than five years.

11.3 Technical committee nr. 28 " Petroleum products and lubricants"

Technical committee 28 "petroleum products and lubricants" (TC 28) is for the moment the most relevant TC concerning an eventually work with standardization of alternative fuels.

TC 28 constitutes of 24 ISO member countries and 45 observer countries, see Appendix 8.

Autumn 2002 TC 28 secretariat was held by The American National Standardization Institute (ANSI) and TC 28 was chaired by:

Dr W. James Bover, ExxonMobil, USA

The secretary function was fulfilled by:

Mrs Paula Watkins, American petroleum Institute (API)

Under the auspice of TC 28 there were in autumn 2002 6 subcommittees and 5 working groups.

11.3.1 Scope and objective of TC 28

Standardization of methods of measurement, sampling and test, thermic classification and specification for petroleum, petroleum products in petroleum based lubricants and hydraulic fluids.

11.4 ISO/TC 28 and standardization of alternative fuels

ISO/TC 28 secretary Mrs Paula Watkins has been interviewed as a part of the work under Appendix XXVII. Much of the information about ISO and TC 28 above and that will follow is based on the information that she has been so kind to contribute.

ISO/TC 28 has until today not decided on any work with or standards for petrol or diesel oil, except for a specification for marine fuels, worked out by TC 28, subcommittee 4 working group 6. ISO/TC 28's work is instead of that concentrated on the standardization of measurements and sampling technique/methods that can be used in national standards and also CEN standards for fuels, as well as standards within the area of lubricants, see Appendix 9. Because of that, in

ISO/TC 28 there have not been any discussions concerning standardization of alternative fuels, alternative fuels with the purpose to replace diesel oil or petroleum used in road vehicles. Mrs Watkins could not either predict any coming initiative in the area of standardization of either conventional fuels or alternative fuels.

However, this is too a great extent depending on the member countries and their interest in the area of alternative fuels and the increased use of alternative fuels that might come. If a member country of ISO would bring up the need for a standard for alternative fuels on the ISO agenda and also reach an agreement on the production of such a standard, the work would probably be managed by ISO/TC 28 and done by a working group under one of the ISO/TC 28 subcommittees. Because of an overlap with other TCs, for example the ISO/TC 22 "Road Vehicles" responsible *inter alia* for test methods of tail pipe emissions from road vehicles, it is not absolutely clear where a future standardization of alternative fuels finally would be taken care of and handled.

ISO/TC 197 "Hydrogen technology" also has an interest in alternative fuels but then of course fuels for fuel cells, and then for the moment mainly hydrogen. See Chapter 3 (Canada), for more information on ISO/TC 197.

The increased interest for alternative fuels has put focus on the need for test methods optimised for alternative fuels. Today test methods for fuels are optimised for oil products. Often they can also be used for alternative fuels but it is not unlikely that they can give a more or less incorrect result. A probably coming scope for international standardization organizations might be the development of test methods etc optimised for alternative fuels or fuels groups.

ISO/TC 28 is for the moment looking at the possibility to extend the scope of test methods for fossil fuels to Fatty acid methyl esters (FAME). However, ISO/TC 28 has yet not done any work on standardization of test methods for gaseous fuels, as for example methane.

It is not unlikely that the European Commission through CEN will give ISO a mandate to produce standardized test and sampling methods for alternative fuels on which CEN initially is focusing. FAME is already on the CEN agenda and ethanol will probably be brought up in 2003, see Chapter 9. To be able to create standards there is a certain need for standardized test methods optimised for the fuel as such. Mrs Watkins pointed also out the problem with storage properties for some alternative fuels as well as flashpoint and sulphur content as areas of importance for an increased use of alternative fuels and in that case also the need of measurement methods of these parameters optimised for alternative fuels.

11.5 ISO/TC 28 and IEA/AMF

During the interview with Mrs Watkins the question about IEA/AMF's possibility to contribute with its competence and knowledge in the international work with standards for alternative fuels was brought up. Mrs Watkins reaction was positive concerning the possibility to in some way engage IEA/AMF in the international work with standards for alternative fuels. Because of the already described situation with ISO mainly focusing on the need for standards for test and sampling methods, this would of course also be the main scope for an IEA/AMF engagement in ISO's work with standards.

Since ISO does not take initiatives on its own to start work on standards, it is not predictable what work that might come the next 5 years but it is very likely that new standard methods for alternative fuels will be brought up by member countries or EU, see above. For this reason there might be a possibility for IEA/AMF to offer its competence and knowledge to ISO in the future.

Mrs Watkins primarily highlighted IEA/AMF's possibility to contribute with proposals for experts to working groups and also as project leaders of working groups in the area of alternative fuels. She also was very positive to the idea of having workshops as a way to start up and maybe also initiate an interest on standards for alternative fuels and test methods for alternative fuels. Preferably this could be a way to work when legal requirement or policy statements concerning alternative fuels is to come but still not yet is formally outspoken. Also in this kind of pre standardization work on an informal base she saw a good possibility for IEA/AMF to participate and contribute both with proposals for experts but also on its own.

11.6 References

[ISO], ISO, *Website:* www.iso.ch

[TC/28], ISO/TC 28, *website: www.api.org/iso/tc28/organiz.htm*

[PW], Paula Watkins, *Telephone interview by Mr Björn Rehnlund on 6 December 2002*

12 ANALYSIS

From the information gained from the interviews and to some extent also information available on websites and in literature, it appears that so far little has been done on national as well as on international level, concerning standardization of alternative fuels. However, some national standards have been developed and it also exists a very small number of international standards.

For further information about existing standards please see "List of standards on alternative fuel specifications" and Appendix 3.

