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Overview and Recommendations on Biofuel Standards for Transport in the EU

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Introduction

This report gives an overview on biofuel standards for transport in the European Union. It will outline the most recent developments in biofuel standardisation to inform producers of biofuels and related technologies, traders, politicians and other stakeholders who are interested in this subject.

With the advancement and expansion of the European Union, generally the role of national standards has been increasingly taken over by international standards, primarily European standards. These European standards are developed by the European Committee for Standardization (CEN).

As the market share of biofuels increased considerably in the last few years, the need for specifications and standards of these biofuels has been highlighted by stakeholders and authorities. Consequently large efforts have been made on biofuel standardisation in the European Union: since 2003 a common European standard for biodiesel exists. Also the standardisation for bioethanol proceeded. The Technical Committee number 19 of CEN is working very hard to issue a common European standard for bioethanol. A first draft is already publicly available.

The development and implementation of standardisations diminishes trade barriers, promotes safety, increases compatibility of products, systems and services, and promotes common technical understanding. All standards help build the 'soft infrastructure' of modern, innovative economies. They provide certainty, references, and benchmarks for designers, engineers and service providers. They give 'an optimum degree of order' (CEN 2006). Thus standards are of vital importance for producers, suppliers and users of biofuels. A standard is a prerequisite for the market introduction and commercialisation of new fuels.

1. Definitions

Before addressing the standardisation of biofuels, some important terms have to be clarified.

Biofuels are any fuels that derive from biomass - recently living organisms or their metabolic byproducts, such as manure from cows. It is a renewable energy source, unlike other natural resources such as petroleum, coal and nuclear fuels. The carbon in biofuels was recently extracted from atmospheric carbon dioxide by growing plants, so burning it does not result in a net increase of carbon dioxide in the Earth's atmosphere. As a result, biofuels are seen by many as a way to reduce the amount of carbon dioxide released into the atmosphere by using them to replace non renewable sources of energy. In this paper mainly biodiesel, pure plant oil, bioethanol and biogas are addressed.

Standardisation, in the context related to technologies and industries, is the process of establishing a technical standard among competing entities in a market, where this will bring benefits without hurting competition. Although this definition will be used subsequently, it can also be viewed as a mechanism for optimising economic use of scarce resources such as fuels.

A **standard** is a concrete example of an item or a specification against which all others may be measured. Standards can be characterised as (PRANKL & WÖRGETTER 1999):

- a written document, approved by a recognised body,
- available to the public,
- drawn up by a method requiring the consensus of all parties concerned and to benefit of all,
- intended for repeated or continous application and
- normally not mandatory (except for being explicitly mentioned in regulations).

2. The European Committee for Standardisation

Different organisations offer standards on different levels, i.e. national, European and international standards are common. The national standards institutes are responsible for standardisation on a national level. These institutes provide the infrastructure and the organisational framework for efficient standardisation work.

On the European level the European Committee for Standardisation **CEN** (Comité Européen de Normalisation) is responsible for the standardisation of products. It is the European counterpart of ISO, the International Organisation for Standardisation. The use of standards is always voluntary, but European standards are sometimes related to European Directives. Thus standards may constitute a basis to the legal requirements of the Directives.

CEN is a nonprofit-making international association of a scientific and technical nature registered in accordance with Belgian law and founded in 1961. Members of this association are the national standardisation institutes of 28 European countries. The CEN central secretariat is located in Brussels and is responsible for promoting the activities of the association. The Technical Board (BT) is primarily responsible for the co-ordination of CEN standardisation work. Technical Committees (TC) are responsible for the drafting of European standards in well-defined sectors. This system ensures that more than 270 TCs are working according to sectorial priorities and avoid the duplication of work. The TCs involve experts from all areas affected by the activities of CEN (industry, public administration, science, consumers, trade unions, etc.).

Standards which are created by CEN provide following advantages:

- a common terminology, to avoid misunderstanding between trade partners
- common and precise methods of sampling and test, to avoid double sampling and testing in evaluating the quality of a product.
- product classification and specifications when, due to the character of the trade, it is preferred to have these in publicly available reference documents rather than in individual contracts between supplier and purchaser.

- common analysis, to avoid double testing in evaluating the quantity of a product.
- common operational procedures, to avoid differences in checking of the quality of a product.

Standardisation issues of transport fuels are covered by the **Technical Committee number 19** (CEN/TC19) "Gaseous and liquid fuels, lubricants and related products of petroleum, synthetic and biological origin". The scope of CEN/TC19 is defined as: "Standardization of methods of sampling, analysis and testing, terminology and specifications and classifications for petroleum related products, fuels, lubricants and hydraulic fluids, that origin from mineral oil and biomass; including the standardization of gaseous and liquid fuels and bio-fuels for transport and stationary applications. The standards include those for characterizing the product quality and for related aspects, e.g. a quality monitoring system for automotive fuels".

