

Summary:

Diesel cars

Particle filters – refitting and costs

Background and conclusions

The various pollutants emitted by cars have local, regional and global effects. Light and heavy diesel vehicles are each responsible for around half of the 2000 tonnes of particulates (PM₁₀) in exhaust emitted from traffic on Norwegian roads. Light vehicles with diesel engines now represent between 70 and 80 per cent of the total sales in Norway, compared with only seven per cent ten years ago. The increasing number of diesel engine vehicles, which usually emit more particles and NO_x than petrol engine vehicles, has a notable impact on the air quality in large cities.

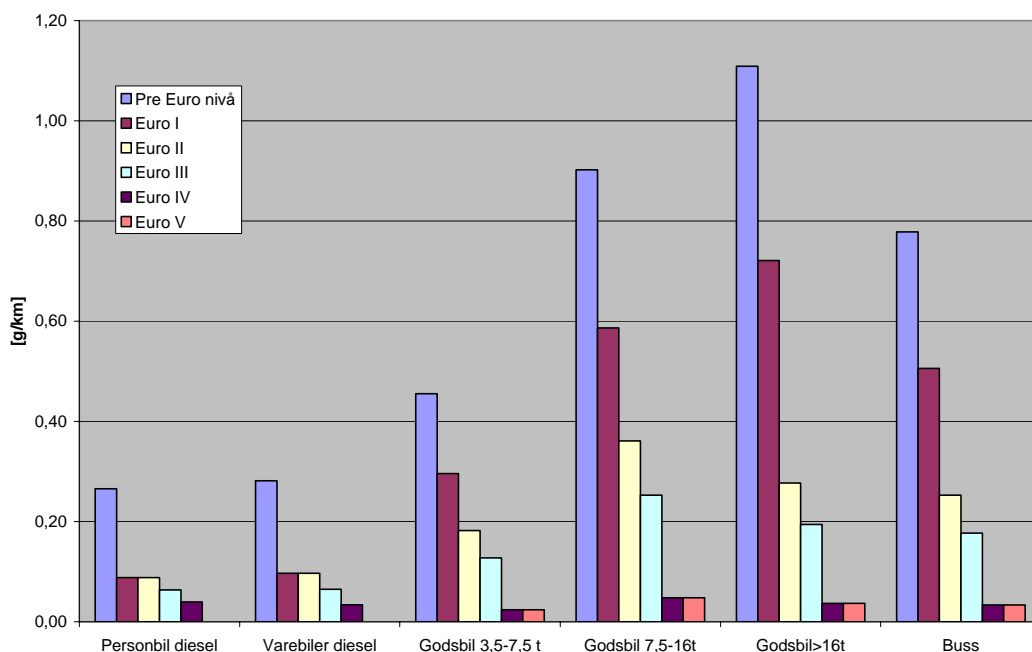
Certain measures can be taken to reduce the amount of particles emitted from diesel vehicles in Norway. The EU has placed increasingly stricter demands on the quality of emissions permitted from new cars (Figure S1), and manufacturers have been obliged to meet them. Particle filters and concerned older cars refitting of particle filters can address the amount of particle emissions.

In this report we have evaluated the socio-economic benefit of refitting particle filters, particularly for vehicles in large cities. It is here, where the traffic is dense, that there is an understandable concern both about the health costs of particle emissions and about the realism and effectiveness of the different ways in which they can be addressed. On this basis the report concludes that:

- Installation of effective integrated particle filters that meet the Euro5 demands for particle emissions (0.005 g/km) is socio-economically profitable for new diesel cars. Refitting of effective integrated particle filters are also socio-economically profitable for used diesel cars that meet the Euro3 and Euro4 demands.
- Refitting of *integrated* particle filters on all post-1999 registered diesel cars in Oslo, Bergen and Trondheim will cost Nok.750 million.
- Refitting of *simpler* particle filters, as carried out in countries such as Germany or Holland, is neither technically nor economically regarded to be a sound measure. *Simple* filters clean output gases with only low and varying effects in older diesel cars. Claims have even been made in Germany, in December 2007, that refitting of certain of these filters does not result in the particle cleansing levels demanded. In any case, their introduction would not be socio-economically profitable in Norway.
- Refitting of particle filters on older buses is with specified assumption concerning reliability calculated to be socio-economically profitable.