From the interviews with people representing standardization interests in the participating countries, it has also been possible to draw some conclusions and to find some common views on alternative fuels and the requirement of standards. These views are summarized below in Section 12.1 and 12.2.

From the interviews with representatives for CEN and ISO, as well as from information from their web sites, it has also been possible to draw some conclusions concerning the international work with standards. These conclusions are presented below in Section 12.3, 12.4 and 12.5.

In Section 12.6 the general points of view that have been put forward during the interviews concerning IEA/AMF role in the future international work with standardization of alternative fuels are summarized.

It is important to make clear that the conclusions and the common views are the opinion of the authors, based on information from the interviews and other information. If people being interviewed are quoted, this is clearly marked in the text.

12.1 National standardization work on alternative fuels

On a national level, work on standardization is performed by independent and non-profit standardization organizations. The members of the organizations constitute of stakeholders from private- and public sectors. The members decide which standards are addressed and finally, if it is possible to reach an agreement, on which standards decision can be made.

The need for a new standard is almost always brought up on the agenda on the initiative of one or more of the participants.

The use of national standards is voluntary, but since standards are brought up, worked out and decided on by representatives of the stakeholders, they have a very broad acceptance in society and are highly implemented.

The responsibility for the standardization work is often delegated from the standardization organization board to a Technical Committee (TC), belonging to the standardization organization. There are often a number of TCs and each TC covers one or several sectors with a broad area of activities. The operational technical work on standardization is mostly carried out in one of several working groups belonging to one of the TCs. A working group is made up of experts, often nominated by the participants to the board/technical committee. When the experts have reached that point in their work that they can agree on a proposal for a standard, the proposal is put forward to the TC. The TC then has to decide if to go further and take the proposal to the board for a formal decision to make it a national standard.

The national standardization organizations also represent their countries in CEN and ISO, if being members of these international standardization organizations. When being a member in CEN and ISO, it is possible to influence the work on all levels from the board to the technical work in working groups etc. Concerning CEN standards this is quite important, since when CEN decides on a standard, the standard has to be implemented by the national standardization organizations as a national standard without any amendments. If a national standard already exists, it has to be withdrawn and replaced by the CEN standard. You can read more about this below. The situation for ISO standards is not the same. ISO standards are voluntary, not only to use, but also to implement. You can read more about this below.

As already said, so far little has been done on national level concerning standards for alternative fuels. This reflects probably that in most countries an introduction and use of alternative fuels so far has been possible to implement without standards. The reason for this is most likely that alternative fuels when used today, this often is carried out in:

- Captive fleets, or in
- Blending with conventional fuels to such low levels that the standard for the conventional fuel still can be fulfilled. What we then really are talking about is a conventional fuel with an “alternative fuel additive”, like for example gasoline with a few percents of ethanol.

Sometimes the introduction might have been done with help of a, for the moment, agreed specification for the alternative fuels being introduced (used). This specification often tends to be similar to what in the future might be decided on as a standard.

One might say that standards are not really asked for, either from car manufactures, oil companies or the consumers, before there is a rather substantial production and use of the fuel. On the other hand, it is difficult to introduce a new fuel in such quantities on the market without having a standard. So we seem to be back, as many times before, on a discussion on what comes first, the chicken or the egg, the standard or the substantial use.

However, when there has been more of a common request for an alternative fuel on the consumer market, as for example bio-diesel in Germany and Austria, ethanol in Sweden and ETBE in France, the specifications have often been taken forward by national stakeholders to the standardization organization for a decisions on a national standard. In some cases like LPG, bio-diesel/FAME and to some extent ethanol, the request for standards has also been taken further from the national level to international level.

12.2 Common view on alternative fuels future and the requirement of standards

The marketing and use of alternative fuels on the commercial market has in most situations not been large enough to require standards, maybe in some cases specifications but no standards. Neither has the use in fleet test has been large enough to require standards, which is more understandable. When used in fleet tests specifications might have been set up just for the test and produced without involvement of any other than those taking part in the test. Such a specification might be of high quality but unfortunately, since being produced in the frame of a rather restricted group of participants it might be difficult to spread it to be used in other tests or to be issued as a base for a standardization work, without repeating most of the work, but then in a much broader group of participants.

Even though opinions are sometimes divergent, most of the people being interviewed seem to agree on that:

- The production and use of alternative fuels has to, and also will, increase substantially the coming five to ten years.

- At first, the increase will be an effect of fulfilling national goals for the reduction of greenhouse gases, which implicates that alternative fuel at first mean bio fuels, but to some extent also natural gas.

- Use of alternative fuels in neat form in adapted vehicles or for low blending in today's conventional fuels, will also contribute to the reduction of emissions with impact on health and environment.

- However, with the great opportunity that we have today to further develop and improve engine technology the environmental properties of today's conventional fuels, as for example done in Sweden and Finland, will in the future make it possible to reduce the emission difference between alternative fuels and conventional fuels to an absolute minimum.

- In Europe the increased use of alternative fuels, *inter alia*, will come as an effect of the discussions concerning a directive for the promotion and taxation of alternative

fuels. This increased demand of alternative fuels will probably happen whether there will be a directive or not, just the discussion seems to be enough to start activities which in a couple of years will lead to increased demand of alternative fuels.

- A prerequisite for an increased production and use of alternative fuels is that the production costs could be lowered to such a level that the alternative fuels could be sold on the consumer market to such a prize that they will be able to compete with conventional fuels. Initially, this requires tax redemption for the alternative fuels. But in a long time perspective the production costs for alternative fuels must be decreased, together with an increased oil prize, to such levels that they can compete with the conventional fuels without such subsides.

- An acceptable price/production cost for alternative fuels also implicates a minimum production capacity or rather plant sizes of a certain level.

