BEST

BIOETHANOL FOR SUSTAINABLE TRANSPORT

SUPPORTED BY THE EUROPEAN UNION

Experiences from introduction of ethanol buses and ethanol fuel stations

June 2007, La Spezia, Madrid, Rotterdam, Stockholm, Sao Paulo

BEST Deliverable No D 2.1 and D 2.2

Issued by: BAFF, www.baff.info

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Language: English
Target groups: Bus operators that wants to introduce ethanol buses

Project no: TREN/05/FP6EN/S07.53807/019854

Project acronym: BEST

Project title: BioEthanol for Sustainable Transport

Instrument: Integrated Project

Thematic Priority: 6.1 Alternative Motor Fuels: BioFuel Cities

Report title:
Experiences from introduction of ethanol buses and ethanol fuel stations

Deliverable no: D 2.1 and D 2.2

Version: 070703 version 1

Lead Participant for the deliverable:	ATC, City of Madrid, SL, City of Rotterdam, Sao Paulo
Date of delivering to EC, contractual:	M 15 and 18
Date of delivering to EC, actual:	[Click here and type]
Period covered:	M 1-18
Revision	[Click here and type]
Approved by	[ ] Site coordinator [x] Wp leader [ ] Evaluation manager [ ] Coordinator [ ] European Commission
Dissemination level:	[x] PU – Public [ ] PP – Restricted to other programme participants (including Commission Services) [ ] RE – Restricted to a group specified by the consortium (including Commission Services) [ ] CO – Confidential, only for members of the consortium (including Commission Services)
Start date of project:	01/01/2006
Duration:	48 months
Project coordinator name:	Gustaf Landahl
Project coordinator organisation name:	City of Stockholm, Environment and Health Administration

Document history

When	Who	Comments

Approval

Responsible reviewer		Approval	Comments
(i) Site coordinator		Yes No	
(ii) WP leader	x	Yes No	
(iii) Evaluation manager	x	Yes No	
(iv) Dissemination manager		Yes No	
(v) Project coordinator	x	Yes No	

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Experiences from implementing ethanol buses and ethanol fuel stations in BEST

Ethanol buses shall be demonstrated in seven sites within BEST. The demonstrations of ethanol buses have met a lot of problems in the first phase of the project. The reason for the delays is connected to the fact that all countries, except for Sweden, have had a lack of regulations for ethanol fuel for buses and fuel stations for ethanol. That has meant that all sites, except for Stockholm, had to get all the rules and regulations in place before the demonstrations could start. This report describes the problems at the sites and how they have been solved. The aim of the report is to guide other local transport authorities on how to deal with the questions raised when a bus demonstration shall start. There are questions connected to safety issues, of what materials to use in the fuel station, on taxation, on excise duties etc. All interested parties are also very welcome to contact the BEST partners to get a closer insight of the layout of the projects.

Summary

All sites in BEST have run into different kind of problems in the implementation of the ethanol bus demonstrations. Many of the problems have been connected to the fact that it is the very first ethanol bus and ethanol fuel station in the country. That has meant lack of experience, knowledge and procedures for handling the fuel and the fuel stations within local and national authorities.

The experience so far has shown that it is important to contact the local authorities as early as possible in the process. The experience from other countries, where the rules and regulations are in place, has also been very helpful.

One large problem has been that the customs authorities have had different ways of classify the ethanol fuel which have meant a lot of difficulties regarding tax issues and tariffs. When the authorities have got information that Swedish customs authority has issued a Binding Tariff Information, BTI, for the fuel ethanol under CN code 3824 90 98 99, the problems have been solved. A BTI is legally binding in all member states and therefore must be used in all countries. It means that a company that wants to use ethanol for the buses applies for a license to receive the fuel in a tax warehouse, or become a registered trader or a non-registered trader for the fuel. The companies apply for the license from their local customs and tax authorities.

The level of tax on the ethanol can also be a great obstacle. To give tax exemption or tax reduction for the fuel is up to the different countries to decide. In Italy the fuel is taxed as diesel whilst in Spain it is tax exempted. This is because Spain has exempted all alcohol used for biofuels from tax until 31 December 2012. The fuel is exempted from tax in Sweden as well. In Rotterdam the tax is as high as for diesel and incentives are given to buses running on natural gas or LPG, which has meant that it’s been impossible to get any interest from the operators to run ethanol buses.