This committee has formulated the aim to "elaborate specification standards for automotive (bio-) fuels in relation to Directive 98/70/EC and revision 2003/17/EC". The Technical Committee also has set up a "New Coordination Group" with the task to advice the Technical Committee on the feasibility and time frames of promising alternative liquid and gaseous fuels for transport.

Therefore CEN/TC19 is the most suitable platform to develop biofuel standards for transport in the EU. A European standard for biofuels embodies the essential principles of global openness and transparency, consensus, technical coherence and national commitment. The Technical Committee initiates work items for which a European-wide basis exists, but it will not initiate work on fuels, which are used in captive fleets or used only in a few European countries. For those cases, other deliverables like **CWA's** (CEN Workshop Agreement) are more appropriate.

3. Overview of European Biofuel Standards

In Europe, a market for different biofuels for transport has been introduced or even established. The two main sectors are bioethanol and biodiesel. Other biofuels such as biogas, vegetal oils, bio-methanol, biodimethylether, bio-ETBE, synthetic fuels and bio-hydrogen are also evolving, but have not or only to a small amount proceeded (OBSERV'ER 2005).

European standards for automotive fuels and a fuel quality monitoring system are linked with Directive **98/70/EC**, which is updated by Directive **2003/17/EC** "Quality of petrol and diesel fuels". Standards for biofuels depend on the European directive **2003/30/EC** "Promotion of the use of biofuels or other renewable fuels for transport". The promotion of biofuels is largely associated with the taxation of biofuels. Issues about taxation of biofuels are included in directive **2003/96/EC** "Restructing the framework for the taxation of energy products and electricity".

3.1. Standardisation of Bioethanol

European Union

The use of ethanol as transport fuel is growing in Europe during the last few years. Parallel to this development the need for specifications and standards raised on European level.

Since recent times there was no European standard, neither on the utilisation of additives in ethanol, nor on ethanol as fuel itself. Consequently the European Commission has inter alia mandated CEN/TC 19 (Comité Européen de Normalisation - Technical Committee 19) to produce a standard on ethanol for blending with petrol. This standard **prEN 15376** "Automotive fuels - Ethanol as a blending component for petrol - Requirements and test methods" is currently under approval and will be issued most probably in October 2007. A first draft is already publicly available. Since the Swedish market is the most established ethanol market in the EU, Swedish stakeholders actively participate in the creation of this standard (ATRAX ENERGI 2005). In parallel the European standard for gasoline, **EN 228**, has been adapted to allow a maximum content of 5 % ethanol.

As mentioned before CEN/TC/19 has set up a "New Fuels Coordination Group", which has the task to advise CEN/TC 19 on "feasibility and time frames of promising alternative liquid and gaseous fuels for transport and stationary applications". The first report of the New Fuels Coordination Group was issued in January 2006 (CEN/TC 19 N1252). In this report standardisation work on 10 % ethanol in EN 228 gasoline was given high priority, but only if the Fuels Directive will allow this (WOLDENDORP 2006).

Under the auspice of CEN, a Workshop Agreement on ethanol for use in Flexible Fuel Vehicles (E85, 85 % ethanol and 15 % gasoline) has been developed (Workshop No 14 on 12.06.2003). Swedish stakeholders actively participate in this work. Furthermore the Swedish standard Institute (SIS) has started working, on initiative from the Swedish stakeholders, to produce a Swedish standard for E85 based on the Workshop Agreement (ATRAX ENERGI 2005).

On a national level Sweden does not have a national standard for fuel ethanol. But the Swedish Standardisation Group (STG) decided in 1997 a Swedish standard (SS) on Alcohols for diesel engines, "Motor fuels – Fuel alcohol for high-speed diesel engines", **SS 155437** in response to a growing demand for a standard on the use of neat ethanol in diesel engines. This standard includes not only ethanol, but also methanol, under the common name "Alcohols". A high-speed engine is defined in the standard as an engine with at least 16 revolutions per minute, at maximum performance (ATRAX ENERGI 2005). The standard furthermore specifies limits, regulations and guidelines for alcohols (ethanol and methanol) to be used as vehicle fuel in high-speed diesel engines. Following properties are addressed by this standard:

- Sampling
- Test methods
- Minimum content of alcohol (ethanol or methanol) (%)
- Maximum content of other alcohols (%).
- Density (kg/m³).
- Ash content (%)