Our cost-benefit analyses are based on assumptions of negligible maintenance costs and long lifetimes for refitted particle filters. In the case of integrated particle filters we can expect that these expenses will be low. We know little about operational reliability of simple refitted particle filters and the calculations are therefore made with the caveat that the costs are potentially greater and could result in lower profitability.

It is difficult to define what particle filters for buses and heavy vehicles actually are. They can either be of the simple type or of a more or less integrated and effective type. Refitting of particle filters in buses can therefore, depending on filter quality and reliability, vary widely from being a socio-economically profitable or a loss-making measure.



*For light vehicles meeting Euro 5 demands emissions are too small to be seen in this Figure.

Figure S.1. Typical values for exhaust emissions of PM_{10} under urban driving conditions (26 km per h) (from Copert III and Skedsmo, 2006)

Different filters have very different effects

There are in principle two types of particle filter. Both use catalytic technology to burn particles. The first very effective type of filter, the *integrated filter*, ensures, together with the engine control system, that between 90 and 99% of particles are burnt and removed. The particles are converted to the gas CO_2 , which subsequently escapes through the side walls of the filter pipes, in this case an array of pipes that are sealed at one end. In 2007 this type of filter was offered on some models of new cars as an additional option. Other car models have for several years been delivered with integrated particle filters fitted as standard.

The other type of particle filter – the *simple filter* – has open-ended pipes and converts only a fraction of the particles to CO_2 . For this simpler type of filter, which can be used to refit cars originally equipped with oxidising catalytic

converters, the suppliers claim cleansing efficiencies of between 20 and 50 per cent. Some of these filters are sold in the service market.

Effects of refitting

Installing *integrated* particle filters that meet the Euro5 demands (0.005 g/km) will have a large effect on light vehicles emissions. If possible, installing *integrated* particle filters in diesel cars that were produced from 2000 to 2005 and meet the Euro3 demands, is a good measure. For new and used cars that meet the Euro4 demands but are delivered without particle filters refit of *integrated* effective integrated filters is also a socio-economically profitable action.

Refitting of *simple* particle filters in pre-2000 diesel models is judged to be a poorer measure, based on limitations concerning lifetime and benefit value. Ongoing efforts with such refitting in Germany, Holland, Austria and the UK should continue to be monitored for evaluation of potential benefits in Norway later on.

Differing views in the motor trade

A survey shows that motor industry businesses want to play a part in ensuring that particle emissions from vehicles are reduced and that there are different opinions about how this should be done.

Car importers can contribute mainly by offering *integrated* filters on all diesel cars imported from 2008. Car importers also have the possibility to offer *integrated filters* for refitting of recently delivered cars models.

The Norwegian motor trade association, *Bilbransjeforbund*, views the refitting of *simple particle filters*, which reduce emissions by between 20 and 50 per cent, as a good and efficient measure.

Approval and inspection

Norway does not have laboratories in which it is possible to inspect or appropriate measure the actual particle emissions of vehicles. In other words it is not possible to decide which Euro class a car with refitted particle filter should be in. Smoke measurements made in periodic vehicle inspections, and other ways of evaluating particle emissions that are simpler than EUs standardised method for emission testing and approval of cars and engines, are not considered sufficient in terms of fairness and practicality. This is considered as a considerable drawback for future arrangements to reduce emissions.

The demand on particle emissions at the Euro5 level (less than 0.005 g/km) for cars with diesel engines, is a verifiable criteria. The particle emissions (in mg/km) measured for all new diesel car model sold in Europe can be found in international databases.