- Neat use of alternative fuels will in the short term be insufficient to build up such a demand of alternative fuels that the volumes will be enough to make it economical feasible to erect and run production plants.

- However, such production levels could be achieved by low blending of alternative fuels in today's conventional fuels. Even if blending just a small percentage of alternative fuels into conventional fuels, the total volume easily can be of such magnitude that production of the alternative fuel could be economical feasible. Low blending of the alternative fuels into today's conventional fuels, as diesel oil and gasoline, therefore should be the first step in introducing liquid alternative fuels on the commercial market.

- In parallel to low blending, vehicles for neat use and neat use as such could be introduced to the market at a slower, but for the issue suitable, time.

- An increased use of the alternative fuels requires that they have to be taken out from laboratories and test fleets and that they are introduced on the commercial market.

- Use of alternative fuels on the commercial market requires acceptance from manufactures of engines and vehicles as well as the consumers.

- Acceptance from manufactures of engines and vehicles and the consumers requires standards.

- In an open society with a worldwide market and trade, there is much more need for international standards than for national standards.

- When dealing with standards for alternative fuels it is important to start with fuels that already are available on the consumer market or close to be introduced at the consumer market.

- There might be a need for different standards for an alternative fuel, in case it will be used in different applications. For example there might be a need for different standards for alcohol if used in neat form in an otto engine or in neat form in a diesel

engine and for low blending in gasoline or for low blending in diesel oil.

- Because of what already has been concluded concerning where to begin using alternative fuels when aiming at a production volume large enough to be produced at economical feasible conditions, it might be a good idea to start with standards for low blending.

12.3 CEN, Standardization of alternative fuels

The European Committee for standardization (CEN) is the association responsible for the development of European standards. The members of CEN are the national standardization institutes of twenty European countries. CEN is also the European counterpart of the International Organization for Standardization (ISO).

Even if the use of international standards is voluntary, CEN or rather European standards must be published by each national standardization institute as an identical national standard. Furthermore, already existing national standards in conflict with the European standard must be withdrawn. In comparison with and contrary to ISO, one may say CEN does not really have its own standards, even if standards are produced by CEN. Instead, the standards produced and decided on by the technical board must be taken over by every member state of CEN.

Even though they are voluntary to use, European directives sometimes mandate European standards. Because of that, conformity to such standards may follow as a consequence of conformity to legal requirements and directives.

With the purpose to support European legislation, the European Commission sometimes gives mandates to CEN concerning production of a European standard. This includes also economical EU sponsoring of the work on the standard. The proposed standard for FAME, on which CEN most likely soon will take a decision, is the result of a EU mandate. The, for the moment discussed, ALTENER project concerning standards for bio (fuel) ethanol is not based on a mandate from the EU Commission but still at the initiative of the EU Commission. If the project will be accomplished, ALTENER will also fund a part of the project. Furthermore, if the ALTENER project will be managed and brought forward in a successful way, the results of the project may be taken as a base for a mandate from the EU Commission to CEN concerning production of standards for ethanol for vehicle use.

Until the middle of 1980s there were no discussions on European standards for vehicle fuels, neither on alternative fuels nor on gasoline or diesel oil. In the beginning of 1990s the first European standard (the standard on unleaded gasoline) was implemented as a result of a mandate from the EU Commission. Every one of today's existing European standards on fuels are results of EU mandates to CEN. Without these mandates it seems not unlikely that Europe still would not have any European standards in this area. This has to be kept in mind, when discussing European standards for alternative fuels and what might seem to be a lack of interest for alternative fuels standards.

The reasons behind this lack of interest on European fuels standards are not absolutely clear. One reason might be that the introduction of gasoline and diesel oil has been a slow process during many years. This process, started at the beginning of the last century in a time when

standards not were a common concept. The need was not obvious to people working with engines and vehicles. Besides that, the beginning of the last century was a time when almost everything, except maybe war, was carried out on national level. At that time most cars were produced in the same country as where they would be used. If cross boarder transportation at that time it was carried out by ships and not cars and trucks. So even standards would have been known as a concept, the need for international standards would have been very low. During the next 40 to 50 years, the use of vehicles and, oil products as a fuel for these vehicles has increased rather slowly, at first. During this time the interest for combustion engines has also been extended to other applications such as work machines and small engines for handheld tools/equipment. But since growing slowly the interest and need for and interest of standards has also increased slowly.

During at least the last 30 years of the last century, transportation continuously has increased heavily, for one reason as a presumption for increased welfare. At the same time, the internationalisation with more contacts and marketing between people and companies in different countries has increased. Parallel to this internationalisation, the need for cross boarder transportation, not only by ships but other transportation means such as aircraft and not at least heavy trucks, has also increased heavily. This substantial increase of international transportation should have required international standards for fuels, but still no country took any initiative until the European Commission did. Even the car manufactures, that strongly support unified requirements and specifications to avoid production of national adapted cars as much as possible, seem to have kept a low profile in the area of standardization of vehicle fuels. It might be understandable that international standards have to follow national standards and if national standards were lacking it would have been premature to bring up international standards on the agenda. But national standards were discussed and decided on already in the beginning of the 1960s. And in some cases maybe even earlier.

It is difficult to explain the lack of acting during 1970s and 1980s, at a time when transportation as such was growing enormously both on national and on international level, and with that the need of international vehicle fuel standards. Maybe it was just a consequence of the long time period during which the need for transportation and the use of vehicles slowly and in absence of standards had been build up. You, so to speak, do not miss what you do not know, until reality more or less forces you. Then it takes time to accept and implement.