- Acidity
- Water content (%)
- Flammability (C)
- Content of aldehydes (%)
- Content of esters (%)
- Content of lead (mg/l)
- Content of phosphor (mg/l)

As there is no official Swedish standard on ethanol for petrol engines, some Swedish manufacturers guarantee product norms for ethanol. Agroetanol AB and Sekab Svensk Etanolkemi AB are the two main providers of fuel ethanol in Sweden. Sekab Svensk Etanolkemi AB markets two different kinds of fuels:

- **ETAMAX D** is a neat bioethanol fuel for use in diesel engines, mainly busses. It consists of ethanol (92.2 mass%), ignition improver (5 mass%), MTBE (2.3 mass%), iobutanol (0.5 mass%), and corrosive inhibitor (90 ppm).
- **ETAMAX B** is a mix of gasoline and bioethanol for Flexible Fuel Vehicles. It consists of ethanol (86 mass%), gasoline (11.6 mass%), MTBE (2 mass%), and isobutanol (0.4 mass%).

In addition to these two product norms Sekab Svensk Etanolkemi AB also specifies the ethanol which is used in these two fuel norms. Two "**Sekab Sales Specifications for Technical Ethanol**", 95 % and 99.5 % are offered and currently serve as industry standard (Table 1) (VONA et al. 2004). Sekab Svensk Etanolkemi AB also guarantees the properties shown in Table 2 although they are not tested on each delivery.

The guaranteed but not regularly tested specifications are selected by the supplier and not discussed by the industry, but some such as methanol and fusel oil may be included in the future EU standard.

Table 1: Sekab 99.5% Ethanol specification (www.sekab.se)

Property	Specification	Test method
Ethanol content, %vol (min)	99.8	AMSE 1112
Density, g/ml (max)	0.790	SS-ISO 758
Appearance	Clear, without particles	ASTM D 2090
Color, Hazen (max)	5	AMSE 1102
Water, %mass (max)	0,3	SS-ISO 760
Aldehydes (as acetaldehyde), %mass (max)	0.0025	AMSE 1118
Acidity (as acetic acid), %mass (max)	0.0025	AMSE 1114

Table 2: Additional specification for Sekab 99.5% Ethanol (www.sekab.se)

Property	Specification	Test method
Distillation Interval: - Starting point °C (min) - Drypoint °C (max)	 77 81	ASTM D 1078
Flashpoint °C	+12	SS-EN 22719
Fusel Oil, mg/l (max)	50	AMSE 1136, GC-method
Methanol, mg/l (max)	20	AMSE 1135, GC-method
Explosion limits, %vol air	3,5 - 15	Accepted from literature
Refractive Index, n_D20	1,3618	Accepted from literature
Evaporation residue, mg/l (max)	10	AMSE 1124

Besides the large efforts on standardisation of bioethanol in Sweden, also Poland has introduced a national standard for anhydrous ethanol as fuel: **PN A 79521**. It is based on the US ASTM D 4806 standard. The Polish standard will be replaced, once the European standard has been finalized. Specifications on the standard in Poland include following properties:

- Test methods
- Ethanol, vol%
- Water, mass%
- Density at 20 °C, Kg/m³
- Refractive Index
- Chloride, mg/l
- Copper content, mg/kg
- Methanol, vol%

- Acids as Acetic Acid, g/l
- Aldehydes & ketones, g/l
- Fusel oil/ Amyl Alcohol, vol%
- Bitrex, g/100 litres ethanol
- Cyclohexane, vol%
- C3-C5 alcohols, ppm
- Non-volatile matter, g/100 ml

Regarding the standardisation of bioethanol, it is worth looking beyond the European Union to other countries like Brazil and USA.

USA

The US industry standard for ethanol is **ASTM D 4806** "Standard Specification for Denatured Fuel Ethanol for Blending with Petrol for Use as Automotive Spark Ignition Engine Fuel" by the American Society for Testing and Materials (ASTM). The purpose of this ASTM specification is to provide parameters so that petrol and petrol oxygenate blends will perform satisfactorily in as wide a range of consumer vehicles as possible. The ASTM has followed the premise that the only ethanol to be used in the marketplace as a gasoline extender will be denatured, and hence the specification D 4806 is for denatured fuel ethanol only (VONA et al. 2004).