The ethanol engine is as energy efficient as the diesel engine but the energy content of the bus fuel is lower compared to diesel. This means that the ethanol bus needs about 60 % more volume of ethanol compared to diesel, due to the lower energy content of ethanol. This is also the reason why it is important to tax the fuel according to the energy content, not by volume, if the ethanol is taxed at all.

No regulations for ethanol fuel in Italy

The public transport authority in La Spezia, ATC, has introduced three ethanol buses within the BEST-project. The buses have been running since the beginning of 2007. The planned start of operation was in September 2006. The major reasons for the delay is connected to problems with the building of the fuel station and problems connected to the fuel and import of the fuel.

Ethanol buses in La Spezia

Fuel station

The problems connected to building of a fuel station:

- No general Regulations
- No safety regulations
- No requirements for the design
- No equipment supply
- No regulations for equipment approval

In Italy there was no legislation or regulations applicable for the building of an ethanol fuel station. That made it impossible for the authorities to give an immediate approval to an application from ATC to build an ethanol fuel station at the bus depot, even if they were positive to the project. Furthermore, there were no safety regulations or requirements of design and what kind of equipment that could be allowed. The authorities also had questions about how the waste water from the stations should be treated.

The solution

ATC has had an extensive dialog with the Italian authorities at all levels in order to get regulations for ethanol fuel stations. The experiences from Sweden and the regulations applied by the Swedish authorities were presented to the Italian authorities. See Annexe 1 for Swedish recommendations for ethanol fuel stations. As ethanol has not been used as a fuel before in Italy new regulations had to be taken at all levels. The local authorities decided that a special collection and drainage system for rain water had to be built around the fuel station. This was done in order to take care of waste water and to prevent mixing with ethanol. In case of leakage a sealed trap will take care of the E95.

The advice from the ATC is to contact the local authorities as soon as possible to discuss how the fuel station should be built. It is also an advice to show cases from other countries, and if necessary present contact persons at authorities at the equal level in a country with experience from the new fuel.

The fuel – ethanol bus fuel

The problems connected with the fuel:

- Lack of General Regulations,
- Lack of Safety rules
- No decisions made regarding classification and excise duty rates for ethanol fuel

In the beginning of the project, the ethanol bus fuel was not classified as a fuel and the authorities had problems to know how to classify the bus fuel. The handling of the applications became more difficult because of this.

The solution

ATC met the Italian customs authorities together with the BEST partner SEKAB who is also distributing the bus fuel. The reason for the meeting was to decide how the fuel should be classed and the excise duty rate for the fuel. The company that imports the fuel has to have a tax warehouse licence, a registered trader licence or a non-registered trader licence for the fuel from the national customs authorities so that the authorities in the exporting country know that the goods will be taxed somewhere else in the EU.

SEKAB described that the Swedish customs authorities' classed the bus fuel as an energy product under CN code 3824 90 98 99 and that the Swedish tax authority exempted the product from alcohol tax since it was used as a fuel and discussed what documents that were required for export to countries within the EU. It was important to get a concordant view that the bus fuel is a fuel and not technical alcohol. The tax level for technical alcohol is much higher than the fuel tax. It is also more difficult to get a tax warehouse licence for ethanol than for energy products, which would be required if the fuel was classed as ethanol (a chemical) and not as a fuel.

The bus fuel is classed as an energy product in Sweden under CN code 3824 90 98 99 in a Binding Tariff Information (BTI) based on the following EU regulations and is binding in all member states:

- Council Regulation (EEC) No 2913/92 of 12 October 1992 establishing the Community Customs Code

- Commission Regulation (EEC) No 2454/93 of 2 July 1993 laying down provisions for the implementation of Council Regulation (EEC) No 2913/92 establishing the Community Customs Code

The fuel is exempted from alcohol tax in Sweden based on the following EU directive:

- Council Directive 92/83/EEC of 19 October 1992 on the harmonization of the structures of excise duties on alcohol and alcoholic beverages

The information worked as a guideline for the Italian rules and regulations. The Italian customs authority could take a decision to classify the bus fuel as a fuel and give ATC a registered trader licence.