12.3.1 CEN/TC 19 and standardization on alternative fuels

The work done so far in CEN/TC 19 on standards for FAME, and also the discussions going on in CEN and NEN concerning an ALTENER project on standardization of fuel ethanol, are a good start of the work on standards for alternative fuels. CEN/TC 19's watch group for fuels for fuel cells also shows that the European organization for standardization has realized that the need for standards on alternative fuels will come and will require time and resources.

It might be argued that the time until the need for standards on alternative fuels will come can be used in a better way. Instead of taking different actions with the purpose to analyse the situation and to prepare for a coming situation, CEN/TC 19 could act as usual and await actions from the participating countries in CEN/TC 19. The need for new standards would then be brought up on initiative of member countries and then be discussed in CEN/TC 19. A proposal for a standard would be produced by a working group and via CEN/TC 19 brought

forward to the CEN technical board CEN/BT for decision. However, when dealing with a rather new area and a maybe limited time period before standards should be in force, it might be argued that CEN itself maybe should take actions to find out how the near future might look and to prepare for coming responsibilities.

Issues that in such a case might be analysed are for example:

- Is it possible to estimate how much the use of alternative fuels will increase?
- If so, what can this assumption imply for the need of standards on alternative fuels?
- Which alternative fuels are already on the consumer market?
- Which alternative fuels are close to being introduced on the consumer market?
- Is it necessary for CEN to prepare itself for what might come concerning standardization of alternative fuels?
- If so, what measures have to be taken with the goal to be prepared?

As already mentioned, this might not be the normal way for CEN/TC 19 to work with standards, but on the other hand, it might be necessary to be able to fulfil coming demands from the members and not at least the market, with an acceptable input of time and resources.

12.3.2 CEN/Technical boards “Task Force on liquid and gaseous alternative fuels".

As a result of the work on standardization of alternative fuels, performed under the auspice of the Swedish standardization institute SIS, and described in the Chapter 7 and 9. SIS 2002 contacted CEN for a first discussion about the issue of international standards on alternative fuels. The reason for SIS was to find out if it might be of interest for CEN to support a European project along the same line as already done for Sweden.

After a preliminary positive reaction from CEN concerning the proposed idea, SIS in late autumn 2002 sent in a formal proposal for a new “project” or rather working group (WG) to CEN belonging to the Technical Board and with the title “New technical Board working group on alternative fuels”.

January 2003 CEN/BT agreed to create a Technical Board working group (BT/WG 149) on “Alternative fuels” and to allocate the convenorship and secretariat function to SIS. The aim of the BT/WG 149 is to initiate a European collective view of the general strategy for improvement of standardization on alternative fuels. BT/WG 149 shall according to CEN/BT’s decision not establish CEN publications. A report with conclusions and recommendations shall be presented to CEN/BT, by mid 2004.

12.4 ISO, Standardization of alternative fuels

The International Organization for Standardization (ISO) is a worldwide federation and a non-governmental organization. ISO is made up of its members. Autumn 2002 there were 143 member organizations.

The mission of ISO is to promote the development of standardization and related activities in the world. ISO’s work results in international agreements, which are published as

international standards. Standards that are market driven and include involvement of all interests in the market place, standards voluntary to implement.

Contrary to CEN, ISO really has its own standards. But also contrary to CEN, the members of ISO are not obligated to publish ISO standards as an identical national standard. ISO standards are not only voluntary to use, they are also voluntary to implement. Because of that it is quite possible for a member state to use an ISO standard as a starting point for a national standard, but more or less changes might be introduced before it is implemented as a national standard.

Today there are no existing ISO standards on conventional fuels, except a single one for marine use, and no standards on alternative fuels. With regard to the discussion above, concerning international standards on conventional fuels and the rather late time for introducing the first European standard for unleaded petrol and then first after a mandate from the European Commissions to CEN, it seems quite understandable that still no global standards for vehicle fuels exist. If it has not been on the agenda in a region, why should it have been brought forward to ISO? It seems rather logic to start with such an issue on a regional level, and when having a standard in one or more regions go further to the global level.

Still one question could be raised:

- With an enormous growth of transport and with global trade of vehicles, how come that engine and vehicle manufactures have not acted more powerful to establish international standards on gasoline and diesel oil?

It is obvious that it is a long and difficult process to obtain an agreement on a global standard. Maybe it is more or less impossible to agree on such a standard. Maybe the advantages of a global standard would have been too small in comparison to the time and resources that would have to be spent on the final product. But why has no attempt been made? Why has the issue not been on the agenda for a discussion? The answer is more than uncertain, but a part of it might be the same as presented for Europe above. The rather long period from introducing vehicles and vehicle fuels on the market until the need of standards was obvious for everyone has contributed to a stiff and cemented national view on the need for international standards. We have our own standards and that is enough. But is this really enough to keep vehicle manufactures satisfied when production costs increase because their vehicles have to be produced in different versions, adapted to national standards and regulations?

12.4.1 ISO/TC 28 and standardization of alternative fuels

ISO/TC 28 “petroleum products and lubricants” is for the moment the most relevant ISO TC concerning an eventual work on standardization on alternative fuels. However, ISO/TC 28’s scope and objective are the standardization of methods of measurement, sampling and test, thermic classification and specification for petroleum products in petroleum based lubricants and hydraulic fluids. Until today, ISO/TC 28 has not decided on any work with standards for petrol or diesel oil, except for a specification for marine fuel. In line with that there have of course not been any discussions on standardization of alternative fuels.

