BWG-P-10-16

Revision of the Low Carbon Emission Bus Target 2010

The Bus Working Group are asked to approve a revision of the target for Low Carbon Emission Buses in order to bring the target line and the accreditation procedure into line with each other.

Issue

The Low Carbon Emission Bus (LCEB) target is based upon a well-to-wheel measure of CO2. The Well-to-tank element is based upon the methodology used by Concawe, which has gone through a number of revisions since its development in 2002. The current LCEB target needs to be revised to take account of the latest revision to the Concawe well-to-wheels study in order to ensure it is consistent with the calculation of well-to-wheel CO2 emissions required by the accreditation procedure for LCEBs. It is therefore proposed that the LCEB target be revised to bring it into line with the current accreditation procedure for LCEBs.

Background

The LCEB target developed by the Bus Working Group is based on well-to-wheel emissions of CO2 expressed as a function of maximum passenger capacity. When originally developed, between 2004 and 2006, a data set of Euro 3 diesel buses tested against the MLTB test cycle was used to provide a measure of tank-to-wheel CO2 emissions. This was then converted into a well-to-wheel measure using the same methodology as adopted by the Concawe study of well-to-wheel CO2 emissions.

The initial Concawe WTW study was published in 2002, it has subsequently been updated and the latest version is version 3. An important reason for the revision of the study is to take account of changes in the carbon intensity of the well-to-tank (WTT) emissions of CO2 resulting from the production and distribution of diesel which have increased markedly from 10.4 g/MJ in 2002, to 14.2g/MJ, a 36% increase.

The LCEB target line is based upon the original WTT figure and consequently underestimates the carbon intensity of the WTT CO2 emissions of a LCEB. In addition the testing accreditation procedures for LCEBs developed Millbrook Proving Ground for LowCVP, and adopted by DfT for the purposes of qualifying for the LCEB BSOG supplement and Green Bus Fund, is based upon the latest WWT CO2 emission factor. Therefore the LCEB target and the accreditation procedure are currently inconsistent with each other.

Recommendation

The LCEB target line is revised to bring it up to date with the current Concawe estimates of the embedded well-to-tank CO2 emissions. This would result in a LCEB target line of:

$$\text{LCEB Target v3 GHG(g/km)} = 502 + 6.28 * \text{Max Total Passengers}$$

The details of the calculation of the proposed new LCEB target line are shown in annex 1.

The LCEB target has been revised once previously in 2008 to adjust for a change in the test procedure of LCEBs to ensure consistency between the approach taken by TfL in testing hybrid buses and the approach taken by DfT in determining eligibility for the LCEB BSOG supplement and the Green Bus Fund. The proposed LCEB target line (version 3) is presented graphically in chart 1 against the two previous versions of the LCEB target line. It is also presented in chart 2 compared to the base data used to develop the original target.