Specifications of the ASTM D-4806 standard include:

- Test methods
- Ethanol, vol%
- Methanol, vol%
- Solvent-washed gum, mg/100 ml
- Water content, vol%
- Denaturant content, vol%
- Denaturant content, vol%
- Inorganic Chloride content, mass ppm (mg/L)
- Copper content, mg/kg
- Acidity (as acetic acid CH_3COOH), mass %
- pHe
- Appearance

A separate ASTM specification **ASTM D 5798** "Specification for Fuel Ethanol (Ed75-Ed85) for Automotive Spark-Ignition Engine Fuel" applies for fuel ethanol to be used in specially designated vehicles as a petrol substitute. This Ed75-Ed85 fuel ethanol is produced from ethanol complying with the ASTM D 4806 standard, and contains additional specifications for parameters applicable to vehicles designed to operate with high percentages of ethanol in their fuel. Additional parameters specified include hydrocarbon volume (as opposed to small amounts of hydrocarbon denaturant in the ethanol standard), vapour

pressure, lead, phosphorus, sulphur, and total and inorganic chloride. The limits of several parameters are also different than the ethanol standard, which is understandable since the fuel is comprised of up to 30 vol% of hydrocarbons. (VONA et al. 2004)

Specifications of ASTM D-5798 standard for fuel ethanol (Ed75 –Ed85) include:

- Test methods
- Ethanol + higher alcohols vol%
- Hydrocarbon vol%
- Vapor Pressure, kPa
- Lead, mg/l
- Phosphorus, mg/l
- Sulfur, mg/kg (max)
- Methanol, vol%
- Higher Alcohols (C3-C8) vol%
- Acidity (as acetic acid), mass% (mg/l)
- Solvent-washed gum content mg/100 ml
- pHe
- Unwashed gum content, mg/100 ml
- Total chlorine as chlorides, mg/kg
- Inorganic chloride, mg/kg
- Copper, mg/l
- Water, mass%
- Appearance at higher of ambient temperature of 21 °C

The 15 % petrol (and 25 % petrol during winter) in the ASTM D 5798 standard specification for fuel ethanol are required to increase the fuel volatility and prevent engine cold-start difficulties. An additional benefit is one of safety, since ethanol burns with a colourless blue flame making it more difficult to detect a fire in the engine system, whereas the presence of hydrocarbons would result in a clearly visible flame. (VONA et al. 2004)

Brazil

Brazil is the world leader in the production and utilization of bioethanol. Ethanol production capacity in Brazil is of the order of 16 billion litres per year. The primary feedstock is sugar from sugarcane.

The National Petroleum Agency (ANP) set specifications for both hydrous and anhydrous fuel ethanol. The test methods specified are from the Brazilian Association of Technical Standards (NBR) and American Society for Testing and Materials (ASTM).

Australia

Besides these fuel quality standards in the US and in Brazil, also in Australia a quality standard for bioethanol is planned. In July 2005, the Department of Environment and Heri-

tage of the Australian Government released a Government position paper for a quality standard for fuel grade ethanol (AUSTRALIAN GOVERNMENT 2005). The objective of this position paper was to inform stakeholders and generate a stakeholder discussion on a suitable quality standard. The call for comments on this paper closed on 17 August 2005.

3.2. Standardisation of Biodiesel

European Union

Compared to ethanol, specifications for biodiesel are much further advanced. There exists a common European standard for biodiesel: **EN 14214** "Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods". The requirements for biodiesel properties in this standard include:

- Test methods
- Ester Content
- Density at 15 °C
- Viscosity at 40 °C
- Flash Point
- Sulfur Content
- Carbon Residue (10 % Bottoms)
- Cetane Number
- Sulphated Ash Content
- Water Content
- Total Contamination
- Copper Strip Corrosion (3hr at 50 °C)
- Thermal Stability
- Oxidation Stability, 110 °C
- Acid Value
- Iodine Value
- Linolenic acid methyl ester
- Polyunsaturated (≥ 4 double bonds) methyl esters
- Methanol Content
- Monoglyceride Content
- Diglyceride Content
- Triglyceride Content
- Free Gylcerol
- Total Gylcerol
- Alkaline Metals (Na + K)
- Phosphorus Content

The European standard for biodiesel EN 14214 removed several national standards in different countries. For example the former standards have been ÖNORM C1191 in Austria, CSN 65 6507 in the Czech Republic, standard of the Journal Officiel in France, DIN E 51606 in Germany, UNI 10635 in Italy and SS 155436 in Sweden.

Apart from the official European norm there may exist additional national standards and quality examinations. For example in Germany the Arbeitsgemeinschaft Qualitätsmanagement Biodiesel e. V. (AGQM, Association for the Quality Management of Biodiesel) offers a complex quality assurance system. The association was founded in 1999 on initiative of the UFOP (Union for the Promotion of Oil and Protein Plants). This was a time when the necessity of organised quality protection emerged through the increased number of biodiesel producers and trading enterprises. Its members are manufacturers, biodiesel traders, filling stations as well as further prospective customers such as additive manufacturers, constructors etc. The aims of AGQM are:

- guaranteeing the minimum quality requirements according to EN 14214,
- guaranteeing the supply of bulk consumers and filling stations with quality biodiesel and
- presenting biodiesel as a high-quality product for establishing confidence with consumers and the automobile industry.