For the near future it seems most likely that the closest ISO/TC 28 might get to alternative fuel issues, if requested by the members, is to take on board issues related to sampling and test methods for alternative fuels This might be very useful for coming work with standardization on alternative fuels. CEN/TC 19 already in their standards often relies on methods that have been produced and standardized by ISO. But experience often has showed that sampling and test methods for petroleum products cannot generally be used for alternative fuels without amendments**.**

If society wants to introduce and promote the use of alternative fuels, standards are inevitable. In standards for alternative fuels, there is a need for specified methods for sampling and test methods that are adapted for the alternative fuel discussed, and methods that preferably also have to be standardized. In line with this, and in line with how CEN and ISO until now have worked together avoiding duplication, much of the work with standardization of methods for sampling and testing of alternative fuels could be done within the framework of ISO.

12.4.2 ISO/TC 197, Hydrogen technologies

In ISO there is one exception to the lack of activities on standardization of alternative vehicle fuels, and that is ISO/TC 197, Hydrogen technologies. This technical committee is working on standardization in the field of systems and devices for the production, storage, transport, measurement and use of hydrogen. The use includes the use as a vehicle fuel, because that is considered a promising market that may lead to an increased use of hydrogen technologies. Fuel cell vehicles are an obvious application for hydrogen, but the use of hydrogen as an additive to existing fossil fuels or as a fuel for internal combustion engines are also considerations for the work of ISO/TC 197.

In all these road vehicle applications, the committee sees a role for hydrogen in significantly reducing pollution levels in urban areas. For the long term, the committee sees a role for hydrogen as a fuel for airplanes, boats and locomotives. The high energy content per unit of weight of liquid hydrogen makes it especially attractive as a fuel for aircraft. An ISO standard ”Hydrogen fuel product specification” has already been established, and also a standard ”Liquid hydrogen - Land vehicle fuelling system interface”. ISO/TC 197 is also working on other topics that are relevant in the total hydrogen fuel chain, for example safety and tank containers for multimodal transportation of liquid hydrogen.

12.5 Comparing CEN’s and ISO’s working methods

Both ISO and CEN are international organizations, working in the global and European arena respectively. Neither of them has been engaged especially in standardization of vehicle fuels and even less in alternative fuels. ISO more or less has not been dealing at all with standards on fuels themselves but rather more with the standardization of sampling and test methods to be used in standards for fuels. CEN has done some work on conventional fuels (gasoline, diesel oil and LPG) and FAME but only when mandated by the EU Commission. For the moment, some work is just to begin in CEN/TC 19 and some work is to be further discussed concerning standardization of ethanol for blending purpose.

CEN's standards must be published by each participating national standardization institute, as an identical national standard. Furthermore, already existing national standards in conflict with the European standard must be withdrawn. ISO's standards on the other hand, are free to use/implement/publish and can very well be used as base material in the production of national standards.

ISO and CEN have an agreement not to duplicate work. From a European point of view, ISO and CEN seem to supplement each other very well, since ISO takes responsibility for the main part of the production of the standardization of sampling and test methods to be used in national standards and also in CEN standards. In a way, one can also say that there is a somewhat similar situation in Europe, avoiding duplication of work, since CEN standards have to be implemented as national standards. That way of working avoids duplication and seems to function very well, even if a system with mandatory acceptance of regional decided standards sometimes might be a little bit stiff and not so flexible.

From an ISO point of view, the advantage with the agreement avoiding duplication of work with CEN must seem somewhat less favourable, since ISO does not have many CEN standards to take over. On the other hand, the members of CEN are also members of ISO and if society does not ask for global standards on fuels, conventional or alternative, there are not many opportunities for ISO to rely on CEN and for example taking over CEN standards.

This situation might change in the future when the demand of alternative fuels will increase, not only on regional level but also worldwide. The introduction of gasoline and diesel oil has at least in the beginning been a slow process over a rather long time period. The decreasing supply of oil, and because of that, oil products like gasoline and diesel oil, might be a faster process. This implicates a faster introduction of alternative fuels on the market than in the case of gasoline and diesel oil. This in combination with the internationalisation of the market and the cross border transportations with trucks and cars, might lead to a more emphasized need for not only national and regional standards, but maybe also international standards. In a situation like that, ISO could very well come to use CEN standards in combination with for example standards from USA and Japan, as a basis in the production of worldwide ISO standards for a alternative fuels.

12.6 IEA/AMF and the international work with standardization of alternative fuels

Many of the people interviewed often had none or very little knowledge about IEA/AMF. However, when being informed about IEA/AMF's goals and objectives, as well as work performed during the last 20 years, they became very interested and often requested more information about IEA/AMF.

The people interviewed have also, with few exceptions, been of the opinion that there might be a need for an informal international forum where to carry out informal discussions and where to share information concerning standardization. In the formal discussions in CEN and ISO, and even in working groups belonging to one of CEN or ISO's technical committees, it might sometimes be difficult to speak open and freely without risking to be quoted as having declared the national standpoint for the country one is nominated of. Such informal discussions could advantageously be arranged by an organization without any formal bindings to CEN or ISO, but with experience in the area to be discussed.

Concerning standardization of alternative fuels, many of the interviewed people have also welcomed an initiative from IEA/AMF with the purpose to act as such an informal discussion forum.

Concerning the form for such discussions, workshops with a clear and plain item for the discussions might be of most interest. It is also pointed out that these workshops preferably could be performed not at the same time but in connection to formal international meetings in for example CEN/TC 19 and ISO/TC 28, maybe some weeks in advance of such a meeting. It has also been forwarded not to perform too many of such workshops, since the time for travelling to international meetings is restricted. Not more that two per year seems to be what people in common are prepared to participate in. Of course more workshops can be arranged when the item for the discussion are so different that it can be assumed the workshops will attract different participants.

