

**Summary:**

# Conversion of passenger cars to ethanol

*In this project we study the experiences of Swedish legislation to allow the conversion of petrol vehicles to petrol-bioethanol “hybrid” vehicles. We review the literature on bioethanol and carry out a survey and cost-benefit analysis for corresponding legislation in Norway. We conclude that although such legislation would have positive environmental effects, it would not be economically profitable.*

## Bioethanol

Bioethanol can act as substitute for fossil fuels (oil, coal and gas). Bioethanol is made from plants containing sugar, cellulose or starch. It is commonly used in a fuel known as E85, which is a mix of 85 percent bioethanol and 15 percent petrol. Accounting for the chain of processes from “well to wheel”, the use of 100 percent bioethanol can potentially reduce CO<sub>2</sub> emissions by 72% compared with the use of fossil fuel.

## Background and Methodology

On 1 July 2008 Sweden legalised the conversion of petrol vehicles (*Law of Motor Vehicle exhaust emissions and motor fuels, SFS 2001:1080*) to enable them to run on petrol-ethanol mixtures. The Norwegian authorities are considering similar legislation, and wish to learn from the experiences from Sweden.

A comprehensive literature study on conversion of petrol cars to “Flexi Fuel Vehicles” (FVVs) has been undertaken. The search was conducted using Scandinavian and English keywords most readily associated with E85 conversion. The Swedish authorities were contacted and surveyed about experiences with the effects of legislation. We also surveyed to obtain views from Norwegian stakeholders, including industrial representatives, experts, NGOs and auto repair shops to obtain their views. Finally, we carried out a cost-benefit analysis of legislation allowing the conversion of cars in Norway.

## **Technology Status**

There exist many different technical solutions for converting conventional petrol cars to FFVs. In Sweden, these solutions can be “type-approved”, in which case a vehicle converting system is certified by the authorities. Vehicles converted using type approved converting kits are more easily approved by the road administration.

Conversion is achieved by adjusting the fuel injection and the ignition time to allow the vehicle to run on petrol with a varying amount of ethanol content.

The problem of fuel evaporation while refueling is not restricted to converted vehicles, but applies to all FVVs.

Studies carried out before legislation of conversion in Sweden pointed out that poorly converted vehicles risked increasing their regulated emissions significantly. The studies recommended that the various car models be tested for their emissions before and after the conversion.

## **Type approval in Norway**

In accordance with the Norwegian Vehicle Regulations Chapter 7.3 a vehicle must be reapproved by the authorities when it no longer accords with the registration book. The registration book holds information about the vehicle`s fuel and power output, both of which are changed on conversion to FVV. Other technical information registered like the weight, the chassis and so on are not affected by a conversion.

## **Type approval in Sweden**

For a type approval of a conversion system there are certain requirements for emissions testing. The power output cannot exceed the original by more than 5 %. Neither can the conversion affect any of the vehicle's system for troubleshooting and self-diagnostics (OBD).

The manufacturer of the conversion system has to document to the road administration that the exhaust gases from the vehicle still meet the requirements that were relevant to that vehicle before the conversion. It must also be documented that the various components are robust enough for use with E85. The conversion system must fulfill these requirements for each vehicle model. The manufacturers must also be ISO 9001 certified or have a similar quality assurance system.

## **Internationally**

Generally the EU strategy is to reduce CO<sub>2</sub> by increasing energy efficiency in the car fleet. Our literature study shows that there is little interest in legislation of conversion at an international level.

## **Economic factors**

The administrative burden of the Swedish road administration has not been high as a result of the treatment of the conversions of vehicles.

The price for a simple conversion in a auto repair shop lies between 7000 - 10 000 NOK depending on the vehicle model. Accounting for fuel efficiency, the number of oil changes needed, the fuel price difference, the conversion is not economically profitable for the consumers for less than 14 000 km driven per year. If however, the authorities pays for the conversion cost, it will become profitable for the consumers to run their car on E85.

At the socio-economic level our calculations show that conversion to E85 is not profitable, given current fuel prices and the current state of technology.

## **The Stakeholder views on E85**

A survey was conducted to gather the opinions of the corporate stakeholder, the NGOs and other. The questionnaire is attached to the report. The response rate was 16.4%.

The low response rate may reflect that the interest in conversion of cars to FVV among the stakeholders is low.