Basically it can be observed that the requirements for biodiesel in the AGQM quality assurance system are stricter than those defined by EN 14214 (AGQM 2006). For example, according to AGQM, some parameters are more detailed to avoid degradation of the product in the whole life cycle (HAUPT 2006). The main criterion for these parameters always is the fuel quality that is received by consumers. The most appropriate feedstock to guarantee this quality fuel is rapeseed. Therefore at the moment mainly RME (Rapeseed oil methyl ester) is labelled by AGQM.

For gaining a higher public recognition in Germany biodiesel fuel pumps are labelled after DIN EN 14214. Additionally fuel pumps may also be marked by the German AGQM label (Figure 1).

Figure 1: Labels for biodiesel in Germany after AGQM (left) and DIN EN 14214 (right)

Besides the general standard for biodiesel there also exists a standard which regulates the blending of fossil diesel with biodiesel. According to the European standard **EN 590**

"Automotive fuels, diesel, requirements and test methods" additions of up to 5 % biodiesel (FAME) to diesel fuel are permissible without labelling. Higher blends (except for 100 % biodiesel) may be sold, but are to be labelled accordingly. When mixed together, biodiesel always has to be in accordance with EN 14214. In Germany the EN 590 standard is in operation since March 2004. As opposed to biodiesel pure vegetable oils are not authorised as blends in standardised fuels.

USA

The most common standard referenced in the United States is standard **ASTM D 6751** for pure biodiesel used in blends of up to 20 percent with diesel fuel.

Similar to the additional quality management programme AGQM in Germany, the respective quality system in the US is the **BQ-9000** standard by the National Biodiesel Accreditation Commission. This BG-9000 programme is a cooperative and voluntary programme for the accreditation of producers and marketers of biodiesel fuel (Figure 2). The programme is a combination of the ASTM standard for biodiesel, ASTM D 6751, and a quality systems program that includes storage, sampling, testing, blending, shipping, distribution, and fuel management practices. BQ-9000 is open to any biodiesel manufacturer, marketer or distributor of biodiesel and biodiesel blends in the United States and Canada.

Figure 2: Labels for biodiesel in the USA: BQ-9000 after the National Biodiesel Accreditation Commission

3.3. Standardisation of Pure Plant Oil

Germany is the leader in research of pure plant oil (PPO) as fuel. A quality standard for rapeseed oil as fuel was in operation since 2000: **RK 5/2000**. Due to climatic and yield reasons, rapeseed is the almost exclusively grown oil plant in Germany.

The RK standard is currently being improved and the standard **DIN V 51605** (2006-07) "Fuels for vegetable oil compatible combustion engines - Fuel from rapeseed oil - Requirements and test methods" will be published by the end of 2006. This new standard can already be ordered from the German Institute for standardisation (DIN Deutsches Institut für Normung e. V.) under www.normung.din.de. On the European or international level currently no standard for PPO exists.

The properties which are included in the DIN V 51605 standard are as follows:

- Test methods
- Density at 15 °C, kg/m³
- Density at 15 °C, kg/m³
- Flashpoint, °C
- Heat value, kJ/kg
- Viscosity, mm²/s
- Freezing property
- Cetane number
- Coke residues, %mass
- Iodine number, g/100g
- Iodine number, g/100g
- Sulphur content, mg/kg
- Total contaminants, g/kg
- Neutralisation rate, mg KOH/g
- Oxidation stability at 110 °C, h
- Phosphorus content, mg/kg
- Ash content, %mass
- Water content, %mass
- Ca, Mg, 20mg/kg

3.4. Standardisation of Biogas

For biogas as transport fuel no common standardisation in the European Union exists. This is attributed to the low level of applications and on the lower complexity of biogas compared to bioethanol or biodiesel. Biogas consists, after different purification treatments, mainly of methane (> 80 %Vol) and CO_2.

Nevertheless there is a Swedish Standard (SS) on biogas **SS 155438** "Motor fuels – Biogas as fuel for high-speed otto engines" as a reaction to the growing demand of biogas in Sweden. The methane content of biogas according to this standard is 97 % (+/- 1-2 %). This Swedish standard was developed by STG Technical Group number 85 (TK 85). It is applied for the use in otto engines, which includes converted diesel engines provided with glows or spark plugs. A high-speed engine is defined as an engine with at least 16 revolutions per minute, at maximum performance (ATRAX ENERGI 2005). This Swedish standard has been adapted in such a way that, from a material-technical point of view, fuelling and engine equipment developed for natural gas may also be used for biogas. In this standard biogas is defined as: "gas produced from microbial fermentation of organic material in an anaerobic (oxygen free) environment" (ATRAX ENERGI 2005).