Concerning CEN and ISO, both organizations through their technical committees CEN/TC 19 and ISO/TC 28 have welcomed IEA/AMF to contribute with its knowledge and experience in the field of alternative fuels. Since ISO not yet has discussed standards for fuels or alternative fuels, it might, except for ISO/TC 197 “Hydrogen” be a little bit premature to try start up a cooperation with ISO immediately. Before going further with some broader kind of cooperation with ISO, ISO’s engagement in standardization of alternative fuels should be awaited. On the other hand, CEN is already involved in the production of standards for alternative fuels. The possibility for IEA/AMF to contribute to the standardization of alternative fuels in CEN is because of that much closer. For the moment, CEN/TC 19 has so-called liaison members or affiliated members, a form of participation that might be of interest for IEA/AMF. As such, a member of IEA/AMF could for example take part in CEN’s pre stage to working groups, so-called watch groups. IEA/AMF could also take part as a kind of expert in CEN/TC 19/WG21 concerning a standard for ethanol as a blending component (5 percent) and the ALTENER project concerning a standard for E85 as well as the feasibility study described in Chapter 10. Another good example is the Technical Board working group 149 (BT/WG149) described in Chapter 7 and 10.

Obviously there are many opportunities for IEA/AMF to come out on the market with its experience and knowledge and to contribute in the increasing work with standards for alternative fuels. One possibility is to act, maybe on request of a standardization organization such as CEN or ISO, in the form of arranging workshops in the area of standardization of alternative fuels. Another possibility is to participate in CEN and/or ISO as some kind of affiliated member and in competence of that take part in the work with standardization of alternative fuels, contributing with experience and knowledge. However, how this best can be done has to be further discussed and analysed in the frame of Appendix XXVII and in the group of IEA/AMF ExCo delegates. Furthermore, if so decided by the ExCo of IEA/AMF, discussions have to be undertaken with representatives from for example CEN and/or ISO with the purpose not only to have a first contact but also to see if and how a future cooperation best could be performed.

13 CONCLUSIONS AND FURTHER WORK

From the information obtained from the interviews, literature and websites as well as from the analysis of the information as presented in Chapter 12 (Analysis), it has been possible to draw

conclusions concerning standardization of alternative fuels today and also on what may come in this area in the near future.

It has also been possible to put forward some ideas concerning the options for IEA/AMF to contribute to future international work on standardization of alternative fuels

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13.1 Conclusions

- The use of alternative fuels is most likely to grow and in some market areas this growth may be rather fast.
- An increased use of alternative fuels requires that the alternative fuels, much more than today, will be introduced on the open consumer market.
- An introduction on the consumer market requires acceptance of the alternative fuel by both vehicle manufactures and vehicle users.
- Acceptance by vehicle manufactures and users requires standards.
- Specifications might be sufficient for a start, but when the use of alternative fuels is growing, specifications have to be replaced by standards.
- Since both transport and trade today are worldwide, standards need to be implemented on an international level.
- To begin with, international standards could be decided on a regional international level, as for example in Europe.
- To some extent the USA could be regarded as region, talking about standardization on regional level as a starting point for international standards on alternative fuels.
- In Europe, standardization is more and more moving away from a national level to a European level. European countries and organizations cooperate in establishing European CEN-standards, which are compulsory to become national standards in participating countries.
- European CEN-standards on gasoline and diesel oil for vehicle use exist since the beginning of the 1990s. CEN-standards on alternative fuels are lacking for the moment but a CEN-standard on FAME is close to be accepted.
- Today at least 6 US standards on alternative fuels exist.
- In the long term, there might also be a need for worldwide, global standards for conventional and alternative vehicle fuels.
- Worldwide, standards on specification and properties of conventional vehicle fuels are scarce. Such standards on alternative fuels are lacking, except for an ISO standard on hydrogen.

- Increasing the use of alternative fuels today requires subsides as for example tax redemption.
- In the long-term, tax redemption will have to cease. At that time the production and distribution costs for alternative fuels have to be decreased to a level where they can compete with the production- and distribution costs for conventional fuels at that time.

- To be able to produce and distribute alternative fuels to as low costs as possible, it is important that the use and with that the size of the production plants will reach certain minimum levels.
- Neat fuels for niche use in small segments of the market are probably not enough to reach such levels for many years.
- Blending of small quantities of an alternative fuel in conventional fuels (low blending) will lead to a much faster growth in market share, with an associated growth in production demand, than the use of a neat alternative fuel in adapted vehicles.
- Low blending will soon demand large production volumes of the alternative fuel – with associated low costs - that the use of the fuel in neat form very well could take off and become a significant part of the total production volume.
- If there have to be different standards for a fuel used for low blending and the same fuel to be used in neat form, it is more urgent to have a specification and standard for the use of the fuel for low blending.

- Today, the transport sector contributes to a very high extent (about a quarter) of the total manmade emissions of carbon dioxide. Because of that, the transport sector also influences the possibility for different nations to fulfil international commitments, such as the Kyoto protocol.
- The main reason today to replace conventional fossil fuels with biomass based/renewable/carbon dioxide neutral fuels is to contribute to the reduction of the net emissions of carbon dioxide and in association with that the impact on the climate.
- In 10 to 20 years time it might also be necessary to replace conventional fuels as diesel oil and gasoline with alternative fuels because of an unacceptable increase of the price of oil and oil products. An increase in the price mainly caused by a diminishing supply of oil may also be followed by an increased use of remote sources.
- Even in the short term there might be a problem with the supply of oil resulting in unacceptable prices on the oil products. One reason for this might be international conflicts and in the worst case also war.
- Both in the short as well as in the long-term there is a need to reduce the consumption of oil products, not at least for vehicle use.
- Since the need for alternative fuels in the short term is mainly focused on the reduction of the climate effects, an introduction of alternative fuels in the short term should be focused on the introduction of carbon dioxide neutral fuels or fuels with obviously reduced net emissions of carbon dioxide. Examples of such fuels are fuels produced from biomass like FAME and ethanol. An example of a fossil fuel that could contribute to the reduction of the emissions of carbon dioxide in vehicle applications is natural gas. Both methanol and DME are produced from synthesis gas. This gas could be produced either from gasified biomass or from natural gas. Depending on the feedstock for the synthesis gas, methanol and DME's contribution to the reduction of the net emissions of carbon dioxide is more or less important.
- Since the use of biomass based alternative fuels, but also to some extent natural gas, contributes to the reduction of the net emissions of carbon dioxide, and in association with that the impact on the climate, it seems reasonable to prioritise the work on standardization on alternative fuels to this kind of fuels.