The taxation of ethanol bus fuel in Italy

At the moment tax value is the same as for diesel: 0, 416 €. But the specific power of Ethanol is much lower (50-60 % lower) so the tax level prevents any competition between the fuels.

In Italy there is a certain volume of renewable fuel that can get tax subsidies every year. ATC will have to apply for tax exemption for 2007.

Alcohol tax on the bus fuel in Madrid

5 ethanol buses have been introduced in the EMT Madrid bus fleet. The buses have been running since the beginning of April 2007. The operation was planned to start in October 2006. The reason for the delay was a decision by the customs and tax authority to impose alcohol tax on the fuel.

EMT Madrid started the project in the beginning of 2006. The planning for the fuel station met some problems because there were no regulations for ethanol fuel stations. EMT decided to classify the fuel as chemical ethanol. That made it easier for the authorities to find the rules and regulations for the fuel pump.

EMT bought the chassis from Scania and the bodies were built by a local body builder, Castrosua. EMT had got information from the customs and tax authority that everything was in order for import of the ethanol for the buses.

In the last minute the authority decided that the chemicals used for denaturation (to avoid drinking) of the bus ethanol (MTBE and Isobutanol) not were allowed to be used if the ethanol should be classified as a chemical in Spain. The authority therefore decided that the ethanol should be imposed with alcohol tax (28 €/litre).

This made it impossible to start the operation of the ethanol buses.

The solution

All the involved parties (EMT, Scania, the city of Madrid and Sekab) worked hard to show that the customs and tax authority that the ethanol was meant to be used as a fuel. EMT sent a written communication to the authority to explain the background to the project. This lead to a debate in the news papers in Madrid. SEKAB sent information from the Medical Products Agency in Sweden, responsible for which chemicals that must be used for denaturation of fuel in Sweden. The customs authority also got information about the Swedish customs

classification of the fuel as an energy product under CN code 3824 90 98 99 in a Binding Tariff Information, BTI, which is legally binding in all member states according to Council Regulations (Council Regulation (EEC) No 2913/92 of 12 October 1992 establishing the Community Customs Code, Commission Regulation (EEC) No 2454/93 of 2 July 1993 laying down provisions for the implementation of Council Regulation (EEC) No 2913/92 establishing the Community Customs Code).

This lead to a reclassification of the fuel in Madrid, and when it was classed as a fuel the product was totally exempted from tax, as all alcohol used for fuel in Spain is tax exempted. EMT received a non-registered trader licence for the fuel and then began the fuel order process. Everything was ready at the end of March and the buses are in operation since April

The ethanol bus fuel station in Madrid

Refuelling of an ethanol bus

No buses in Rotterdam

The city of Rotterdam aimed for 3 ethanol buses within the BEST project. The first step was a study on the possibilities for ethanol buses in the city. The study showed that there are a number of obstacles for introduction of ethanol buses. The local policies describe that the buses should be at least Euro 5 and have particle filters (ethanol buses reach Euro 5 without particle trap). There are no goals for renewable fuel in the bus fleet. The local bus operator RET has been privatised during the period. This has made it more difficult to raise interest for an investment in renewable fuel buses. There are also a number of obstacles at the national level. Firstly there are no tax incentives for biofuels in the Netherlands, secondly the use of natural gas and LPG are stimulated through purchase taxes and there is also a tax deduction for particle filters. These obstacles together have led to the conclusion that it will not be possible to introduce ethanol buses in the city of Rotterdam within the time frame of the BEST-project.

127 ethanol buses in Stockholm

Ethanol has a long history in Sweden. The first buses were introduced in the late 1980's. Since then a Swedish standard for the ethanol part of the bus fuel has been developed. The ethanol fuel for buses is exempted from tax (all ethanol used for fuel is exempted from tax). 127 ethanol buses and 5 fuel stations have been introduced in Stockholm within the BEST-project.

Ethanol buses in Stockholm

Regulations for fuel stations

Ethanol fuel station for buses, Stockholm

There are Swedish national recommendations for safe storing and dispensing of ethanol fuel developed by the Swedish Petroleum Institute. The recommendations focus on E85, but are applicable on E95 as well, see Annex 1.