In Germany already 650 filling stations for natural gas are field tested. There, natural gas for transport is divided by the German Technical and Scientific Association for Gas and Water (DVGW Deutsche Vereinigung des Gas- und Wasserfaches e.V.) into two classifications: natural gas of **group H** (high caloric gas) which contains 87 – 99.1 vol% methane

and natural gas of **group L** (low caloric gas) which contains 79.8 – 87 vol% methane (Figure 3).

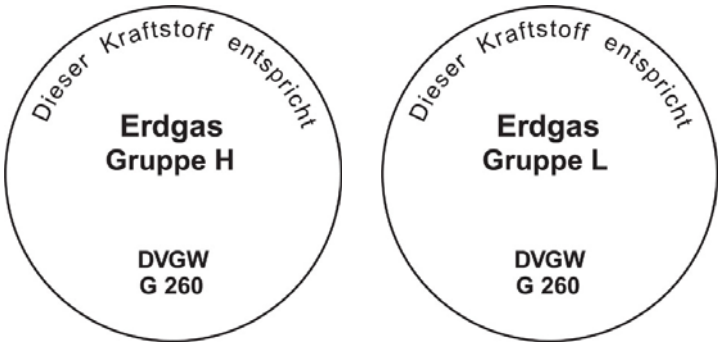

Figure 3: Labels for gas pumps with natural gas in Germany

Since the existing filling infrastructure for natural gas could be easily modified for the use of biogas, a similar labelling for biogas would be useful. Such a standard for biogas does not exist at the moment, as the first biogas filling station in Germany opens in June 2006.

3.5. Sustainability Standards

Sustainability is a systemic concept, relating to the continuity of economic, social, institutional and environmental aspects of human society. It is intended to be a means of configuring civilization and human activity so that society, its members and its economies are able to meet their needs and express their greatest potential in the present, while preserving biodiversity and natural ecosystems, and planning and acting for the ability to maintain these ideals in a very long term.

Today, a variety of sustainability standards and certification schemes exist or are under development mainly in the areas of agriculture and forestry. However, no such system exists specifically for biofuels neither in the European Union nor elsewhere.

But sustainability standards could help to establish minimum social and ecological principles for biofuels and to guarantee responsible use of biomass from the raw material stage through its final application (WORLDWATCH INSTITUTE 2006).

Without sustainability standards and safeguards, greenhouse gas savings will not be guaranteed and biodiversity will be harmed by production and use of biofuels. Unless biofuels are produced in a sustainable way, more energy-intensive and environmentally damaging farming practices will hasten the degradation of ecosystems. Consequently the public could reject biofuels if they are not seen to be a credible environmental alternative to fossil fuels. Therefore fuel supply, climate change and biodiversity loss need to be addressed and sustainability standards for the production and use of biofuels have to be created.

4. Recommendations

The recent "Biomass Action Plan" of the European Commission (2005) describes various actions that will be taken to encourage the use of all kinds of biomass for renewable energy production. In the EU, transport is responsible for an estimated 21 % of all greenhouse gas emissions that are contributing to global warming, and the percentage is rising. In order to meet sustainability goals, in particular the reduction of greenhouse gas emissions agreed under the Kyoto Protocol, it is therefore essential to find ways of reducing emissions from transport (EC 2006).

In the communication paper "An EU Strategy for Biofuels" (EC 2006) three aims are stated:

- to further promote biofuels in the EU and developing countries, ensure that their production and use is globally positive for the environment and that they contribute to the objectives of the Lisbon Strategy taking into account competitiveness considerations;
- to prepare for the large-scale use of biofuels by improving their cost-competitiveness through the optimised cultivation of dedicated feedstocks, research into "second generation" biofuels, and support for market penetration by scaling up demonstration projects and removing non-technical barriers;
- to explore the opportunities for developing countries – including those affected by the reform of the EU sugar regime – for the production of biofuel feedstocks and biofuels, and to set out the role the EU could play in supporting the development of sustainable biofuel production.

An important issue to fulfil these aims is the ***standardisation of high quality biofuels***. As the development of biofuel production increases, also the need for standardisation rises. Uniformisation in Europe is essential to ensure trade in biofuels and related technologies among countries. A growing market needs common rules. Further, standards on biofuels are necessary for several reasons:

- To avoid damages on engines
- To unify fuel characteristics so that energy content and other properties of the fuel are the same.
- To ensure guarantee claims in case of engine damages
- To ensure minimum requirements according to the defined standards
- To ensure long term functioning of the engine with low maintenance efforts.