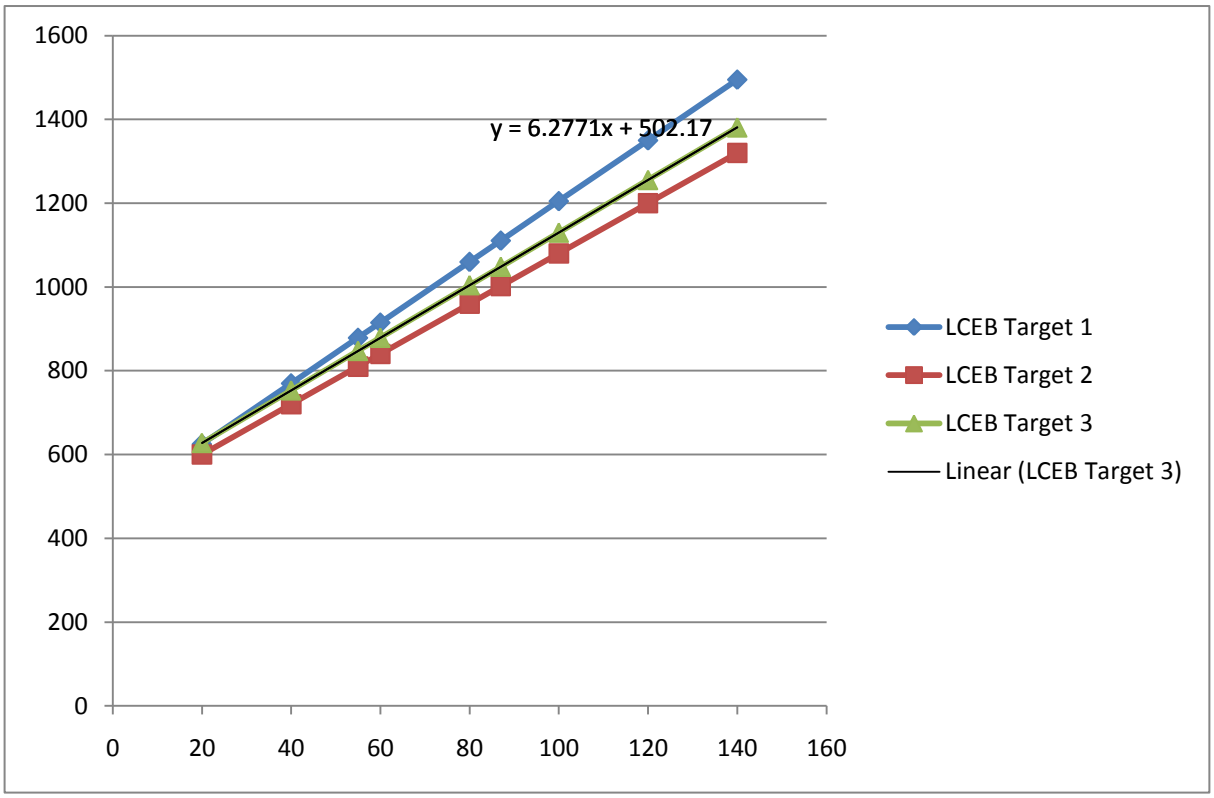

Chart 1: LCEB target version 3 compared to its predecessors

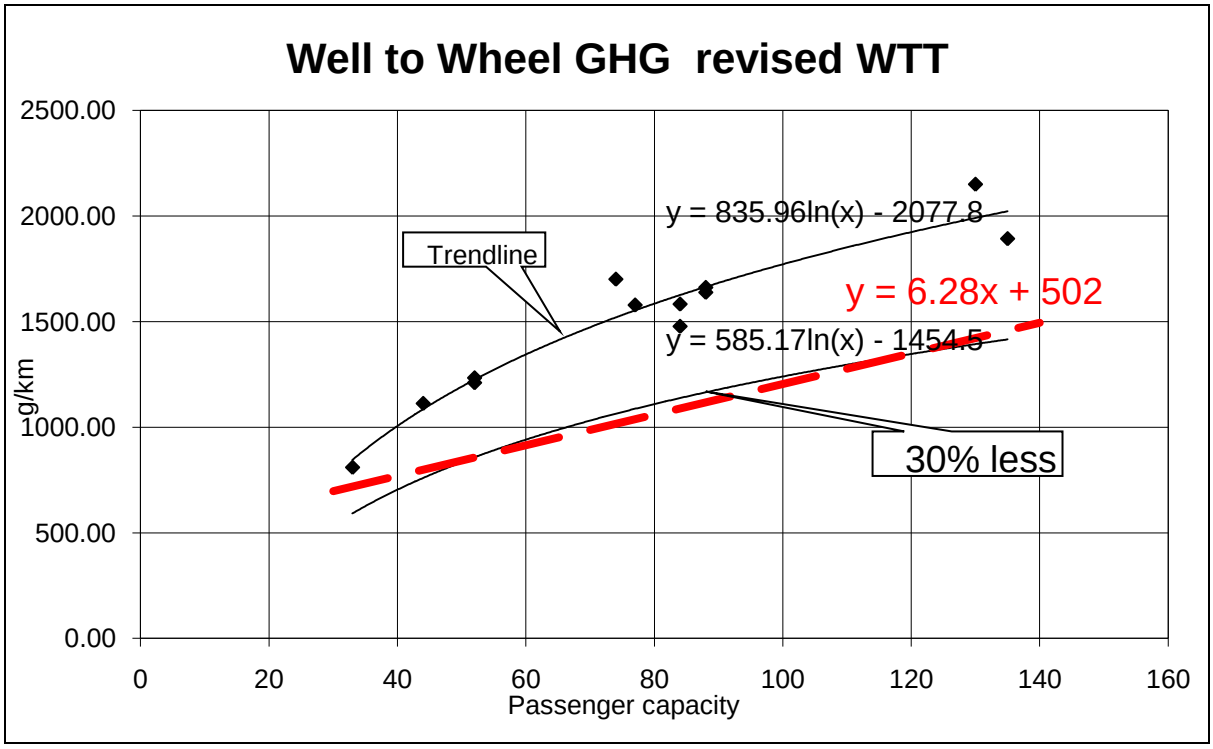

Chart 2: LCEB target version 3

Annex

In order to take account of the changes in the carbon intensity of the WTT the current LCEB target, which is a WTW target, needs to be converted back to a TTW target using the assumptions used in the original Concawe study. Then the new WTW LCEB target is calculated using the assumptions in the current Concawe study 2008.

Equation 1 is the current LCEB target.

$$\text{GHG WTW} = 480.02 + 6.0 \times \text{TPC} \qquad (1)$$

The Concawe study uses two factors from which to calculate the well-to-wheel GHG emissions. These the GHG intensity of the energy consumed by the vehicle and the GHG intensity of the energy consumed in the production and delivery of the fuel to the vehicle, both these measures are expressed as g/MJ.

The table below shows the carbon intensity assumptions used in the original and latest Concawe studies, and the figure used by LowCVP.

LowCVP			
TTW	73.678	g/MJ	GHG intensity of energy consumed on vehicle (Source: not clear but similar to Concawe 2002)
WTT	10.4	g/MJ	GHG intensity of energy consumed in production and delivery of fuel to vehicle (Source: Concawe 2002)
Ratio 1	**1.141155**		Ratio WTW/TTW
Concawe v1 2002			
TTW	73.54	g/MJ	GHG intensity of energy consumed on vehicle