Ethanol fuel is a class 1 flammable liquid, just as petrol and shall be handled like petrol. Everyone that wants to set up a fuel station for ethanol fuel has to present a safety consequence analysis to the authorities that shall be included in the application for a building permit. The basis for an application for authorization should always be an assessment of the risks of fire and explosion and the likely injuries and damage that could occur.

The ethanol bus fuel station has to be built outside (the same requirements as for petrol). It also has to be equipped with a fire extinguisher, according to the regulations from the insurance company.

Buses on the way to Sao Paulo

The firm order of buses did not take place in M3 due to on-going discussions with Scania (Sweden) and Scania do Brasil. Scania do Brasil was reluctant to carry out a new test on ethanol buses. A test was carried out in 1997 and they expected the results to be very much the same. After a decision to look at the project from a strategic point of view, and in the new light of climate change debate Scania do Brasil declared a high interest to take part in the project.

One important question for the project is the future tax on ethanol fuel for buses. The tax for ethanol for otto-engines has lower tax but it's not the same for ethanol for compression engines. The Sao Paulo State Secretariat for Environment has offered to sign a document on potential tax reductions for future large-scale implementation of ethanol buses in Brazil. Brazilian biofuel producers have agreed to provide ethanol for the test fleet at a reduced price which enables the buses to operate competitively with respect to diesel buses.

There operation of one ethanol bus will start in June/July 2007 and the second in August.

Ethanol fuel station

Special agreements with local suppliers and the installation of a fuel station for E95 are under preparation. The price of the additive has been agreed upon with SEKAB. Due to the long-term experience with ethanol in Brazil, the installation of an E95 fuel station is not regarded as main problem. An agreement has been reached with SEKAB to supply only the additive for the E95 fuel to Sao Paulo. The economic performance of the BEST ethanol bus demonstration will be considerably improved if local suppliers for the ethanol can be used.

Annex 1. Recommendations from the Swedish Petroleum Institute for the safe handling of E85 fuel at petrol stations **(the same is applicable for E95)**

More and more cars are now using ethanol (E85) fuel. There are now several new installations at petrol stations around the country to meet the demand for E85 from the growing number of customers. And the number of E85 installations in petrol stations is expected to increase dramatically in the next few years.

The aim of these recommendations is to provide instructions on the specific measures that need to be taken, from a safety perspective, at petrol stations now selling E85. The basis for the recommendations is the risk assessment that was carried out on a comparison between the properties of E85 and petrol.

The recommendations have been compiled by the Swedish Petroleum Institute in consultation with the Swedish Rescue Services Agency, and are intended for use by the petrochemical branch and the municipalities in their role as authorising and supervisory authorities.

The Swedish Rescue Services Agency is of the opinion that if these recommendations are adhered to the handling of E85 will be safe and therefore meet the requirements of flammables and explosives legislation. If other technical solutions are opted for then the site owner must, by means of a specific risk assessment for the site, prove that the selected solutions will result in safe handling – from a fire and explosion perspective. As regards the establishment of new sites the recommendations can be followed straightaway.

Existing sites must as soon as possible be refitted in accordance with these recommendations, with regard to flame arresters, vapour recovery and depth gauging. The alterations needed at these sites to the materials and surface treatments used in order to follow the recommendations could from a risk perspective take some time.

Legal requirements

Authorisation is required for the handling of flammables at petrol stations. Authorisation granted for the handling of petrol does not automatically also apply to the handling of E85. A petrol station that sells petrol must, when wanting to also sell E85, also obtain authorisation for the handling of E85.

The basis for an application for authorization should always be a satisfactory assessment of the risks of fire and explosion and the likely injuries and damage that could occur. Sites intended for the handling of E85 must not be put into commercial use before they have been officially inspected and deemed to meet the technical requirements for safe handling. This of course also applies to the establishment of new sites that either handle just E85 or that handle both E85 and petrol.

E85 like petrol is a class 1 flammable liquid and is governed in Sweden by the regulations in SÄIFS 1997:9 and SRVFS 2004:7. The rules for classification of hazardous areas plans that

must be drawn up for all petrol stations and which govern the choice of fittings are the same for stations that only handle E85 as they are for those that handle E85 and petrol.

During application of the regulations consideration should be given to the specific differences in the properties of E85 when compared to petrol; therefore it is recommended that certain extra precautionary measures are taken for E85 installations.

