

**Date:** 26 June 2017

**Item:** Low Emission Bus Technology - Compressed Natural Gas

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## **This paper will be considered in public**

### **1 Summary**

- 1.1 This paper is in response to an action raised at the Panel on 21 March 2017. The paper seeks to establish if Compressed Natural Gas (CNG) is a viable option for reducing tailpipe emissions from TfL's contracted bus fleet, and whether a vehicle trial might be worth considering.

### **2 Recommendation**

- 2.1 The Panel note the paper.

### **3 Emissions Performance CNG vs Diesel**

- 3.1 There is little difference between the tailpipe CO<sub>2</sub> emissions of the latest CNG and hybrid diesel-electric bus engines. This is because CNG, produced from natural gas, has a lower thermal efficiency which prevents it converting its lower carbon content into reduced carbon emissions. The previous generation of engines (Euro V) reduced particulate matter (PM) and oxides of nitrogen (NO<sub>x</sub>) by up to 65 per cent and 30 per cent respectively.
- 3.2 The emission standards for the latest Euro VI bus engines set the same stringent emission limits, and make no distinction between whether they are powered by gas, diesel or petrol. These standards, backed by a certification process using Portable-emission Measurement Systems (PEMs), provide assurance tailpipe performance achieves the benefits anticipated under real-world conditions.
- 3.3 The complex exhaust gas after-treatment systems that are now fitted at Euro VI (to both diesel and gas buses) has led to an order of magnitude reduction in oxides of nitrogen (NO<sub>x</sub>) emissions at Euro VI.
- 3.4 The emission factors shown for bio-methane in Figure 1 are for when it is used to directly power the bus similar to TfL's bio-diesel programme includes a 20 per cent component of renewable fuel.
- 3.5 In line with the Mayor's aim to introduce new double-deck buses that are hybrid diesel-electric or zero-emission from 2018, and then move to an exclusively zero-tailpipe-emission buses, any CNG vehicle use would be short term.

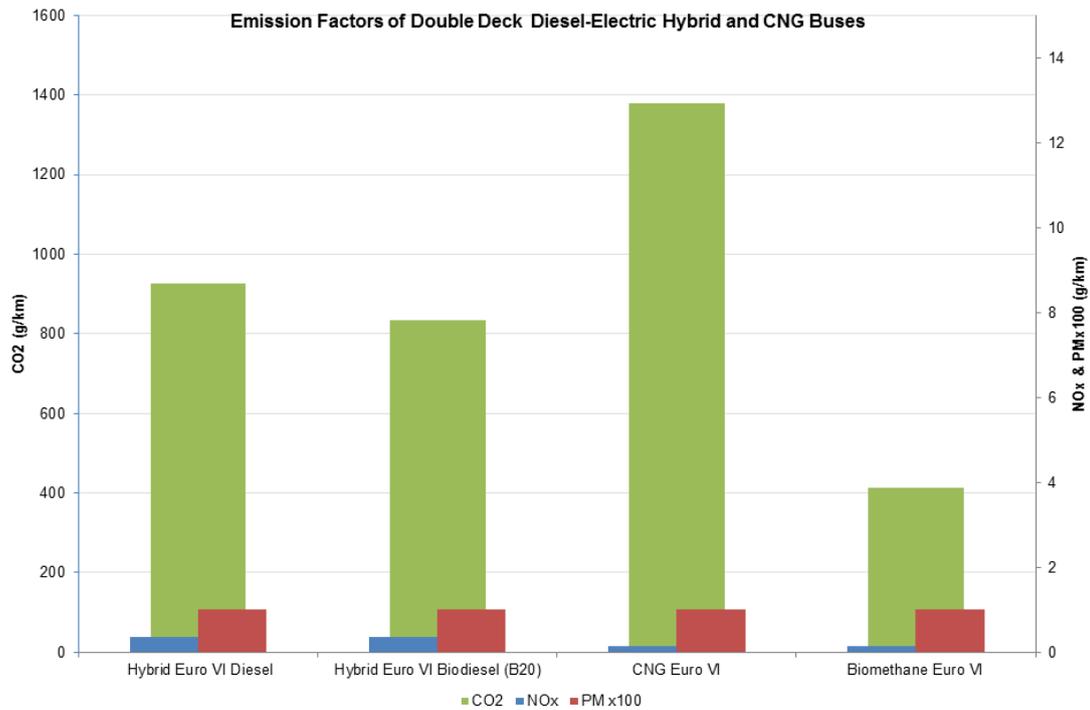


Figure 1: Emission of Double Deck-Electric Hybrid and CNG Buses

## 4 Renewable Sources of Energy and Traceable Benefits

- 4.1 CNG and bio-methane are fundamentally the same fuel (methane – CH<sub>4</sub>), derived from fossil or renewable sources. As is the case with diesel compared to biodiesel, the ‘tank to wheel’ emissions for both fuels are similar but, when lifecycle emissions are taken into account using Department for Environment Food and Rural Affairs (Defra) emissions factors, ‘well to wheel’ carbon emissions for the bio-fuels are better.
- 4.2 The difficulty with attributing bio-fuels benefits to buses is that bio-methane is typically injected into the gas grid rather than used to directly power gas vehicles. The rules for the Bus Service Operators Grant – the Government scheme which enables vehicle operators to claim a rebate for running low-carbon vehicles – allow the use of bio-methane to be tracked through a Green Gas Certificate to claim the Low Emission Bus Incentive.
- 4.3 However, the current Defra Greenhouse Gas reporting guidelines require the grid carbon emissions factor to be used rather than that from the Green Gas Certificate. This means TfL would not be able to report on reduced CO<sub>2</sub> from bio-methane fed into the grid. From a reputational perspective, the buses would be using gas from the grid with no way of determining its source or demonstrating a direct link to renewable sources.

## 5 Infrastructure and Requirements

- 5.1 All bus garages have diesel refuelling infrastructure, typically in the form of underground tanks. When TfL implemented the hybrid bus programme, this option was chosen as it offered the most cost-effective means of CO<sub>2</sub> reduction for the TfL bus fleet, taking into account both vehicle and infrastructure cost.

5.2 Gas from the grid is typically compressed to 200 bar pressure for refuelling which takes up significant space, as shown in the two illustrations of Reading Buses premises in Figure 2. In most operator garages in London, there would not be space for such infrastructure to be installed.



Figure 2: Illustrations of Reading Buses premises.

## 6 Financial Implications

6.1 Gas refuelling infrastructure can cost between £400k and £1m to install per bus depot (Gasrec Limited, a London gas company) and many bus depots in London do not have the space for installation.

## 7 Conclusion

7.1 Given the effectiveness of Euro VI emissions standards, gas-powered buses no longer offer a significant air quality (NO<sub>x</sub> and PM) benefit. They are likely to only provide a reduction in green-house gas emissions when powered by bio-methane which will lead to lower 'well to wheel' CO<sub>2</sub> emissions. This bio-methane would have to power the bus directly (not fed into the grid) for the benefit to be claimed. For the above reasons, TfL has concluded that CNG-powered buses do not offer significant emission benefits and has considerable cost and logistical constraints. Therefore TfL is not currently considering CNG-powered buses for use in London.

### List of appendices to this report:

None

### List of background papers:

Low Emission Technology Buses, Safety, Sustainability and Human Resources Plan, 21 March 2017

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