WTT	10.4	g/MJ	GHG intensity of energy consumed in production and delivery of fuel to vehicle
Ratio 2	**1.14142**		Ratio WTW/TTW
Concawe v3 2008			
TTW	73.25	g/MJ	GHG intensity of energy consumed on vehicle
WTT	14.2	g/MJ	GHG intensity of energy consumed in production and delivery of fuel to vehicle
Ratio 3	**1.193857**		Ratio WTW/TTW

It appears that the original LowCVP LCEB target didn't use the correct Concawe v1 2002 figure for the GHG intensity of the well-to-tank energy consumption, although the figure used was similar, 73.678 instead of 73.54.

WTW = TTW + TTW x (GHG intensity of energy consumed in fuel production / GHG intensity of the energy consumed by vehicle) (2)

OR

WTW = TTW x (1 + (GHG intensity of energy consumed in fuel production / GHG intensity of the energy consumed by vehicle)) (3)

WTW = TTW x Ratio WTW/TTW (4)

The ratios based upon LowCVP's original assumptions, and the assumptions in Concawe v1 and v3 are shown in the table above.

The LCEB target expressed as a tailpipe measure is derived by dividing the WTW LCEB target by ratio 1.

GHG TTW = CO2 WTW /1.141155 (5)

The revised LCEB target expressed as a well-to-wheel GHG emissions, can then be found by multiplying the TTW measure in equation 5, by the ratio 3.

GHG WTW = 1.193857 x CO2 TTW (6)

Therefore equation 1 is the revised LCEB target based upon the revised Concawe assumptions.

GHG WTW = 402 + 6.28 x TPC (7)