

**For Information
27 June 2012**

**LEGISLATIVE COUNCIL
PANEL ON ENVIRONMENTAL AFFAIRS**

SUBCOMMITTEE ON IMPROVING AIR QUALITY

**Interim Findings on the Trial of
Retrofitting Franchised Buses with Selective Catalytic Reduction Devices**

PURPOSE

This paper reports on the interim findings of the trial of retrofitting selective catalytic reduction (SCR) devices on Euro II and III franchised buses and the way forward.

BACKGROUND

2. Franchised buses could account for up to 40% of the traffic flow in busy corridors. At present, about 67% of the existing franchised bus fleet are Euro II and III buses. Reducing their emissions could help improve roadside air quality, particularly at busy corridors. To this end, the franchised bus companies have already retrofitted their Euro II and III buses with diesel particulate filters (DPF) which could reduce their particulate emissions by about 80%, thereby upgrading their particulate emission performance to that of Euro IV buses.

3. To reduce nitrogen oxides (NO_x) emissions, some places in Europe, such as London and Belgium, have successfully retrofitted some of their Euro II and III buses with SCR devices that could reduce their NO_x emissions by about 60%, thereby upgrading their NO_x emission performance to that of Euro IV buses. To assess the technical feasibility and effectiveness of retrofitting our Euro II and III franchised buses with SCRs, we are conducting a trial jointly with three franchised bus companies. Subject to satisfactory trial results, the Government will fund the full cost of retrofitting these buses with SCRs.

PROGRESS OF THE TRIAL

4. So far we have retrofitted SCRs on four Euro II and two Euro III buses respectively. They came from three major bus models, namely Euro II Volvo Olympian, Euro II Dennis Trident and Euro III Dennis Trident. About 58% of the current Euro II and III franchised buses are of these three models. The SCRs are provided by two suppliers and each of them is servicing three trial buses. One supplier started the trial in September 2011 while the other commenced in February 2012. The trial will last for 12 months for assessing the full performance of the SCRs.

5. The buses on trial have been put on normal bus routes comprising both urban and highway traffic conditions. Together with the franchised bus companies, we have been monitoring the performance of the SCR devices in the following aspects –

- (a) the reduction in NO_x emissions;
- (b) the backpressure on the bus engine;
- (c) the consumption rate of urea solution, which is required for the chemical conversion of NO_x emissions into non-harmful nitrogen and water vapour; and
- (d) other implications, if any, on the operation and maintenance of the trial buses.

6. Up to end April 2012, the trial shows that SCR retrofit can reduce effectively the emissions of local franchised buses of the above three models while not increasing excessively the backpressure on the bus engines. The trial also reveals that the design and construction of the SCR system is critical to its successful operation. During the initial trial period, we have observed some mechanical problems, e.g. broken heat shield and mounting rubber, and excessive filter movement causing damages to the filters, which have since been rectified by the relevant SCR supplier through modifying the design and construction of the SCR. Details of the interim trial results up to 30 April 2012

are presented below.

(a) Emission Performance

The average NO_x emission reduction efficiency for the first batch of trial buses between September 2011 and April 2012 is around 67%, and those for the second batch of trial buses between March and April 2012 ranged from about 66% to 86%. This 60-plus percent of NO_x emission reduction brought by SCR devices will raise the emission performance of the retrofitted Euro II and III buses, together with the DPF already installed, to those of Euro IV and V buses respectively.

(b) Consumption of Urea Solution

The average urea consumption rates for the first batch of trial buses between September 2011 and April 2012 ranged from about 3% to 7% of the corresponding fuel consumption rates. For the second batch of trial buses between March and April 2012, it ranged from about 3% to 6%. These outcomes are in line with the findings of overseas retrofit studies.

(c) Additional Backpressure

Adding a retrofit device to the exhaust system of a vehicle could increase the backpressure of the engine. Excessive increase in backpressure could raise engine temperature, reduce power output and increase fuel consumption. During the trial, the alarm levels set for the DPFs, which are already retrofitted in the trial buses, have been adopted to monitor the implications of the retrofitted device for backpressure. There were occasional backpressure alarm warnings indicating that the system requires attention but none of the backpressure increase reached the level requiring immediate corrective actions. In response to the alarm warnings, the relevant SCR suppliers had taken remedial actions by either cleaning the DPF or fine-tuning the backpressure setting parameters.

(d) Operational Performance

While SCR technology has been effective in the trial for reducing NO_x emission in local buses, some mechanical problems have been found

during the trial, including broken heat shield and mounting rubber, excessive filter movement causing damages to the filters, blockage of exhaust pipe due to crystallization of urea, urea leakage, and exhaust gas leakage resulting in the thermal lagging material being burnt. These problems are however due to the design and construction of the SCR systems, and modification (including replacement of damaged parts) and adjustments have since been made which are found effective in rectifying the problems.

7. The performance of the SCR systems as well as other operation parameters including urea consumption rate, urea dosing control, fuel consumption rate, durability of the SCR system components (including the sealing and insulation materials), and frequency of maintenance will be closely monitored and evaluated in the rest of the trial period. We plan to make a final report on the trial by the end of 2012.

WAY FORWARD

8. Given the positive findings from the trial, we have sought the support of the franchised bus companies to start preparation for launching a large-scale retrofit for Euro II and III buses with an aim to completing, on a best endeavour basis, the retrofit by end 2015. Specifically, we will make the following joint efforts with the franchised bus companies –

(a) Further batches of Euro II and III bus models

About 58% of the existing Euro II and III franchised buses are of the three models already under trial. As for the remaining Euro II and III buses, about 34% are of another six models, which will be the target of the next batches to be tested. We have already started working with the franchised bus companies and SCR suppliers to assess whether these six key models have the space for the retrofit of SCR, and subject to positive confirmation, we aim to test out SCR products on these bus models as soon as possible. For the remaining models which cover only a very small number¹ of buses, we will undertake the same assessment

¹ The number of these buses range from one to about 60. For those bus models having a larger number, they are mainly single-deckers.

afterwards.

(b) Engaging other potential suppliers of SCRs

Given that the retrofit will cover about 3,000 buses, it is prudent to test out as far as possible other market suppliers for identification of the most cost-effective products. We therefore agree with the franchised bus companies to follow their usual practice to engage interested potential suppliers to test out their products on the selected bus models for the retrofit before tendering for a full-scale retrofit. We will work with them to start preparing the relevant technical specifications for SCR products, making reference to the findings of the current trial.

9. We plan to report the findings of the trial to the Panel by the end of 2012. By then, the findings will have covered those from a nine month to a full year trial of the first two batches of buses, which could provide a reliable basis to confirm the effectiveness of the SCR in reduction of NOx emission. Subject to the support of the Panel, we will seek funding approval from the Finance Committee in early 2013 for the large-scale retrofit with an aim to completing the retrofit in 2015.

ADVICE SOUGHT

10. Members are invited to note the interim findings of the trial and the way forward.

**Environmental Protection Department
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