- E85 has different corrosion properties compared to petrol, which must be taken into consideration when selecting materials for the various parts of an installation. Unsuitable materials for use with E85 are, for example, aluminium, zinc and brass. E85 has a different affect to petrol on certain plastics and rubberized materials.

- Ethanol and petrol have different explosive limits. This means that an explosive gas atmosphere in an E85 storage tank will exist across a wider temperature range than in a petrol storage tank. There are varying details about the temperature range but the SAE Technical Papers Series, 950401, “Flammability Tests of Alcohol/Gasoline Vapours” gives the temperature range at which a gas atmosphere in a closed container is explosive as being from -41o C till -10o C for petrol and from -33o C to +11o C for E85. Exactly what the temperature range is does not influence the shape of the practical extra precautionary measures that are recommended here.

Design of petrol stations handling E85

Selection of materials

The corrosion properties of E85 must be taken into consideration when selecting materials for the various parts of an installation. The petrol companies require that the suppliers concerned state in writing that the materials used in various parts of the system are suitable for use with E85. A suitable way of doing this is via certificates or other written documentation.

- Storage tanks should be manufactured from suitable materials or have a surface treatment that is approved for use with E85. Petrol storage tanks often only have rust protection on one third of the inside tank bottom. That is not sufficient for E85. The entire container must be manufactured from materials that are approved for use with E85.
- The filling pipe should be of a suitable plastic material or hot-dip galvanized steel. Hot-dip galvanized steel is acceptable in those cases in which the filling pipe is usually empty.

- Distribution pipes should be of a suitable plastic material.

- Gaskets and other materials in the dispenser unit should be made of materials that are suitable for use with E85.

- Hoses and filling nozzles should be made of materials that are suitable for use with E85.

- The overflow protector on an E85 installation should be specifically adapted for use with E85. The same type of overflow protector that is used for petrol will not work.

Increased risk of ignition

The following measures are recommended to prevent an ignition from spreading to the system, because the gas atmosphere in an E85 system will have a compound within the explosion range more often than is the case with petrol.

- There should be flame arresters on the storage tank ventilation system in accordance with SÄIFS 1997:9 marginal 4.2.6. As this applies to new installations, the new regulations based on the ATEX directive also apply and state that flame arresters should be designed in accordance with current EU standards. Flame arresters in accordance with class IIB1 are recommended.
- Some form of flame arrester should also be in use during the filling up of petrol station underground storage tanks. This can either be a flame arrester, a well-functioning interlocking shut-off valve or a liquid type flame arrester.

- It is rare but it has occurred that static electricity has caused small fires or small flames that have quickly gone out during the filling up of vehicles. To eliminate this risk as far as possible, the filling nozzles on E85 pumps should not be fitted with any latched fuel dispenses, i.e. driver operated snagging devices.

Recovery system for gases

The Swedish Environmental Protection Agency's regulations SNFS 1991:1 contain requirements for the recovery of vapours from vehicle petrol. E85 is not covered by these requirements. Accordingly there are no requirements for the recovery of vapours from and recycling of E85.

Vapour recovery systems are usually divided into two stages. Stage I is for the recovery of vapours from storage tanks and then on to the depot for recycling; and stage II is for the recovery of vapours during the filling up of vehicles and in to the storage tank. If vapour recovery systems are connected to an E85 installation consideration should be given to the safety risks involved.

Until this issue has been studied further it is recommended that stage II not be connected to vapour recovery systems. If E85 is connected to stage I the person responsible for the site should ensure with the supplier of the vapour recovery system at the relevant depot that this does not entail any safety risks. This should be documented in a suitable manner.

Depth gauging

During manual depth gauging (level measuring) the increased risk of ignition should be observed. As an extra precautionary measure a wooden stick should be used and there should be written instructions on how to carry out this task in a safe way. There are alternatives to level measuring with a measuring stick, for example, automatic tank measuring, which is preferable from a safety perspective.

Extinguishing agents

In the assessment of the fire service consideration should also be given to the need for dedicated alcohol resistant extinguishing foam for use on E85, because detergent foam does not have sufficient extinguishing capacity for E85.

(http://www.srv.se/templates/SRV_Page____17990.aspx).

See also BEST Deliverable 4.2 A Storing and dispensing E85 and E95.