- International standards are best produced by standardization organizations like CEN and ISO.
- CEN and ISO have shown to be interested in some form of cooperation to use IEA/AMF's competences, knowledge and experience on alternative fuels.
- The form of such a cooperation has to be discussed. The existing form of a liaison membership might be suitable.
- Among people engaged in the standardization of vehicle fuels there is also an interest to have a kind of informal discussion forum where issues related to standardization of alternative fuels could be discussed, free from formal negotiations and in advance of such negotiations. These informal discussions could be the start of discussing new topics in the standardization organizations technical committees and working groups.
- Such informal discussions could preferably be arranged/organized in the form of annually workshops by an organization independent from CEN and IS.
- There should preferably be not more than one or at the most two workshops on the same topic each year.
- IEA/AMF has good prerequisites of organizing such workshops. This could be done at the request of CEN and/or ISO.

13.2 Further work

To further work on the role that IEA/AMF could play in international standardization of alternative vehicle fuels, the following activities are recommended:

- Further and closer contacts and discussions with representatives of the international standardization organizations ISO and CEN, and their technical committees, to better understand:

  - Their need for IEA/AMF contributions.

  - Their wishes on how IEA/AMF could contribute to their work.

  - How IEA/AMF also could contribute to the international work on standardization of alternative fuels, outside ISO and CEN, acting as an arranger and/or organizer of international seminars/workshops in this area.

- Collecting and summarizing existing information and new insights obtained from the discussions mentioned above.

- Analysing the summarized information with the purpose to see in which way IEA/AMF best could contribute to the international work on the standardization of alternative fuels.

In parallel to and in interaction with these activities it would be possible to investigate and put forward proposals for:

- IEA/AMF's further cooperation with CEN and ISO, their technical groups and in some cases maybe even CEN and ISO's working groups.
- IEA/AMF's further activities in the area of standardization of alternative fuels.

ABBREVIATIONS

ACEA European Automobile Manufacturers Association
AENOR Asociatión Espanol de Normalizacion
Alliance Alliance of Automobile Manufacturers
AFNOR Association Francaise de Normalisation
AMF Advanced Motor Fuels implementing agreement of the IEA
ANS American National Standards
ANSI American National Standardization Institute
API American Petroleum Institute
APLAC Asia Pacific Laboratory Accreditation Cooperation
ASTM ASTM International, Former American Society for Testing and Materials
BA Administrative Board, CEN
BN Standards Bureau, France
BNPe Bureau de Normalisation de Pétrole, France
BNQ Bureau de Normalisation de Québec, Canada
BSI Britisch Standards Institute
BT Technical Board, CEN
CEN Comité Européen de Normalisation (European Committee for Standardization)
CGSB Canadian General Standards Board
CNG Compressed Natural Gas
CRFA Canadian Renewable Fuels Association
CRIQ Centre de Recherche Industrielle du Québec, Canada
CSA Canadian Standards Association
CSNI Czech Standards Institute
CWA CEN Workshop Agreement
DIN Deutsche Institut fur Normalumg
DIS Draft International Standard (in ISO)
DME Dimethyl ether
DOE The Department of Energy, The USA
DS Dansk Standards
EA European Cooperation for Accreditation
ELOT Hellenic Organization for Standardization
EMA Engine Manufacturers Association)
EN European Standard
EPA Environmental protection Agency, Sweden or the USA
ETBE Ethyl-tert-Butyl- ether
EU European Union
ExCo Executive Committee
FAME Fatty Acid Methyl Ester
GTL Gas-to-liquids
HEV Hybrid and Electric Vehicles technologies and programmes implementing agreement of the IEA
HPGS High Prssure Gas Safety Imstitute, Japan
IAAC Interamerican Accreditation Cooperation
IAF International Accreditation Forum

IBN Institut Belge de Normalisation
IDA International DME Association
IEA International Energy Agency
IEC International Electrotechnical Commission
IFP Institut Francais du Pétrole, France
ILAC International Laboratory Accreditation Cooperation
IPO Instituto portuguése de Qualidade
ISO International Standardization Organization
JAMA Japan Automobile Manufacturers Association
JARI Japan Automobile Research Institute
JASAC Japan Accredittation Sustem for product Certification Bodies
JDF Japan DME Forum
JIS Japanes standards
JNLA Japan National Laboratory Accreditation system
JNOC Japan National Oil Corporation
JSA Japanese Standardization Association
LCA Life Cycle Analyse
LEVO Organization for the promotion of low emission vehicles, Japan
LNG Liquefied Natural Gas
LPG Liquefied Petroleum Gas
MAFF Ministry of Agriculture, Forest and Fischeries, Japan
MC Management Committee, CEN
METI Ministry of Economy Trade and Industry, Japan
MEXT Ministry of Education, culture, Sports, Science and Technology, Japan
MILT Ministry of Land, Infrastructure and Transport, Japan
MOE Ministry if the Environment, Japan
MSA Malta Standards Authority
MTBE Methyl-Tert-Butyl- Ether
NAAC North American Calibration Cooperation
NEDO New Energy and Industrial Technology Development Organization, Japan
NEN Nederland Normalisatie-Instituut
NGV Natural Gas Vehicle
NSAI Natinal Standards Authority of Ireland
NSF Norges Standardiserings forbund
OECD Organization for Economic Cooperation and Development
ON Östereichesches Normalungs Institut
PAC Pacific Accreditation Cooperation
pHe Acidity of ethanol
PWGSC Public Works and Government Services Canada
RME Rapeseed methyl ester
SAE The Society of Automotive Engineers
SC Sub Committee
SCC Standards Council of Canada
SEE Service de l´Energie de l´Eat
SFS Finnish Standards Association

