Certification of dual-fuel diesel/gas Low Carbon Emission Buses Guidance for bus manufacturers and operators

1. What is a Low Carbon Emission Bus (LCEB) and what is the Bus Service Operators Grant (BSOG) LCEB incentive?

A LCEB is a bus that is able to achieve the LCEB target for greenhouse gas (GHG) emissions, which is equivalent to a 30% reduction in its GHG emissions compared to the average Euro 3 diesel bus of the same total passenger capacity.

A vehicle will **not** qualify as a LCEB simply by using a fuel type which allows it to achieve a 30% reduction in its GHG emissions, unless it uses is 100% biogas.

Existing guidance outlines the definition of a LCEB and details the full testing procedure and is available on the DfT website at:
http://www.dft.gov.uk/publications/certification-of-a-low-carbon-emission-bus/

Since April 2009, bus operators have been able to claim the BSOG LCEB incentive of 6p per kilometre for all eligible kilometres operated.

2. How are greenhouse gas (GHG) emissions for LCEB testing calculated?

Total GHG emissions for a LCEB are calculated as the combination of a) the tank to wheel emissions and b) the well to tank emissions.

a) Tank to wheel emissions

The tank to wheel emissions and fuel consumption are measured by putting the bus through a whole vehicle test using the Millbrook London Transport Bus (MLTB) test cycle as outlined in the LCEB guidance.

The gas values of methane and nitrous oxide are converted to carbon dioxide equivalent and added to the carbon dioxide emissions to provide a CO_2 equivalent g/km figure.

b) Well to tank emissions

The fuel consumption measured during the MLTB test is used to calculate the CO_2 equivalent emissions of the vehicle on a well to tank basis, using the appropriate emission factor for the fuel intended to be used in service i.e. natural gas or biogas.

The well to tank emissions are determined using an appropriate analysis, such as that used in the CONCAWE study '*Well-to-Wheels analysis of future automotive fuels and powertrains'* which was developed by L-B-Systemtechnik GmbH. An alternative approach can be used *subject to approval in advance* by the Department for Transport. The results are expressed in grams of carbon dioxide equivalent per MJ of fuel delivered. Knowing the fuel consumption of a vehicle in MJ/km, the well to tank CO_2 equivalent figure can be expressed in g/km.

c) Total greenhouse gas emissions – Well to wheel emissions

The tank to wheel emission figure is added to the well to tank emission figure to give the total well to wheel emission (c) figure with CO_2 equivalent emissions expressed as CO_2 equivalent grams per kilometre.

This total well to wheel emissions figure is then assessed against the LCEB emission target, which is expressed as a function of total passenger capacity and is calculated as:

$$CO_2 \text{ (well to wheel)} = 6.28 \times \text{total number of passengers} + 502$$

If the total well to wheel emissions figure for the dual fuel bus is equal to, or less than, the LCEB emission target then the bus is awarded full LCEB status.

3. How does a dual fuel bus become fully certified as a LCEB?

A dual fuel diesel/gas bus is required to undergo full MLTB testing using a combination of diesel and methane to determine its tank to wheel emission figure. Methane is used in the testing, regardless of whether the bus will operate on methane, biomethane or a combination of the two, as the measured tank to wheel emissions will be the same regardless of the fuel used to operate the bus in service.

The tank to wheel emission figures are then used to calculate the equivalent well to tank emission figures. These calculations will take account of the proportion of diesel and methane/biomethane which will be used by the bus when operating in service.

The tank to wheel and well to tank figures are then combined and compared to the LCEB target to assess for LCEB certification. If the bus's total emission figure is equal to, or less than, the LCEB target then the bus is awarded LCEB status. If it is higher than the target line the bus is not awarded LCEB status.

3.1 Dual fuel buses certified using methane

The default approach to calculate emissions for a dual fuel bus is to use the well to tank emission factors for diesel and methane (and not biomethane). If the bus can achieve the LCEB target in this way then the dual fuel bus is certified in the normal way. Operators of diesel-methane buses are required to supply evidence as part of their BSOG claim that they have purchased methane for use on the buses.

3.2 Dual fuel buses certified using biomethane

If a dual fuel bus can only achieve the LCEB target by assuming that it will run on biomethane (or a methane/biomethane mix) then the bus must be operated using at least the minimum proportion of biomethane used in the LCEB calculations. As LCEB status awarded to such a bus is dependent on the bus being operated using **at least** this minimum proportion of biomethane, this **minimum proportion of biomethane must be printed on the bus's LCEB certificate** which must be submitted with the corresponding BSOG claim.

For example, a bus operating using 50% diesel, 35% methane and 15% biomethane would undergo LCEB testing using 50% diesel and 50% methane. The subsequent LCEB calculations would substitute 50% methane for 35% methane and 15% biomethane. Should the bus meet the LCEB target based on these calculations, it will be required to have a LCEB certificate stating the bus complies as a LCEB **only** when a minimum of 15% of the fuel consumed is biomethane when calculated on an energy basis.

4. What does LCEB certification mean in terms of the BSOG LCEB incentive?

In order to identify that a particular vehicle is eligible for the LCEB incentive, the vehicle's manufacturer will need to issue the bus operator with a certificate certifying the vehicle has undergone and passed the LCEB testing procedure.

At the time of submitting a BSOG claim, operators of dual fuel buses must supply the relevant LCEB certificate(s), along with evidence of the fuel(s) used to power the buses.

4.1 Dual fuel buses certified using methane

Where a dual fuel bus has LCEB status based on methane use and has been operated using methane, providing the operator supplies evidence that methane has been purchased to operate the bus, then the bus's LCEB status applies and the DfT will pay the incentive for all eligible kilometres operated (including dead kilometres).

If no evidence is provided then LCEB status does not apply and DfT will not pay the incentive for this claim period,

4.2 Dual fuel buses certified using biomethane

Where a dual fuel bus has LCEB status based on biomethane use and has been operated using biomethane, LCEB status is dependent on the bus being operated using a minimum proportion of biomethane. Providing the proportion of biomethane in the claim is equal to or above the minimum specified on the LCEB certificate, then the bus's LCEB status applies and the DfT will pay the incentive for all eligible kilometres operated (including dead kilometres).

If the proportion of biomethane in the claim is less than the minimum specified on the LCEB certificate then LCEB status does not apply and DfT will not pay the incentive for the claim period,