

Summary

This report is the conclusion of BEST – BioEthanol for Sustainable Transport, a four-year project to demonstrate the use of bioethanol in cars and buses. The project included ten sites – BioFuel Region (SE), Brandenburg (DE), Somerset (UK), Rotterdam (NL), the Basque Country and Madrid (ES), La Spezia (IT), Nanyang (China) and São Paulo (Brazil) – and was coordinated by the City of Stockholm (SE). Imperial College London was the evaluator and also led work on sustainability issues. BEST was part of the Alternative Motor Fuel programme within the Sixth Framework Programme, and co-funded by the European Union.

The transport sector is facing serious challenges, brought on by the oil and climate crises. Countries must urgently focus on developing more effective transport systems, where unnecessary transport is reduced, energy is used more efficiently, and a wide range of alternative fuels account for an increasing share of the market. In order to meet the European Commission's goal of a 20% emission reduction in the EU by 2020, new fuels are needed.

BEST addressed the use of clean vehicles and fuels. BEST focused on bioethanol, because of its good properties for wider use. BEST studied the use of bioethanol from economic, technical, social, environmental and sustainability perspectives. One finding is that bioethanol is well suited as an important part of the future fuel mix.

Many ethanol fuels tested

High blends (E85, E100 and ED95) require dedicated vehicles and infrastructure, whereas low blends do not. High blends contain high proportions of bioethanol and effectively substitute fossil fuels. Low blends (E5, E10, HE15, E25, E-diesel and ED-diesel) represent a quick way to introduce large volumes of biofuel into road transport fuels without making alterations to fuel supply infrastructure or vehicles. The 2009 Fuel Quality Directive approved the use of blends including up to 10% bioethanol in petrol in the EU. This means that blends such as E5 and E10 can be marketed and sold as petrol in the EU.

FFV sales confirm – the cars run well

The most noticeable activity in BEST is the introduction of flexifuel vehicles (FFVs) running on E85 – a mixture of 85% bioethanol and 15% petrol. FFV cars can run on E85, petrol, or a mixture of the two. During the project, nine BEST sites introduced over 77,000 FFVs, far exceeding the original aims. In 2008, there were around 170,000 FFVs in operation and 2,200 E85 pumps installed in the EU. 45% of the vehicles operate at BEST sites and 80% of the E85 pumps are found in the BEST countries. 70% of all FFVs operating in the EU are found in Sweden.

BEST sites also evaluated both dedicated E85 pumps and flexifuel pumps and found very few problems. Guidance and regulations on safe handling and storage of E85 have been developed in Sweden and elsewhere and can be easily transferred to other EU Member States.

Satisfied FFV drivers

Evaluations carried out during the project show that drivers and fleet managers are satisfied and recommend the vehicles to others. They find FFVs reliable and easy to operate and maintain. The slightly higher purchase price can be offset by financial incentives to stimulate the sale of clean vehicles. However, the price of E85 and access to fuelling infrastructure are major concerns. Competitive pricing can be achieved by lower customs tariffs or by introducing a fuel tax system that takes into account energy content and emissions.

Better fuel economy than expected

A detailed assessment of the technical performance of 93 FFVs (11 different models used in a variety of situations at all sites) revealed 1–26% higher energy efficiency when running on E85, which resulted in better fuel economy than expected. In the best case only 1.14 times more E85 than petrol was necessary (instead of the theoretically assumed 1.41). This represents a significant finding and is an important area for future research. If engines could be adapted to the higher octane value in E85, increases in energy efficiency could be obtained and the fuel/energy consumption of bioethanol cars could be further reduced.

Parts of existing fleet can be converted to E85

Normal petrol cars can be successfully converted to FFVs if carried out by authorised specialists. Conversion of petrol cars to FFVs has been legalised in Sweden and could be applied in other EU Member States. A large percentage of the EU petrol vehicle fleet could be converted to FFV standard. It is estimated that up to 500,000 vehicles (one-eighth of the national fleet) could be converted in Sweden alone. BEST also included the conversion of a diesel vehicle to run on ED95. Tests showed that this is not viable using today's fuel and components. However, it should be possible to build bioethanol cars with diesel engines at the factory, resulting in better energy and emissions performance compared to diesel.

All links in the bioethanol chain must be addressed

Cooperation with key decision makers and stakeholders is crucial for stimulating the market and for development of effective incentives. BEST brought together manufacturers and consumers in constructive dialogue and identified actors that could be ambassadors for the use of FFVs and E85. For successful market development, all parts of the “bioethanol chain” – feedstock, production, vehicles, distribution, taxes and regulation, and end users – must be activated simultaneously. BEST recommends, for example, expanding alternative fuel supply infrastructure in parallel with other aspects of market development, such as fuel production and vehicle sales.



Fuel price highly important

Incentives must be relevant to the state of market development in a specific location. In a premarket phase incentives should promote vehicle supply and fuel distribution as well as remove legal barriers and tax disincentives. In a market development phase monetary incentives for end users and reliable information become effective tools.

A wide range of incentives were introduced during the project, including motor tax rebate, local purchase grants, free parking and access to restricted areas.