In order to create standards for biofuels three main requirements are claimed:

- Defined and constant quality
- Quality variation only in a defined narrow range
- Quality reserve for transport and storage

4.1. Bioethanol

In many European member states different biofuels are introduced and established. For instance the leading EU producers of bioethanol are Spain and France. The leading consumer of bioethanol is Sweden, with about 80 % of the quantities imported, mostly from Brazil. Contrary to the market situation of bioethanol in Sweden, Spain and France, bioethanol in Germany is not yet distributed. Only first introduction initiatives have been set up. Nevertheless in 2004 the European Union estimated to have produced 10 % of the world's bioethanol, with production at almost 0.5 million tonnes (EC 2006).

Quality standards for bioethanol already exist in Sweden and Poland, as well as in the USA. On European level it is urgent to define and to make public a common standard for bioethanol and high blends of gasoline. Thereby experiences from Brazil and USA should be taken into account. The introduction of the European standard **prEN 15376**, which is currently under approval, has to be realized as soon as possible. The adoption of this standard is planned for October 2007 and delays should be avoided. A first draft is already available.

Different types of biofuels give rise to different environmental and technical issues. The EU Fuel Quality Directive 2003/17/EC stipulates specifications for petrol and diesel, for environmental and health reasons, e.g. limits on the content of ethanol, ether and other oxygenates in petrol. It also limits the vapour pressure of petrol. In EN 228 the volume of ethanol in petrol is limited to a maximum content of 5 vol%. It has to be discussed and examined if the allowed maximum content of ethanol for blending with gasoline should be raised in EN 228. A maximum content of 10 vol% is suggested by several stakeholders.

The European Commission already announced to review the qualitative limits on ethanol (EC 2006).

4.2. Biodiesel

The standardisation of biodiesel on European level is well established and exists since 2003: EN 14214. The application of this standard should be introduced to all EU member states. To avoid confusion and complications national standards should be adapted to the European standard. Nevertheless further quality systems which are even stricter (like the German AGQM-standard) may also be useful in certain countries.

Standard EN590 sets further limits for technical reasons, and states that diesel must contain no more than 5% biodiesel by volume (4.6% in energy terms). These limits put constraints on the increased use of biofuels (EC 2006).

Several stakeholders for example like the European Biomass Association (AEBIOM 2006) postulate an increase of biodiesel percentage in the diesel standard EN 590. AEBIOM also claims for an adjustment of standard EN 14214 in order to allow the use of ethanol in the biodiesel production process.

The European Commission has announced that it will review the quantitative limits on biodiesel as well as on ethanol and ethers in 2006 (EC 2006). The Commission mentioned also to propose amendments to the "biodiesel standard" to facilitate the use of a wider range of vegetable oils for biodiesel production, and allow ethanol to replace methanol in biodiesel production (EC 2006).

4.3. Pure Plant Oil

Pure plant oil (PPO) for transport is mainly used in Germany. There the standard DIN V 51605 was established. But there is a deficiency as no European common standard for PPO exists at the moment. The European Biomass Association (AEBIOM 2006) claims for defined specifications for pure plant oil in Europe.

4.4. Biogas

The production of biogas has increased significantly, but it is mainly used for combined power and heat generation. Although in Europe more than 500 000 gas-fuelled vehicles have been sold in recent years, they mainly run on natural gas. However, biogas as a transport fuel is used in some countries: Sweden has about 50 biogas refuelling stations (EC 2006).

Apart from Sweden biogas is also used in Switzerland where no standard exists. In Germany the first public filling station for biogas will open in June 2006. There the potential for establishing biogas for transport is very high since already 650 filling stations for natureal gas are installed and modifications to biogas applications can be conducted without large efforts.

Regarding this potential a common standardisation for biogas in the European Union will be necessary. The development of such standards should be stimulated.

4.5. Sustainability

As mentioned in chapter 3.5 no sustainability standard for biofuel production and use exists. Sustainability standards are urgently needed to guarantee a biofuel production that minimises the negative social and environmental impacts.

In the food sector sustainability standards are already well established and in many countries organic food is promoted. Similarly, sustainability standards in the biofuel sector would aim to address some of the dominant environmental and social concerns related to biofuels and their feedstock, particularly when these are developed on a large scale.