SIS	Swedish Standards Institute
SMDS	Shell Middle Destillate Synthesis
SME	Soy Bean methyl ester
SNV	Schwezerische Normen-Vereinigung
STEM	Swedish National Energy Administration
STRI	IcelandicStandards
TC	Technical Committee
TR	Technical report
TS	Technical specification
UNI	Ente Nazionale Italiano Unificatizione
WG	Working groups

LIST OF STANDARDS ON ALTERNATIVE FUEL SPECIFICATIONS

Alcohols and Ethers

Country/organization	Standard	Title	Contents/remarks	Reference
Canada	CAN/CGSB-3.514-98	Fuel methanol (M85) for automotive engines		
Sweden	SS 155437	SS Motor Fuels- Fuels alcohols for high-speed diesel engines		[AO]
USA	ASTM D 4806-01a	Specification for denatured fuel ethanol for blending with gasoline for use as automotive spark-ignition engine fuel.		[ML]
USA	ASTM D 5798-99	Specification for fuel Ethanol (Ed75-Ed85) for automotive spark-Ignition engines.		[ML]
USA	ASTM D 5797-96	Specification for fuel methanol (M70-M85) for automotive spark-ignition engines.		[ML]
USA	ASTM D 5983-97	Specification for Methyl Tertiary-Butyl Ether (MTBE) for downstream blending for use I automotive spark-ignition engines.		[ML]

Bio-diesel

Country/organization	Standard	Title	Contents/remarks	Reference
Austria	ÖN C 1190 (1991)		On RME (rapeseed oil methyl ester).	[Ade, Kor]
Austria	ÖN C 1191 (1997)	Kraftstoffe - Dieselmotoren;		[Ade, Kor]

		Fettsäuremethylester; Anforderungen. (Fatty acid methyl ester - Requirements)		
CEN	EN 14214 (end 2002)			[Kor]
Czechia	CSN 65 6507			[Ade]
Czechia	CSN 65 6508		Standard for fossil diesel fuel containing (30 ... 36)% RME.	[Ade]
Czechia	CSN 65 6509		Standard for fossil diesel fuel containing (3 ... 5)% RME.	[Ade]
Europe	EN 590	Automotive Fuels – Diesel – Requirements and test methods	Diesel Specification which includes up to 5 % blending of FAME	[AO]
Europe	EN14214	Automitive Fuels – Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods		[[AO]
France	Journal officiel (1997)		VOME (Takes over CEN standards)	[Ade]
Germany	DIN E 51606 (1997-09)	Flüssige Kraftstoffe; Dieselkraftstoff aus Fettsäuremethylester (FAME); Mindestanforderungen. (Diesel fuel of fatty acid methylester - FAME)		[Ade, Kor]
Italy	UNI 10635 (1997)	Esteri metilici di oli vegetali (bio-diesel); Caratteristiche chimico-fisiche. (Methylester of vegetable oils - Bio-diesel; Chemical and physical characteristics.)	VOME	[Ade]
Sweden	SS 15 54 36 (1996)	Automotive fuels - Vegetable fatty acid methyl esters - Requirements and test methods.	VOME	[Ade]
USA	SAE 971687			[Ade]

USA	ASTM D 6751-02	Specification for Bio-diesel fuel (B100), blend stock for destillate fuels		[ML]

Hydrogen

Country/organization	Standard	Title	Contents/remarks	Reference
ISO	ISO/DIS 13985	Liquid hydrogen - Land vehicle fuel tanks	This is a draft standard	[ISO]
ISO	ISO 14687: 1999/Cor.1:2001	Hydrogen fuel -- Product specification		[ISO]
ISO	ISO/DIS 15869	Gaseous hydrogen and hydrogen blends - Land vehicle fuel tanks	This is a draft standard	[ISO]

LPG

Country/organization	Standard	Title	Contents/remarks	Reference
CEN	EN 589: 1993	Automotive LPG specification		[Owe, San p.175, San2 p.192]
USA	ASTM D 1835-97	Specification for liquefied petroleum (LP) gases.	US National specification for automotive LPG (Special duty propane grade.) Gives specifications for propane as a motor fuel.	[Fue p.80&82, San p.192, San2 p.199]
USA - California	HD-5		Maximum 5 % propene content in LPG.	[Owe p.565]

Methane, Natural gas or Biogas

Country/organization	Standard	Title	Contents/remarks	Reference
Sweden	SS 155438	Motor Fuels – Biogas as a fuel in high-speed otto engines		[AO]
USA	SAE J1616		This is a recommended practice, which establishes acceptable compositional limits for natural gas intended for use in CNG vehicles.	[Owe p.569]
USA		Specifications of natural gas used for emissions certification and for general automotive use.	CARB certification, CARB in-use, EPA certification categories.	[San2 p.199]

Diesel/water emulsions

Country/organization	Standard	Title	Contents/remarks	Reference
France	NF M07-096 to 104	For more information please go to section 5.5.1	For more information please go to section 5.5.1	
France	NF M15-021	For more information please go to section 5.5.1	For more information please go to section 5.5.1	

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