In Stockholm/Sweden, sufficient data was available to make a statistical analysis of the effect of various incentives. This showed that in a market development phase, the single most important incentive is to ensure that the price of bioethanol is equal to or lower than petrol. As long as bioethanol is subject to higher customs duties and energy taxes than fossil fuels, other incentives must be used to compensate for this. Exemption from congestion charging was the second most important instrument to stimulate the use of clean vehicles and bioethanol in Stockholm. The Swedish market was also boosted by a new “pump law”, compelling petrol stations above a certain size to introduce pumps for alternative fuels.

Greenhouse gas reductions of 4–79%

The greenhouse gas benefits of bioethanol used in BEST vary from marginal to substantial (4–79%). Bioethanol produced from sugarcane in Brazil was the best-performing supply chain. However, European bioethanol produced using renewable energy and with efficient nitrogen use also achieved high greenhouse gas emission reductions. Effective implementation of the Renewable Energy Directive (RED) is likely to depend on the extent to which EU Member States synergise the use of bioethanol from the best-performing supply chains and make optimal use of high-quality imports.

Production can be multiplied

There is great potential for increased bioethanol production in the EU and volumes are predicted to rise dramatically. Estimations indicate that it is fully possible for global production to increase five- to sevenfold by 2030.

Sustainable production must be ensured

Bioethanol for fuel can be produced in a number of ways, using a variety of feedstocks. If produced under socially and environmentally sustainable conditions, bioethanol can be a viable transport fuel, considerably reducing emissions of greenhouse gases (GHG). Bioethanol is biodegradable and less toxic and explosive than petrol.

Regulated emissions within limits

More research is needed to determine the net effect on local emissions of switching from petrol or diesel fuels to ethanol, and the impact this would have on health and the environment. Knowledge about emissions from bioethanol fuels should improve as more and larger standardised tests are carried out.

Bioethanol buses now in several countries

When BEST was launched, the only bioethanol buses operating were in Sweden, and the Swedish partners have provided advice and guidance to other sites wanting to introduce the technology. Problems included the absence of regulations, procedures and guidance on how to import, handle and supply bus fuel. BEST demonstrated more than 190 bioethanol buses and 12 ED95 pumps at five sites, and helped increase knowledge about bioethanol buses in Europe, Brazil and China. An innovation within BEST was the demonstration of two dual-tank E100 buses developed by the Chinese vehicle producer Dongfeng. The new bus types were invented to overcome import duties and are a low-cost alternative for Chinese cities seeking to introduce bioethanol to their public transport systems.

All BEST sites will continue to drive their bioethanol buses in regular traffic and some are already planning to expand their fleets. The spin-off effects include the potential for wider use in heavy vehicles.

More suppliers would speed up market for buses

In Europe, there is a huge difference between the market for FFVs and E85 and the market for bioethanol buses and ED95. At present, there is only one supplier of bioethanol buses (Scania) and one supplier of ED95 (SEKAB). More suppliers would speed up the development of standards, which in turn would promote market development and the emergence of a stable second-hand market. Introducing bioethanol buses and ED95 is largely a question of political will, and public transport authorities can play a key role in supporting operators. Issues such as the price of ED95, number of filling stations, and ways to reduce fuel consumption in bio-fuel buses with the use of hybrid technology must be addressed.

Low blends can contribute to – but not fulfil – EU targets

Fuel suppliers appear to favour low-blends as a cost-efficient way of implementing EU targets for renewables. It is unlikely that the use of low blends alone will enable the EU to meet its climate and energy targets, but low blends in petrol and diesel can make a contribution towards fulfilment of these goals. The urgent need to reduce diesel consumption in the EU means that development of infrastructure to supply both diesel low blends and ED95 should be a priority. Market introduction of diesel low blends is challenging, as they require separate pumps, have low flash point and different infrastructure complexity compared to standard diesel.

If low blends are not compulsory, they must be competitively priced for consumers. Taxation and excise on low blends varies in different EU Member States. It is questionable whether tax exemptions for the bioethanol part of low blends are effective policy. Making low blends compulsory – or increasing taxation on the fossil content of fuels – may well be a better approach.



Lack of standards causes delay

In order to raise consumers' trust in bioethanol, as well as increase the quality of bioethanol production, fuel standards for the different high and low blends need to be harmonised in the EU. They must also be adopted and recognised in all relevant legislation. Standards for fuel storing and dispensing, and vapour-recapturing systems, are also necessary. Emission and type-approval standards must apply to vehicles running on different high blends of bioethanol. The standards should recognise the special properties of bioethanol and introduce the concept of non-bioethanol hydrocarbons.

Governments must create a level playing field

The use of bioethanol vehicles and fuels can help raise the profile of national and local governments and help improve public perceptions of the public transport system. Governments can remove barriers to the introduction of clean vehicles and fuels, develop climate change action plans, and adopt clean vehicle strategies, clean vehicle definitions and criteria for sustainable transport fuels. They should ensure procurement of clean vehicles and fuels in public fleets, and cooperate with wider EU and international schemes supporting clean vehicles and fuels. Counter-productive incentives that actually support the use of fossil fuels should be removed. Governments can demand development of energy-efficient vehicles that use alternative fuels.

EU framework must encourage use

Bioethanol can play a role in helping the EU achieve its 20-20-20 by 2020 strategy. But to enable a bioethanol market to develop further, the EU must work on a harmonised legislation for safety and environment, and directives and taxations that reflect energy content and well-to-wheel greenhouse gas emissions. A system for certification of sustainable biofuels must be launched and implemented. The EU and national bodies should encourage E10 and FFVs to be standard in petrol and petrol vehicles.

