

## Freiburger Verkehr AG – Retrofitting buses

### Clean Fleets case study

- Buses retrofitted to meet stricter emissions standards
- The entire fleet now meets a minimum Euro 5 standard. CO and NMHC emissions reduced by 92.5%, NOx by 81.5% and PM (particulates) by 78%.



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### Summary of initiative

In 2010 Freiburger Verkehrs AG (VAG) decided to retrofit buses with particulate- filters. 5 buses were retrofitted, going from a EURO 3 standard to EURO 5.

### Business Case for retrofitting

Achieving high exhaust emission standards is a very important strategic goal for VAG. New buses are required to meet EURO 6 emission standards, and the existing fleet is expected to meet at least EURO 5 standard. In 2010, there were still five buses in the VAG fleet that only met the EURO 3 standard. The buses were Mercedes Benz Citaro G models with OM 457 EURO 3 engine. At 7 years old, they were only halfway through their expected 12-14 year lifecycle.

Two options were available to ensure that the whole bus fleet met its obligatory EURO 5 standard: either sell the buses and buy new ones, or retrofit the existing stock. The decision to retrofit the buses instead of replacing them was the more cost effective option for achieving the set emission goals.

VAG used this project as a pilot to gain experience, as this type of retrofitting was not well established in the market at the time and few other companies had experience in this area.

### Technology choice

VAG had already bought several buses that included particulate- filters, with positive results. It was therefore decided to use the same system for retrofitting. The main advantage to this decision was that only one system of particulate- filters would need to be maintained, meaning just one type of spare parts would be required.

The system which was bought for retrofitting is called SCRT. This means **C**ontinuously **R**egenerating **T**rap and **S**elective **C**atalytic **R**eduction (SCR+CRT=SCRT). It reduces the toxic element particles, NO<sub>x</sub>, HC and CO.



## Procurement approach

VAG decided to retrofit its buses with a complete system that was offered on the market rather than buying individual components.

In a first step a market analysis was carried out to learn about the available suppliers and systems. The decision to buy the same system that was already being used in newer buses reduced the range of systems to choose from.

As the estimated project costs were well below the EU limit for European-wide tenders, VAG requested offers only from possible suppliers of the SCRT system. The offers were analysed and the supplier with the best offer was chosen.

## Assembly

VAG mechanics worked with the supplier to learn how to install the SCRT system. The supplier assembled the first two systems, giving the VAG mechanics a chance to learn the installation process. The last three systems were installed by VAG mechanics as the retrofitting process turned out to be fairly uncomplicated. It took about 3 days with 2 assemblers to install one retrofitting system.

## Results

As VAG chose to buy the same system already installed in some of the buses the range of possible suppliers was limited to two companies. The bidder offering the cheapest service was chosen. The initial investment was lower than foreseen because the installation could be carried out in-house. Maintenance costs, on the other hand, were higher than estimated because the filters need to be cleaned more often than was foreseen.

The requirement that the existing VAG bus fleet meet at least EURO 5 standard forms part of the company's environmental strategy. Other elements of this strategy include using 100% green energy in tram operation and a tram washing system which collects and reuses rainwater.

VAG is convinced that the population of Freiburg chooses the public transport instead of cars not just for convenience reasons but also as a positive commitment to protecting the environment. Therefore there are many marketing initiatives to communicate the climate protection impacts of using public transport. These include using the commercial space on buses and trams to communicate this message, distribution of a flyer on the climate protection initiative and an educational program for school children called "VAG KlimaKlasse" that is attended by several thousand pupils every year.

The public response to initiatives like the retrofitting system is very positive, as seen the results of market research. VAG takes part in the annual "ÖPNV Kundenbarometer" carried out by TNS infratest, covering 33 German public transport companies. When asked to rate initiatives for climate protection, VAG is regularly voted into the top three transport companies. This shows that initiatives like retrofitting to reduce the environmental impact of



the fleet are understood and appreciated by customers.

## Costs

The cost of each SCRT system was 15.000€. The total investment in upgrading five buses from EURO 3 to EURO 5 standard was 75.000€ without assembly cost.

Following the decision that three of the systems should be installed by VAG mechanics, it was possible to renegotiate prices with the supplier.

As the alternative for the retrofitting would have been to buy five new buses, the retrofitting was a much more cost effective choice.

No data is available on the impact of the retrofitting on vehicle maintenance costs.

## Environmental impacts

The supplier of the SCRT system commissioned TÜV Nord (a German testing institute) to measure the gaseous and particulate pollutants. Different measurements on an engine test bed were carried out. The engine was measured with and without the retrofitting system. The test results showed that the retrofitting system reduced CO emissions by 92.5%, NMHC by 92.25%, NOx by 81.5% and PM (particulates) by 78%.

## Lessons learned

The maintenance volume and costs were underestimated, although the overall saving was still significant when compared to buying a new bus. When buying a retrofitting system this should be discussed in detail with the supplier.

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