From an environmental perspective, the primary concerns include (WORLDWATCH INSTITUTE 2006):

- ecological impacts of monoculture crop plantations
- damage to water and soil from the application of pesticides and fertilizers
- soil erosion
- nutrient leaching
- increased use of fresh water resources
- loss of biodiversity and wildlife habitat, particularly if cropland area is expanded into previously undisturbed sites

Relevant social issues include (WORLDWATCH INSTITUTE 2006):

- potential impacts on agricultural and rural incomes
- access to biofuel markets by small landholders and indigenous groups
- job availability and quality (which could increase or decrease, depending on the level of mechanization, local conditions, etc.)
- potential use of child labour
- access to education and health care for workers

It is important to note that these problems are not necessarily larger or worse with biomass production than with similar agricultural activities, such as large-scale food and feed production. Nevertheless, establishing a certification program could help minimize the potential negative impacts of biomass production while also working to promote sustainable biofuel trade (WORLDWATCH INSTITUTE 2006).

Therefore the creation and introduction of a common European sustainability standard is heavily recommended. Some organisations European Environmental Bureau (EEB), BirdLife International, Transport and Environment (T&E) called on the European Commission to introduce sustainability safeguards as part of the ongoing revision of the Biofuels Directive.

Since no standard exists today, this gap offers a unique chance to develop an EU sustainability standard for biofuels which will be adopted commonly in all member countries and beyond.

5. Conclusion

The utilisation of biofuels instead of fossil fuels should foster a stable and reliable demand for the services of rural communities, provide a source of additional income and employment for exporting countries, contribute to the sustainable management of natural resources, fulfil GHG emissions reduction targets in a particularly sustainable manner and should decrease dependency. These targets may best be achieved through implementation of sound standards and certification framework (WORLDWATCH INSTITUTE 2006).

In Europe standards exist for certain biofuels and technologies. For instance the standardisation for biodiesel EN 14214 is already very well established. It regulates the specifications and test methods for different properties of biodiesel. Standard EN 590 mandates that fossil diesel is blended with no more than 5 % biodiesel. Both standards (EN 14214, EN 590) are currently reviewed by the European Commission to facilitate the use of a wider range of vegetable oils for biodiesel production, to allow ethanol to replace methanol in biodiesel production, and to increase limits of diesel blending with biodiesel. The European Commission encourages an increased use of biodiesel for transport.

On the other hand, standards for bioethanol and biogas are still not in place, and large efforts are needed to develop, introduce and establish standards for these fuels. A standardisation of these fuels could significantly contribute to an enhanced production and use of biofuels in Europe.

For ethanol the European standard prEN 15376 is currently under development. Today fossil petrol may be blended with up to 5 % according to standard EN 228. The European Commission reviews this standard so that a higher concentration of ethanol blend in petrol will be allowed.

Hitherto no efforts have been made on biogas standardisation on EU level. Only in Sweden the standard SS 155438 for biogas as transport fuel exists. Regarding the high potential of biogas, a common standardisation in the European Union is necessary.

Also no common European standard exists for the use of pure plant oil. In Germany where PPO is used for several applications, the former standard RK5/2000 for PPO will be replaced by standard DIN V 51605 this year.

Besides the technological aspects of biofuel standardisation, sustainability standards for the production of biofuels should be introduced. Sustainability standards address some of the dominant environmental and social concerns related to biofuels and their feedstock, particularly when these are developed on a large scale. Until today no sustainability standardisation exists for biofuels production and use.

In conclusion, common standards on a European level will increase utilisation, promotion and trade of biofuels. But as there is a lack of standardisation for certain biofuels today, new standards have to be created and existing standards have to be improved and adapted to the current state-of-the-art.

6. List of Relevant Standards

Standard	Full Title	Country
ASTM D 4806-03	Standard Specification for Denatured Fuel ethanol for Blending with Gasolines for Use as Automotive Spark-Ignition Engine Fuel	USA
ASTM D 5798-99	Standard Specification for Fuel Ethanol (Ed75-Ed85) for Automotive Spark-Ignition Engines	USA
DIN V 51605: 2006	Fuels for vegetable oil compatible combustion engines - Fuel from rapeseed oil - Requirements and test methods	EU
EN 14214: 2003	Automotive fuels - Fatty acid methyl esters (FAME) for diesel engines - Requirements and test methods	EU
prEN 15376: 2006	Automotive fuels - Ethanol as a blending component for petrol - Requirements and test methods	EU
EN 590	Automotive fuels – Diesel – Requirements and test methods	EU
EN 228	Automotive fuels – Unleaded petrol – Requirements and test methods	EU
SS 155437	Motor fuels – Fuel alcohol for high-speed diesel engines	Sweden
SS 155438	Motor fuels – Biogas as fuel for high-speed otto engines	Sweden
PN A 79521		Poland

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